Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

Competitiveness, innovation and sustainability – clarifying the concepts and their interrelations

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Franziska Wolff
Katharina Schmitt
Christian Hochfeld

Öko-Institut e.V.
Institut für angewandte Ökologie
Büro Berlin
Novalisstraße 10
D-10115 Berlin
Tel.: +49-30-280 486-80
Fax: +49-30-280 486-88

Büro Freiburg
Postfach 50 02 40
79028 Freiburg
Tel: +49-761-45295-0
Fax: +49-761-45295-88

Büro Darmstadt
Rheinstraße 95
64295 Darmstadt
Tel: +49-6151-8191-0
Fax: +49-6151-8191-33

Content

1 Introduction

The pervasive discourse on competitiveness

In the past years, competitiveness concerns have ascended high on the agenda of national governments and of the EU. One observer states that '*the necessity of competitiveness has been hammered home by governments, corporations, and the media to the point that it is taken for granted, a fact of life that is so obvious that we unthinkingly acquiesce to its dictates*' (Rinehart 1995: 14). Growing economies like those of Asia and the US are perceived as major challenges, as are internal trends such as an ageing Europe and high rates of unemployment. As a consequence, in order to boost growth and jobs, many states attempt to tackle seeming strains on the competitiveness of their key industries and their economies as a whole. Social and environmental policies are among those strains perceived to have obstructive effects on competitiveness. However, the assumption that such policies impact negatively on competitiveness and on growth in general is contentious to say the least.

EU context

Major impulses to the debate on competitiveness have come from the European level. Defining the Lisbon Strategy in 2000, the European Union aimed to address the challenge of enhancing economic growth and at the same time fostering social inclusion. The Sustainable Development Strategy (SDS), which was adopted at the EU's Gothenburg Council 2001, added to the Lisbon commitments an environmental dimension and claimed to build an umbrella for tackling in an integrated way economic, social and environmental sustainability. With the 2005 mid-term review of the Lisbon Strategy and its emphasis on growth and jobs, however, the aimed at balance of the three Lisbon pillars was given up. Since then, social and environmental policies in the European Union have come under rising pressure. Increasingly, they need to be legitimized by emphasizing that they can add to – or at least do not harm – competitiveness. As a consequence, the Lisbon Strategy threatens to sideline both the environmental and the social component of the EU's Sustainable Development Strategy, despite the political boost the SDS received in its 2006 review.1

A background paper

This paper aims at providing introductory information for all those who are interested in the topic but have not yet been confronted to a greater extent with the scientific background to it. Many citizens, members of social movements and civil society organisations are concerned about the potential impacts of the competitiveness discourse and the resulting policies on the social and environmental realm. While their expertise lies in the social and environmental areas, they are often not familiar with the competitiveness discourse and its snares. There is also substantial terminological and conceptual confusion in this discourse which sometimes even seems to be promoted deliberately. In this context, the paper may serve as a background paper. We will first explain the basic terms and concepts of the discourse: competitiveness, but also innovation and sustainability (Chapter 2). What does competitiveness mean at the firm, industry and national level, and what is its relation to innovation and sustainability? In Chapter 3, we will portray core arguments on the relation between the three concepts, drawing on traditional and new trade theory as well as the Porter hypothesis and on insights from ecological and evolutionary economics. For each of the sections, we will indicate both relevant primary sources (in footnotes) and useful additional reading as it is available on the internet (in boxes).

The Öko-Institut project

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[1] This tendency has manifested itself in the redesign of the EU's Thematic Strategies on the Environment, particularly the marine, soils and resources strategies as well as the air-pollution strategy and the greener cities strategy.

2 What are we talking about?

Chapter outline

The purpose of this chapter is to present and explain the core concepts at the heart of the debate: competitiveness, innovation and sustainability. These terms are often used in different contexts, meaning different things to different people. In this chapter we will therefore give brief overviews of important definitions and concepts; the focus will be on the concept of competitiveness. In Chapter 3, we will then discuss the interactions between the three concepts, as a basis for a more systematic understanding of the causal relationship of competitiveness, innovation and sustainability.

2.1 Competitiveness

A concept at several levels

The concept of competitiveness is rather complex. Much of its opaqueness stems from the fact that the term is used at different levels of aggregation, leading to different meanings as well as different indicators. We will introduce separately the concepts of competitiveness at the level of products, business units and firms (micro level), at industry (meso) and national or regional (macro) level. We will also point out how competitiveness is measured at the respective levels.

2.1.1 The level of products, business units and firms

A definition

Competitiveness at firm level is commonly defined as the ability or capacity of companies to compete, and sometimes more specifically as the ability to compete *'in international markets, with a satisfactory rate of return'* (OECD 2001: 28).

Organisational and strategic factors

Structurally, this ability is shaped by the *'various aspects of corporate organization that command the effectiveness of industrial R&D and other innovation-related investments'*.[2] Strategically, companies may strive to build competitive advantage over their rivals through cost leadership – i.e. producing cheaper than the competitors – or through product differentiation – i.e. offering a product with specific features or at a high quality. In the medium or long term, a competitive advantage also requires the ability to learn and innovate. Finally, companies may also gain competitive advantages by shaping the framework conditions under which they operate, including the market and regulatory frameworks.

Indicators

The above definitions suggest various ways in which competitiveness at the firm level can be measured. In practice, indicators on the firm's input side include financial, physical and human capital, R&D expenditure, or stock to turnover ratios. On the output side, the indicators employed encompass profitability, market share, export performance, firm growth, comparative international or relative national productivity performance, and patents.

Pros and cons of this level of analysis

The firm is often described as being the most obvious level to which the concept of competitiveness can be applied. It is firms which compete with one another in the market place and Porter argues that '*an economy can not be competitive unless companies operating there are competitive, whether they are domestic firms or subsidiaries of foreign companies*' (Porter 2002). Some authors furthermore break down the concept of competitiveness to the individual business unit and product level: *'The competitiveness of firms is not a global measure. For multiple-product companies it is particularly difficult to evaluate competitiveness at firm level. Rather, it makes*

[2] These include among others the successful management of production flows and raw material; effective integration of market planning, formal R&D, design, engineering and industrial manufacture; successful supply chain management; and measures to enhance employees' skills, see OECD 1992: 239.

more sense to evaluate a firm's competitiveness at the level of its business units or product categories (Belz 1995).

2.1.2 The industry level

A definition

Competitiveness at industry level is understood by mainstream economic literature as the ability to compete, particularly in international markets, with satisfactory rates of return (OECD 2001: 28). Porter/van der Linde specify that '*The proper definition of competitiveness at the aggregate level is the average productivity of industry or the value created per unit of labour and per dollar of capital invested'* (Porter/Van der Linde 1995: 98).[3]

Indicators

Indicators used for measuring industry competitiveness include among others a sector's growth, its profitability, employment and productivity. Productivity is commonly defined as a ratio of a volume measure of output to a volume measure of input use. Broadly, productivity measures can be classified as single factor productivity measures (relating a measure of output to a single measure of input) or as multifactor productivity measures (relating a measure of output to a bundle of inputs) (OECD 2001: 11). The measures most frequently used to represent the productivity of an industry are labour and capital productivity, either based on gross output or value added.

Pros and cons of this level of analysis

When looking at the impact of public policies on competitiveness, it is often argued that it is more informative to explore industry than firm level competitiveness. This is because a competitive advantage that an individual firm may gain as a result of the public policy is often realised at the expense of competitors. At industry level, however, impacts by public (e.g. environmental or sustainability) policies on competitiveness may be assessed in an aggregated way and in comparison to other industries either within the same country or the same industry in another country.

2.1.3 The national level

Two dominant views

In the political debate, the competitiveness concept most often addressed is that of the national level (frequently denominated as 'international', 'national' or 'economic competitiveness'). So what is commonly described as 'national' competitiveness? Porter distinguishes between (a) an understanding of competitiveness as a country's share of world markets for its products ('market share view'), and (b) a productivity oriented understanding of competitiveness (Porter 2002: 5).

'Market share' view

(a) The 'market share' view of competitiveness is based on an interpretation of national competitiveness as a *zero-sum game*, with each country gaining at the expense of others. Bill Clinton, for example, held that each nation is *'like a big corporation competing in the global marketplace'*, implying that the United States and Europe are competitors in the same way as Coca Cola and Pepsi. The OECD describes a nation's competitiveness as '*the degree to which it can, under free and fair market conditions, produce goods and services which meet the test of the international markets, while simultaneously maintaining and expanding the incomes of its people over the longer term*' (OECD 1990: 9). The 'market share' view, which is also held by economists representing traditional or strategic trade theory, frequently links competitiveness to trade flows.

[3] Emphasis in original.

'Productivity view'

(b) Many critics, however, stress that competition of such a zero-sum kind does not exist between nations. US economist Paul Krugmann, for example, points out some crucial differences in the competition between economies and firms: above all, a country that looses its competitiveness does not go out of business. Also, nations are not able to externalise social and environmental costs to the same degree as companies in order to increase their 'efficiency'. These discrepancies make competitiveness a somewhat elusive concept at national level. What's more, *'if Pepsi is successful, it tends to be at Coke's expense. But the major industrial countries, while they sell products that compete with each other, are also each other's main export markets and each other's main suppliers of useful imports. If the European economy does well, it need not be at US expense; indeed, if anything a successful European economy is likely to help the US economy by providing it with larger markets and selling its goods of superior quality at lower prices'* (Krugman 1994: 34). At the same time, foreign-owned firms that produce and do research in Europe contribute to European welfare, not only to that of the country where they are originally headquartered (Strange 1998: 101-114). While the 'market share' view of national competitiveness stresses a country's performance on *international* markets, critics like Paul Krugman or Michael Porter are convinced that a *'country's standard of living depends almost entirely on its own domestic performance, and not how it performs relative to other countries' (*Porter 1990: 71). Consequently, domestic performance can best be expressed in the form of productivity measures of an economy – thus lending the name to the concept of 'productivity-based view'.

Indicators for national competitiveness

Indicators for economy-wide competitiveness differ according to the underlying assumptions. The 'market share' view with its emphasis on international competition refers among others to trade flows, net exports, and countries' shares of the world market. Proponents of the 'productivity view' obviously use productivity as main indicator. Productivity can be measured by the value of goods and services produced per unit of the nation's human, capital and natural resources. It depends both on the value of a nation's products, measured by the prices they can command in open markets, and the efficiency by which they can be produced. Other indicators include growth, employment, market share or profitability. More complex and compound indicators are used by the World Economic Forum (WEF). Its annual Global Competitiveness Report (WEF 2006) evaluates the economic competitiveness of a large sample of countries. For the analysis, it uses two complementary approaches: the Growth Competitiveness Index (GCI) is to grasp the macro-economic dimension of a nation's competitiveness by assessing the capacity of an economy to achieve sustained growth in terms of GDP per capita over the next five years. It uses component indexes reflecting a) the level of a country's technological readiness; b) the state of public institutions; and c) quality of the macroeconomic environment. The GCI has been complemented by the Business Competitiveness Index (BCI), which covers microeconomic factors in order to assess the aggregated ability of firms to create valuable goods and services using efficient methods. The BCI specifically measures a) the sophistication of company operations and strategy, and b) the quality of the overarching national business environment in which they are operating. All (sub-) indexes used by the WEF are calculated on the basis of both 'hard' data and survey data. In summary, it can be stated that the comparison of national competitiveness that is conducted on the basis of absolute numbers entails questionable results. Comparing growth and/or change rates of these absolute numbers delivers more credible results in as far as the set of indicators used during the comparison remains equal throughout the enquiry period.

Pros and cons of this level of analysis

Applying the concept of competitiveness to national (or regional/European) level is highly contentious. In addition to the conceptual objections raised by Krugman, Porter and the like, there are methodological and political concerns. National competitiveness is a highly complex aggregate of the varying levels of competitiveness of individual firms and industries. The use of general equilibrium models often holds the danger that results are not very robust when model parameters are slightly changed. Furthermore, the evaluations depend to a large extent on the set of indicators used to analyse national competitiveness and therefore judgement and rankings of the world's most competitive countries vary from one measurement to the next. When it comes to assessing the impacts that (sustainability) policies have on competitiveness, however, the OECD describes the national economy as the most preferred level of analysis: '*When evaluating a particular policy, the effects on the economy as a whole should be considered, not just the effects of individual sectors. With all policy reforms, there are likely to be winners and losers in the short term. These impacts can be addressed through flanking measures […] but their existence should not hamper the realisation of the longer-term economy-wide environmental and economic efficiency benefits that can be achieved through implementing the policy changes*' (OECD 2004: 20)[4].Still, it is likely to remain a big challenge to the research community to distinguish the effects of one policy (e.g. REACH) from another policy (e.g. pension reform) on the aggregated level of the national economy. Different policies may either thwart each other or be synergetic.

Political critique

Other observers reject the debate on nation level competitiveness in particular on grounds of its expected political implications and effects on state governance. Fougner points out that against the backdrop of globalisation talk, the debate on international competitiveness has shifted from how governments can support 'national' companies to export and invest abroad, to how states can attract investors. While in the first case, firms were the main subject of competition, it is now the state itself that competes – it competes with other states for mobile capital and firms. He underscores that 'the primary governmental problem on the part of state authorities is no longer to make firms more competitive, but to make the state itself more competitive' (Fougner 2006: 175). Hirsch warns that such competition among nation states makes governments susceptible to industry 'blackmail' (Hirsch 1998). It results in a far-reaching transformation of the state and in a shift of public expenditure burdens to blue and white collar employees; to counter the ensuing social inequality governments among others employ repressive measures. Critics also caution against treating the problem of international competitiveness as one that is seemingly 'given' or 'natural' and that states cannot but attend to.

[4] Own emphasis.

2.2 Innovation

A definition

Innovations can provide firms with a competitive edge. Innovation can be understood as the process of introducing and exploiting a new idea, of developing and exploiting on the market new products and services. Innovations may be technical, institutional, or cognitive, and they may induce changes ranging from incremental to radical (Freeman/Perez 1988). Different types of innovation can be distinguished. To illustrate, we will give some examples from the environmental realm:[5]

Types of innovation

- *Product or service innovation* involves the introduction of a new good or service which differs in terms of functional characteristics, technical abilities, ease of use, durability, or other dimensions such as biological inputs, toxic or environmental qualities. Service innovations may substitute physical products and reduce resource use.
- *Process innovation* is the implementation of a new or improved production or delivery method. These include end-of-pipe/filter technologies as well as integrated technologies by which processes and possibly products are redesigned to reduce waste, material and energy inputs as well as environmental impacts (resource-/ eco-efficiency).
- *System innovations* go beyond product and process innovations. They comprise the introduction of complex system products such as the fuel cell or new product-service-systems. The latter combine physical products with sharing- and leasing models that contribute to an intensification and prolongation of product use. System innovations may also relate to more encompassing transformations in systems of provision such as electricity, transport, or agriculture.
- *Organizational innovation* involves the creation of new business practices or ways to run an organization. Environmental management systems (e.g. EMAS, ISO 14000) constitute well-known organizational innovations. In firms, organizational innovations can be said to include *marketing innovations*, i.e. new marketing methods that improve product packaging, product promotion or pricing.
- *Policy innovations* are public policies that are new to the setting in which they are being adopted. With regard to environmental policies, policy-makers may innovate on the biophysical subject matter they tackle (e.g. waste water, soil, greenhouse gas emissions), the instruments they employ (standards, eco labels, green taxes, environmental impact assessment) and wider organisational forms (environmental ministries, advisory bodies).

Stimuli and success factors

Innovation may be 'pushed' by scientific and technological progress, 'pulled' by consumer demand, induced by regulation, and formed in a non-linear way by both internal feedback processes and external impulses. Cognitively coined paradigms, technological 'trajectories' as well as 'lock in' and 'path dependence' shape innovation processes, too (Dosi 1988; Arthur 1997). While failure is recognized as an inevitable element of innovation, there has been ample analysis of success factors. These include firms' research and development efforts, internal structures, their calculated innovation management, learning in company networks as well as supportive public policies. The latter do not only include research and technology policies. Environmental policies, too, may stimulate inno-

[5] Eco-innovations can be defined as new and modified processes, techniques, practices, and products that reduce or even avoid detrimental environmental impacts (Rennings 2000: 319-332)..

The role of environmental policies

vation. Innovating on products, processes, marketing methods or corporate organisation constitutes a possibility to 'circumvent' (substitute away from) an environmental policy measure. This holds when the respective R&D costs in the medium run are lower than the compliance costs (in polluting industries), or when the innovation promises a first mover advantage (for environmental technology industries). Innovation as key to productivity growth may thus offset potential negative competitiveness impacts by sustainability policies (see Chapter 3) (Porter/ Van der Linde 1995: 97-118). To what extent specific (e.g. economic) policy instruments more apt to promote innovation is the subject of an ongoing debate (Hemmelskamp et al. 2000; Jänicke 1999).

Different impacts and 'ex-novation'

Summing up, a competitive edge may be gained by benefiting the environment – through innovating on resource efficiency, clean production processes etc.. But while innovation typically adds value, it may also have negative effects, both economically and ecologically: less innovative organisations may be crowded out by more innovative ones; previous practices may be superseded by new ones that are actually more resource intense, toxic, or involve novel risks. In the case of such negative effects, innovation should be flanked by political interventions, e.g. setting maximum limits for C02 emissions/km for the automotive industry. Occasionally, the need may arise to consider 'ex-novation'. Ex-novation describes the removal of existing structures or products in favour of other more appropriate structures or products. Finally, even in the case of per se sustainable innovations, negative effects for society or the environment may occur. Such 're-bound effects' include e.g. the creation of positive effects on one sustainability challenge and negative effects on another; generating a growth in consumption of certain resources rather than limiting it; or cementing per se unsustainable consumption patterns (driving a car) by presumably offering a more sustainable alternative (a car with a catelist) (Peach 2005: 324-326).

Innovation phases and competitiveness

To better understand the relation of innovation and competitiveness at company level, Schumpeter's classic distinction of innovation phases (Schumpeter 1934)[6] is illuminating, too:

- An *invention* is a new idea that can be realised as a product or process. The competitiveness implications are limited to the fact that the underlying research and development cause costs.
- An *innovation* is the first introduction of a new product into the economy, allowing productivity gains and hence a competitive advantage to the innovator only.
- *Diffusion* means that the innovation is finally traded on the market. Only now the production gains induced by the innovation can be realised by all of the economy. As long as the innovation has not been copied and the innovator is the only one to offer it on the market (e.g. due to patents), she may use her competitive advantage and gain monopoly profits.

[6] However, this classification should not be read as an empirical phase model of innovation, which is considered nowadays to be less linear and more complex (e.g. Van de Ven et al. 1999); ; Rip/ Kemp 1998: 327-399).

2.3 Sustainability

A multi-dimensional concept

As many observers realise, there '*can be little doubt that sustainability is one of the most frequently used but least understood terms of our time*' (Hart 2005: 57). The multidimensional nature of the term leads to a lack of precision and until today, no broad agreement on contents of sustainability has been reached. This directly hints us to the difficulties that exist in operationalising the term of sustainability into activities and structures. We will outline four – sometimes complementary – approaches to defining sustainability in the following:

Inter- and intra-generational justice

As is well known, the term of sustainability originated from forest management and was crucially shaped by the debate on environmental protection and development at the 1992 United Nations Earth Summit in Rio de Janeiro. The Brundtland Commission defined sustainable development as being '[…] a *development that meets the needs of the present generation without compromising the ability of future generations to meet their needs'* (World Commission on Environment and Development 1987). The two elements of intra- and inter-generative justice constitute the core of this sustainability understanding. The European Union's Strategy for Sustainable Development (European Council 2001: 4–8) adopted at Gothenburg in 2001 as well as the its Renewed Sustainable Development Strategy (2006) draw on the Brundtland concept: *'Sustainable development means that the needs of the present generation should be met without compromising the ability of future generations to meet their own needs. It is an overarching objective of the European Union set out in the Treaty, governing all the Union's policies and activities. It is about safeguarding the earth's capacity to support life in all its diversity and is based on the principles of democracy, gender equality, solidarity, the rule of law and respect for fundamental rights, including freedom and equal opportunities for all. It aims at the continuous improvement of the quality of life and well-being on Earth for present and future generations'* (European Council 2006: 2).

Three pillars

A further well-known concept of sustainability often employed 'complementarily' comprises three dimensions (or 'pillars'): the social, the environmental and the economic (UNCED 1992a). While some authors argue that these three concerns must be given equal consideration, thus implying that the dimensions may be traded-off against each other, others support the view that the environmental dimension needs to be considered as the basis for the other two dimensions, with the environment underpinning both society and the economy (IUCN 2006). This is held because social and economic development depends on a resource base, a liveable environment and resource justice. The EU's Sustainability Strategy, however, which uses the three pillar approach to put into more concrete terms the Brundtland definition, refrains from such a prioritisation: environmental protection, social equity and cohesion, economic prosperity and the meeting of the Union's international responsibilities are given equal weight (European Council 2006: 3-4). The environmental integration principle codified in Art. 6 of the Treaty establishing the European Community is one instrument to help mainstream environmental concerns into the other policies. In general, the three pillar approach neglects the call for securing future generations' ability to meet their own needs, e.g. by stopping to deplete natural resources and exceeding the 'carrying capacity' of earth.

Substitution of natural by man-made capital

In the economic discussion, this flaw is tackled by distinguishing 'weak' from 'strong' sustainability. The two categories differ in the extent to which types of 'capital' – in particular manufactured vis-à-vis natural capital (e.g. natural resources, ecosystem services) and social capital – may be substituted against each other (Daly 1990: 1-6; Dieren 1995; Pearce et al. 1990). In the case of weak sustainability, manmade capital can be replaced by natural capital of the same value. However, eco-

logical economists have pointed out that it is not always easy to value in monetary terms people's preferences for natural capital such as an intact ozone layer or a swamp ecosystem: besides the economic benefits (or 'use value') there may be other values ('non-use values') linked to it, such as aesthetical values or potential for future development (Pearce/Turner 1990). In the case of strong sustainability, the existing stock of natural capital may only to some extent be replaced by manmade capital. Since its functions cannot just be performed by manufactured goods and services, 'critical' natural capital needs to be maintained. Uncertainty, complexity irreversibility and the unknown scale of environmental effects require precautionary action. Economic systems, it is stressed, are underpinned by ecological systems and not vice versa.

Integration and societal learning

A further approach stresses that sustainability is not a final condition, but a searching process. Complex modern societies are seen to hold the danger that processes in one field create negative impacts in other fields ('externalities') with a destructive potential. A typical example is economic activity that creates unintended 'side effects' such as the ozone hole or climate change. In addition, *'[s]ocietal discourse on sustainability has revealed the ambiguity of social goals, uncertainty about cause and effect relations and feedback between steering activities, and the dynamics of social, technological, and ecological development. Sustainability calls for new forms of problem-handling' (*Voss/Kemp 2006: 17). These aim at the integration into action strategies of the above mentioned 'side effects', above all through 'reflexive governance'. Reflexive governance can be described as *integrative* and *participatory* processes of analysing the problems at hand, of formulating joint goals and of implementing them. Sustainable development is to a large extent about organising societal learning and adaptive institutions – a conclusion shared by advocates of the strong sustainability notion.

3 How do the concepts relate to each other?

In which way do the concepts of competitiveness, innovation and sustainability relate to each other? This relation has been researched from the 1970s and 1980s onwards, with a preliminary focus on environmental aspects. With increasing competition among firms and states, fuelled by technological change as well as trade and investment liberalisation ('globalisation'), research efforts peaked in the 1990s, broadening the focus to embrace sustainability that goes beyond environmental aspects. Despite the fierce political debate on the compatibility of sustainability and competitiveness academic activity has slightly thinned out in the recent years. However, this is not because definite answers could be provided. Rather, both the theoretical and empirical literature presents an ambiguous picture. It is clear, however, that literature does not generally confirm the assumption that strict sustainability policies decrease competitiveness.

In the following, we will present a (non-exhaustive) set of standard economic positions on the relation between competitiveness, public sustainability policies and innovation. The overview includes traditional trade theory, strategic trade theory, and the micro-economically founded Porter hypothesis.[7] In our conclusions we will additionally refer to insights from ecological and evolutionary economics to comment on how competitiveness, sustainability and innovation relate to each other in terms of means and ends.

3.1 Traditional trade theory

Comparative advantage

Traditional (neo-classical) trade theory understands international competitiveness via the comparative advantage of nations: A nation engages in trade and gains a comparative advantage not because it can produce a good or service absolutely cheaper, but because it is *relatively* more efficient than other nations in producing this good or service (Ricardo 1806). The Heckscher-Ohlin theorem (Ohlin 1933) assumes that especially the relative endowments of production factors such as natural resources, labour and capital determine a nation's comparative advantage.[8]

Role of environmental policy

Environmental policy is accounted for in this framework in two ways: To the extent it aims to curb pollution, environmental policy can firstly be seen to increase on the input side the relative scarcity of the production factor 'natural resources'. A country rich in natural resources thus would reduce its competitive advantage for pollution-intense sectors. Environmental regulation can secondly be seen to raise the price on the output side, when pollution is considered a joint output of production.

Economic adjustments

Trade relations (i.e. net exports) are expected to adjust to the differences in national policy stringencies and in the respective relative prices, and countries are assumed to specialise accordingly. This division of labour in general is assessed to be welfare enhancing. A similar pattern as with regard to trade is posited to emerge with regard to the regulation-related flow of

[7] Apart from directly analysing competitiveness effects, it is also common to look – more indirectly – at the overall social costs and benefits of environmental policy. For this purpose, macroeconomic measures such as economic productivity, growth and employment are used. General equilibrium models attempt to account for the interaction between (negatively and positively affected) industries and the accumulation of changes in investment and growth levels. This more indirect macroeconomic evidence will not be analysed here.

[8] Hence, a country has a competitive advantage in goods and services for whose production it uses those production factors intensely which it is richly endowed with. In the long run, a country can influence its general set-up and thus its comparative advantages ('acquired comparative advantage').

capital and investment. There are different approaches as to how the adjustments take place and how they can be measured:[9] First, within a nation the net exports of heavily regulated industries with high compliance costs would be systematically lower compared with exports from less regulated industries. With exports less attractive and imports more so, domestic production (and employment) generally would be expected to decline, at least in the short term. Second, the net exports of pollution-intensive goods[10] originating from countries with stringent environmental policies would need to be systematically lower than the exports from countries with lower standards.[11] It is furthermore expected that rising prices will shift some of the domestic consumption to imports. Third, a high level of regulation incurred production costs in a country would be expected to impact negatively on investment patterns, i.e. on foreign direct investment (FDI) and on plant location.[12]

Discussion

The relevance of traditional trade theory with regard to the relation between environmental policy and competitiveness is arguable (Nill 1999: 4): Theoretically, the approach is rooted in the neoclassical market model with its contentious assumptions that market participants have complete information and that there are no oligopolies or monopolies. Traditional trade theory ignores economies of scale and incomplete competition that are however prevalent characteristics of many (international) markets. Furthermore, it neglects the influence of exchange rates on the relation between sustainability/environmental policy and competitiveness.[13] It thus fails to account for the respective adjustments that operate when such policies are introduced. Empirically, neither the hypotheses of environmentally induced specialisation / trade flows nor on capital flows have been strongly and consistently supported. Typically, *'[a]lthough the long-run social costs of environmental regulation may be significant, including adverse effects on productivity, studies attempting to measure the effect of environmental regulation on net exports, overall trade flows, and plant-location decisions have produced estimates that are either small, statistically insignificant, or not robust to tests of model specification'* (Jaffe et al. 1995: 157-158).

3.2 New trade theory

Strategic action

Unlike traditional trade theory, new trade theory assumes that competition on international product and factor markets is incomplete due to 'economies of scale' (Helpman/Krugman 1989).[14] Against this backdrop, countries may strategically design environmental policies in a way as to create competitive advantages for domestic producers (Barrett 1994: 325-38; Feess/Taistra 2001: 18–31; Simpson/Bradford 1996: 282-300; Ulph 1996: 265-281). The level of these taxes, emission or product standards may be kept low; as a result, environmental costs are not fully reflected ('internalised') in the prices of goods and services. Furthermore, export or

9 See Jaffe et al. 1995..

10 Defined as goods produced by industries that incur the highest levels of pollution abatement and control expenditure, e.g. mining, steel, metals, chemicals, paper etc. (Jaffe et al. 1995: 144).

11 It is assumed that due to the costs induced by environmental policy the export of pollution intense goods will drop and that the rising prices will shift some of the domestic consumption to imports.

12 It is assumed that due to the costs induced by environmental policy the production of pollution intense goods will be moved to regions with less stringent regulation and some of the domestic consumption will be shifted to imports.

13 It is possible, for example, that an environmental policy measure increases the production costs in one sector. In reaction, exports may decline and the exchange rate will adapt. As a consequence of the fall in the exchange rates, other sectors' exports may rise, although these sectors have not increased their competitiveness in 'real' terms. Such effects eschew the models used by traditional trade theory.

14 Strategic trade theory also points out that an increasing share of international trade is intra-industry trade between countries with similar factor endowments rather than inter-industry trade between countries based on differences in their factor endowments, as posited by traditional trade theory.

technology subsidies may be introduced for (environmental) goods. Like governments, companies may act strategically. This means that in their production and investment decisions they systematically consider potential reactions of competitors, with the aim of redirecting rents.

Economic adjustments

Various theoretical models have been developed on strategic environmental policy in oligopoly markets. The models typically comprise several decision levels, with governments first determining the stringency of environmental policy measures. In a second step, companies react to those by choosing the level of their output ('Cournot' case) or prices ('Bertrand' case),[15] taking into accounting the expected strategies of international competitors. It is argued that when the domestic company takes the lead in adapting its output quantity it can gain a competitive advantage over the foreign followers ('Stackelberg leadership'), redirecting rents to the home market. In specific cases however, e.g. when considering cross-border pollution and changes in environmental quality or when firms compete in prices rather than quantities, a more ambitious environmental policy may enhance profits of the domestic company and ultimately the social welfare (Rauscher 1995; Barrett 1994). Dynamic models account for the possibility of firms to adapt their production technologies and to innovate, either on processes or products. Here, too, specific cases are possible where a tightening of environmental policies increases corporate profits and thus competitiveness.[16]

Discussion

It is problematic that conclusions of new trade theory on the relation of environmental policy and competitiveness depend strongly on the assumed nature of competition (e.g. price vs. quantity competition; number of companies in the domestic market; production of goods for exports only or for domestic consumption, too). As small changes in the premises tend to turn around the relation, the conclusions are not robust (Schmid 1997: 37).

3.3 The Porter/van der Linde hypothesis

Dynamic perspective

A third strand of debate is triggered by Porter and van der Linde's critique of what they describe as the 'conventional view' on the costs of environmental regulation (Porter/Van der Linde 1995: 97-118). This conventional view which is taken by traditional and new trade theory as described above is based on a static approach in which technology, products, processes and consumer demands are taken as given. In their 'revisionist view', Porter/van der Linde stress that in a dynamic perspective regulation may weed out inefficiencies in the current mode of production, induce innovation offsets and create an international technological forerunner role. As a consequence, environmental policies can actually enhance industry and national competitiveness. Therefore, the tackling or cross-border environmental conflict does not necessarily presuppose international cooperation[17] but a national forerunner role can induce strict environmental standards, too. Underlying the Porter hypothesis is a productivity-oriented understanding of competitiveness and a rejection of the neoclassical model of perfect competition.

Efficiency effects

Firstly, Porter/van der Linde argue that companies operate in an ever changing, dynamic world of imperfect information, organizational inertia and control problems. At the same time, they

[15] While in some (oligopolistic) markets, companies compete about quantities, in other markets they compete about prices.

[16] With regard to process innovations, this scenario is the more likely the more emissions can be reduced through an increase in R&D expenditure. With regard to product innovations it is the more likely the higher the ratio of R&D expenditure compared to production costs in achieving the quality improvements. Cf. Schmid 1997: 52-53.

[17] International cooperation is frequently assumed necessary as it prevents national free-riding, i.e. not putting regulatory 'burdens' on the own industry and instead benefiting from environmental protection activities by other countries.

tend to think statically. As a consequence of these two effects, profitable opportunities for innovation and for enhancing resource efficiency often go unnoticed. Environmental regulation, however, signals to companies resource inefficiencies and potential improvements, raises corporate awareness towards cost cut potentials, and reduces uncertainty that environmental investment will be valuable. Hence, environmental policies may stimulate companies to employ more energy- and resource-efficient technologies, reduce waste, and enhance their risk management – thus increasing the efficiency of their production and reducing costs. This argument is based on the assumption that companies frequently do not fully realise efficiency potentials and hence squander (private) goods.[18] Although this contradicts the core posit of neoclassical theory, which holds that firms maximise their utility and are weeded out if they fail to be efficient, findings from innovation literature and evolutionary economics, behavioural economics or organisational analysis tend to support the point that empirical actors often take sub-optimal choices, thus making inefficient solutions a regular occurrence in the markets. A further potential efficiency effect not specifically addressed by Porter/van der Linde may occur in sectors other than the one addressed: once the environmental quality of a good is enhanced through regulatory provisions, the costs that emerge in other sectors which use this good as an input factor will decrease, or the good's productivity will increase respectively. For example, the costs for water treatment sink for all sectors when specific dirty industries are required to reduce their effluents.

Innovation

Porter/van der Linde further argue that innovations may increase productivity and/or resource efficiency, creating costs savings in the production along with the reduction of pollution (process offsets), or may induce the development of new products (product offsets) for which premium prices can be achieved. When these indirect effects of regulation exceed the costs of compliance they lead to absolute advantages over firms in foreign countries which are not subject to analogous regulation ('free lunch' hypothesis). When the indirect effects do not exceed but at least partly compensate the compliance costs, the companies in question will lose competitiveness. However, this holds only until other countries introduce the respective policy, and to the extent that consumers are willing to pay the environmental premium. Porter/van der Linde also stress that addressing environmental improvement without innovation in production practices, e.g. merely through installing end of pipe technologies, clean-up or remediation measures will not benefit competitiveness.

Early mover advantages

According to Porter/van der Linde, the innovations resulting from demanding environmental policies can also create first/early mover advantages on international markets. A domestic sector may emerge with companies specialised in innovative technologies. When other countries start introducing similar environmental requirements, these first movers have already built up a dominating position by means of learning curve effects or patenting of the technology. An important precondition for the first mover assumption is the possibility to exclude other (including foreign) producers from accessing the technology e.g. through intellectual property rights. Advantages for the national economy can either emerge in the polluting industry itself through technology-induced cost cuts or in the emerging/ strengthened environmental technology industry, when its first mover advantage overcompensates for the polluting industry's competitive disadvantage (Taistra 2000: 34). Other authors have pointed out a positive feedback process: once

[18] While neoclassical theory concedes that in the case of (quasi-) public goods inefficiencies are to be expected (due to freeriding), this usually is not assumed for private goods.

the new technology is internationally available and reduces pollution reduction costs, this may stimulate a tightening of environmental policy in other countries. As the abroad market for the technology grows domestic suppliers may temporarily achieve monopoly rents. Timing is relevant in triggering first mover advantages, since too early regulatory attempts might lead industry to innovate in the wrong direction, possibly through creation of lock-ins.

Discussion

The Porter hypothesis is criticised on several accounts, often from within a neoclassical market model. It is argued that innovation offsets are likely to be rare or small as profitable companies will not systematically miss innovation opportunities; and that innovation induced by environmental regulation may crowd out other potentially more productive investments. Students of new trade theory observe critically that Porter/van der Linde do not account for differing market structures or incomplete competition. In empirical terms, a number of case studies back up at least individual components of the Porter hypothesis.[19] The OECD confirms that innovation effects, first mover advantages and spillover benefits may (over-) compensate for negative competitiveness effects of environmental regulation. They point out that in addition environmental protection costs may be too low to influence competitiveness and that environmental standards are ultimately (at least in the OECD) relatively comparable (OECD 2001: 71-85).

3.4 A note on methodological challenges

Figuring out the concrete interconnections between competitiveness, innovation and sustainability is fraught with methodological difficulties. As Jaffe et al. (1995: 135) point out for the relation between environmental policies and competitiveness impacts, the poor comparability of existing analyses makes it difficult to obtain a clear picture. Studies use different theoretical and methodological approaches, different model specifications[20] as well as varying indicators for 'competitiveness' and 'environmental policy stringency'. Last, not least, the data basis for environmental spending and compliance expenditure is small, even in OECD countries. Problematically, many studies into competitiveness impacts caused by environmental policies look at the cost side only and disregard the *benefits* of regulation – i.e. the cost savings that accrue for industry when air, water or other environmental input factors are cleaner; the reduction of health costs for the whole of society, including employers; the reduction of labour costs that may result from environmental policies, when e.g. eco taxes are recycled to cut employers' contribution to the welfare system. Such long-term benefits can far outweigh short-term costs.

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[19] A good summary of this can be found in the paper of the Network of Heads of European Environment Protection Agencies (2005): The Contribution of Good Environmental Regulation to Competitiveness.

[20] Such different specifications include e.g. the assumed market structure; the extent to which the products or production factors affected by an environmental policy are internationally traded; the relative weigh of the polluting industries in the economy and share of their exports; short- and long-run demand and supply elasticities; existence of economic rents and above-normal profit rates; the type of environmental conflict; type and design of environmental policy; the ability to substitute away from an environmental policy; existence of relieving mechanisms such as import protections or other border tax adjustments; extent of pre-existing pollution costs that are reduced by environmental policies; the potential for positive competitiveness impacts on non-target industries; the extent of innovation offsets and spillover benefits.

4 Conclusions

On the basis of the above findings and with additional insights from ecological economics and evolutionary innovation theory, we will attempt to sum up the relationship between competitiveness, innovation and sustainability.

Relations between sustainability goals

Let us first briefly comment on the relation among the different ends inherent in most concepts of sustainability. In principal, with the concept of sustainable development, the notion is abandoned of environment as simply an additional constraint of an ecological sort on economic growth, as was the norm in the 1970s with the concept of zero growth. Ecological economists have instead pointed out that economic systems are underpinned by ecological systems rather than the other way round. Sustainable development aims at reconciling the fulfilment of the needs of future and present generations, and at reconciling the pursuit of goals traditionally associated with economic growth, ecological protection and equity/social welfare. However, as mentioned in Chapter 2.3, the 'three pillar' approach as well as the concept of weak sustainability allow trade-offs which may ultimately result in an erosion of earth's carrying capacity to sustain future generations. The concept of strong sustainability is geared to prevent this.

Sustainability as (procedural) end

We will now scrutinize the relation between ends and means when it comes to competitiveness, innovation and sustainability. To do so, we will use a sustainability concept rooted both in the notion of strong sustainability and in the societal learning approach, and we will relate to competitiveness at firm or industry level. With its normative call to maintain critical natural capital – as a basis for reconciling the needs of today's and of tomorrow's generations –, sustainability can be regarded as an end in itself. At the same time, the 'societal learning' approach to sustainable development underscores that sustainability constitutes above all a *procedural* end: it is not a state that can be achieved once and for all, but rather a searching process for a precarious balance between social goals that continually needs to be adjusted without surpassing the earth's carrying capacity. Biophysical systems have their own internal dynamics which react to exploiting economic activity and which trigger feedbacks on economic and social relationships, so that socio-economic systems and their biophysical constraints ultimately 'co-evolve'.

Competitiveness and innovation as means?

Competitiveness and innovation are no ends in themselves. Both are being sought for in order to achieve other goals. The question arises whether and to what extent they are means to promote the search for a sustainable path into the future.

While a traditional understanding of competitiveness does not immanently relate to sustainability, there is a growing body of literature on 'sustainable' or 'responsible competitiveness' that attempts to forge this link by emphasising the long-term perspective of market behaviour (Swift/Zadek 2002). In this sense, competitiveness can be defined as the long-term capacity of firms to successfully maintain market relations. This capacity requires a durable balance of profits, innovation, market stability, community or stakeholder relations, and respect for the environment. Integrating social and environmental concerns into business is a possible source of competitive advantage for companies, industries and – arguably – nations: it helps sustaining the resources and hence the very basis of business; among competing firms, it is a means of differentiation and allows taking premium prices; it ideally furthers employee motivation, organisational learning and the ability to innovate. However, the following aspects call for consideration: While increased competitiveness of firms and industries, signalling enhanced productivity, may create growth and jobs both locally and abroad thus building manufactured and social capi-

tal, it can at the same time put pressure on critical natural capital and ecosystem functions. This holds in particular when 'qualitative growth'[21] is not attained. In general, the strong sustainability concept does not require a stationary economy ('steady state'). Changes in resource allocation over time are acceptable if they do not significantly affect the overall ecosystem parameters and if the stability (resilience) of the system of its crucial components is not jeopardised (Turner 1992: 14-15). Economic growth can be 'decoupled' from ecological impacts through restoring damages and through technological change. The latter comprises innovation as well as diffusion of existing clean or environmentally sound technologies. The Porter hypothesis as elaborated above holds that stringent ecological policies through innovation may provoke increases in competitiveness and at the same time contribute to the protection of the environment. In this sense, innovation may be a means to promote both competitiveness and sustainability.

Innovation and competitiveness

However, this is not an automatic relation. In the case of regulation-induced innovation, for example, several scenarios are conceivable in which innovation does not suffice to improve a company's or sector's competitiveness. This is the case in polluting industries when the costs of innovating exceed the medium- and long-term costs of complying with the regulation at issue. In environmental technology industries the incentive to innovate may sink with the number of competitors that invest in R&D, as the probability decreases to win the 'patent race'. When we give up the assumption of perfectly functioning markets there are lock-in effects, path dependencies and technological trajectories that can prevent an invention from turning into a marketed innovation. Furthermore, too early regulation may cause an industry to innovate in the wrong direction, forfeiting a first mover advantage.

Innovation and sustainability

Likewise, innovation does not automatically promote sustainability. For example, innovations may promote the substitution of workforce by way of a more efficient technology, thus straining equity. In ecological terms, there is e.g. widespread concern that the innovation of genetically modified organisms (GMO) will harm the stability of ecosystems and cause irreversible impacts. Another instance is Chlorofluorocarbons (CFCs): initially considered a major technological advance, they are now regarded as a driver of stratospheric ozone depletion and cause of damages to human health and the environment. Less obvious is that even 'green' innovations, which increase material or energy efficiency, contribute to an absolute demand for resources that may ultimately eat up the relative efficiency gains (rebound effect). Innovations furthermore may cause so called alibi-effects. For example, introduction of the catalytic converter rendered the substitution of automotive mobility less urgent. And when 'green' or 'sustainable' innovations do not replace unsustainable products, processes and systems (through 'ex-novation'), but merely co-exist with them structural change is delayed and pollution continues. While to improve sustainability, radical innovations are particularly important, such transitions from one technological trajectory to a more sustainable one are often impeded by path dependencies.

The role of public policy

To sum up, the relation between competitiveness, innovation and sustainability is complex, uncertain and not necessarily harmonious. Within this context, the role of public policies is decisive: At a general level, a reflexive governance framework may help to account for uncertainty and complexity in the interrelations of innovation, competition and policy processes. It does so

[21] By qualitative growth we mean an increase in the quality of goods and services that avoids depleting or degrading the quality of natural resources to unsustainable levels for current and future generations, and a recognition of non-commodity satisfactions such as leisure, economic security etc. Indices like the Index of Sustainable Economic Welfare (ISEW), the Genuine Progress Indicator (GPI) and the Human Development Index (HDI) try to capture aspects of qualitative growth.

e.g. by promoting integrative and participatory knowledge production, goal formulation and strategy development; and by furthering adaptive strategies and the anticipation of long-term systemic effects of action strategies (Voss/Kemp 2006). A regulatory framework is necessary to promote sustainable innovation, as the technological push and market pull frequently do not suffice to stimulate clean technologies. This is due to the problem of 'double externality': While positive spillovers of R&D activities typically accrue for all kinds of innovations, ecological innovations create positive spillovers also in the diffusion phase (due to a smaller amount of external costs compared to competing goods and services on the market). As a consequence, the incentive is reduced for firms to invest in environmental innovations (Rennings 2000: 319-332). Policies that internalise environmental externalities (i.e. 'get the prices right') are apt to steer investment, innovation and consumption decisions into a more sustainable direction, and may at the same time promote competitiveness. Beyond such 'market correcting' approaches, a broad range of instruments is necessary that stimulate (system-) innovations. This includes among others ambitious emission reduction targets, dynamic technology standards (e.g. the top runner model), stimulation of company learning in networks and the strategic development of niche markets where 'disruptive' environmental technologies can develop. Such a systematic integration of innovation policy and environmental/sustainability policy is recommended in order to promote a genuine transition to more sustainable systems of production and consumption (Foxon 2006; Jacob et al. 2005: 24).

5 References and internet resources

Arthur, W. Brian (1997): Increasing Returns and Path Dependence in the Economy. Ann Arbor, MI.

Barrett, Scott (1994): Strategic environmental policy and international trade. In: Journal of Public Economics 54 (3), pp. 325-38.

Barrett, Scott (1992). Strategic Environmental Policy and International Trade, CSERGE Working Paper GEC 92-19. Available at http://www.uea.ac.uk/env/cserge/pub/wp/gec/gec_1992_19.pdf

Beise, Marian/Rennings, Klaus (2001): Lead Markets of Environmental Innovations: A Framework for Innovation and Environmental Economics. ftp://ftp.zew.de/pub/zewdocs/dp/dp0301.pdf

Belz, F. (1995): Ökologie und Wettbewerbsfähigkeit in der Schweizer Lebensmittelbranche, Bern, Stuttgart, Wien. Own translation.

Cerny, Philip G. (1997): Paradoxes of the Competition State: The Dynamics of Political Globalization. In: Government and Opposition 32(2), pp. 251-274.

Daly, Herman E. (1990): Toward some operational principles of sustainable development. In: Ecological Economics 2, pp. 1-6.

Dieren, Wouter van (ed) (1995): Taking Nature into Account. A Report to the Club of Rome. New York.

Dosi, Giovanni (1988): The nature of the innovative process. In: Dosi, Giovanni et al. (eds): Technical Change and Economic Theory. London, pp. 221-238.

EEB (2006): Does the Lisbon Process Produce Sustainable Development? Available at http://www.eeb.org/activities/sustainable_development/JH-PRESENTATION-060306-on-LISBON.pdf

Esty, Daniel C./Porter, Michael E. (2002): Ranking National Environmental Regulation and Performance: A Leading Indicator of Future Competitiveness? In: The Global Competitiveness Report 2001. Oxford, pp. 78-100. Available at http://www.isc.hbs.edu/GCR_20012002_Environment.pdf

European Council (2006): Renewed Sustainable Development Strategy, 10917/06, Brussels 26 June 2006, p. 1-29. Available at http://ec.europa.eu/environment/eussd/

European Council (2001): A Strategy for Sustainable Development. Presidency conclusions, Göteborg European Council, 15-16 June 2001, pp. 4-8.

Feess, Eberhard/Taistra, Gregor (2001): Environmental regulations and managerial myopia, Jahrbücher fuer Nationalökonomie und Statistik 220(1), pp. 18–31.

Fougner, Tore (2006): The state, international competitiveness and neoliberal globalisation: is there a future beyond 'the competition state'? In: Review of International Studies (32), pp. 165-185. Available at http://journals.cambridge.org/download.php?file=%2FRIS%2FRIS32_01%2FS0260210506006978a.pdf&code=950581e4ea3114849ea5704c1f57a0b3

Foxon, Timothy J. (2006): Applying systems thinking and practice for promoting sustainable innovation. Paper.

Freeman, Christopher/Perez, Carlota (1988): Structural Crises of Adjustment, Business Cycles and Investment Behaviour. In: Dosi, Giovanni et al. (eds): Technical Change and Economic Theory. London.

Frondel, Manuel/Horbach, Jens/Rennings, Klaus (2005): End-of-Pipe or Cleaner Production? An Empirical Comparison of Environmental Innovation Decisions Across OECD Countries. Discussion Paper No. 04-82. http://opus.zbw-kiel.de/volltexte/2005/2887/pdf/dp0482.pdf

Hart, Stuart L. (2005): Capitalism at the Crossroads – The unlimited business opportunities in solving the world's most difficult problems. New Jersey.

Helpman, Elhanan/Krugman, Paul (1989): Trade policy and market structure. Cambridge/MA, London.

Hemmelskamp, Jens/ Rennings, Klaus/ Leone, Fabio (2000): Innovation-Oriented Environmental Regulation - Theoretical Approaches and Empirical Analysis, ZEW Economic Studies, Vol. 10, Heidelberg.

Hirsch, Joachim (1998): Vom Sicherheitsstaat zum nationalen Wettbewerbsstaat. [From the security state to the national competition state] Berlin.

IUCN (2006): The Future of Sustainability. Re-thinking Environment and Development in the Twenty-first Century. http://www.iucn.org/members/future_sustainability/docs/iucn_future_of_sustanability.pdf

Jacob, Klaus et al. (2005): Lead Markets of Environmental Innovations. Heidelberg and New York.

Jänicke, Martin (1999): Policy patterns and innovation impacts: An international comparison. Paper.

Jaffe, Adam B. et al. (1995): Environmental Regulation and the Competitiveness of U.S. Manufacturing: What Does the Evidence Tell Us? In: Journal of Economic Literature, pp. 132-163. Available at http://economia.unife.it/ materia/29/jaffe.pdf

Jessop, Bob (2002): The Future of the Capitalist State, Cambridge.

Krugman, Paul (1994): Competitiveness: A Dangerous Obsession. In: Foreign Affairs 73(2), pp. 28-44. Excerpt available at http://www.pkarchive.org/global/pop.html

McFetridge, Donald G. (1995): Competitiveness: Concepts and measures. Occasional Paper Number 5, Industry Canada, April 1995. Available at http://strategis.ic.gc.ca/epic/internet/ineas-aes.nsf/vwapj/op05e.pdf/$FILE/op05e.pdf

Network of Heads of European Environment Protection Agencies (2005): The Contribution of Good Environmental Regulation to Competitiveness. Available at http://www.eea.europa.eu/documents/prague_statement/prague_statement-en.pdf

Nill, Jan (1999): Zwischen Öko-Dumping und First-Mover-Vorteilen. Schriftenreihe des IÖW 139/99, Berlin.

OECD (2006): The Social Dimension of Environmental Policy, in: Policy Brief, June 2006, pp.1-7. Available at http://www.oecd.org/dataoecd/31/0/36958774.pdf

OECD (2005): Measuring Sustainable Development. By Candice Stevens. Statistics Brief, September 2005, pp. 1-8. Available at http://www.oecd.org/dataoecd/60/41/35407580.pdf

OECD (2004): Meeting of the Environment Policy Committee at Ministerial Level, Issues Paper, pp. 1-20. Available at http://www.oecd.org/dataoecd/34/44/31462225.pdf

OECD (2001): Environmentally Related Taxes in OECD Countries. Issues and Strategies. Paris, pp.71-85.

OECD (1992): Technology and the Environment. The Key Relationships, Paris.

OECD (1990): Technology Economy Programme (TEP). Draft Background Report. Paris.

OECD/EUROSTAT (2005): Oslo Manual. Guidelines for Collecting and Interpreting Innovation Data. Paris. http://epp.eurostat.cec.eu.int/cache/ITY_PUBLIC/OSLO/EN/OSLO-EN.PDF

Ohlin, Bertil (1933): Interregional and International Trade. Cambridge/MA.

Paech, N. (2005): Richtungssicherheit im nachhaltigkeitsorientierten Innovationsmanagement. In: Fichter, K.; Paech, N.; Pfriem, R. (2005): Nachhaltige Zukunftsmärkte – Orientierung für unternehmerische Innovationsprozesse im 21. Jahrhundert, Metropolis, Marburg, 2005.

Pearce, David (2002): Technology, Environment and Sustainable Development: What Role For Technology Policy? In: OECD (ed): Technology Policy and the Environment. Paris, pp. 15-26. http://www.oecd.org/dataoecd/32/18/1830589.pdf

Pearce, David/ Barbier, Edward/ Markandya, Anil (1990): Sustainable Development. Economics and Environment in the Third World. Brookfield.

Pearce, David/Turner, R. Kerry (1990): Economics of Natural Resources and the Environment. New York.

Porter, Michael (2002): Enhancing the Microeconomic Foundations of Prosperity: The Current Competitiveness Index. In: World Economic Forum (ed): The Global Competitiveness Report 2001. Cambridge, pp. 2-26. Available at http://www.isc.hbs.edu/Micro_9201.pdf

Porter, Michael E. (1991): Green Competitiveness. In: New York Times, 5 April 1991, excerpted from April 1991 'Scientific American'. http://www.worldpolicy.org/globalrights/environment/scientam-apr91.html

Porter, Michael (1990): The Competitive Advantage of Nations. London

Porter, Michael/Van der Linde, C. (1995): Towards a New Conception of the Environment-Competitiveness Relationship, in Journal of Economic Perspectives 9(4), 1995, p. 97-118.

Rauscher, Michael (1995): Strategic Environmental Policy in Oligopolistic Markets. Nota di Lavoro 65.95, Fondazione Eni Enrico Mattei, Milano.

Rennings, Klaus (2000): Redefining innovation: eco-innovation research and the contribution from ecological economics. In: Ecological Economics 32(2), pp. 319-332.

Ricardo, David (1806): Principles of Political Economy and Taxation. London.

Rinehart, James (1995): The Ideology of Competitiveness. In: Monthly Review 47(5), pp. 5-14.

Rip, Ari/Kemp, René (1998): Technological Change. In: Rayner, Steve/ Malone, Elizabeth (eds): Human Choice and Climate Change. Columbus, Ohio, pp. 327-399.

Schmid, Stefanie (1997): Umweltpolitik und internationale Wettbewerbsfähigkeit. Kieler Arbeitspapiere Nr. 823. Kiel, pp. 52-53.

Schumpeter, Joseph (1934): The Theory of Economic Development. Cambridge.Simpson, R. David/Bradford, Robert L. (1996): Taxing variable cost: Environmental regulation as industrial policy. In: Journal of Environmental Economics and Management 30 (3), pp. 282-300.

Strange, Susan (1998): Who are EU? Ambiguities in the concept of competitiveness, Journal of Common Market Studies 36(1), pp. 101-114.

Sturm, Daniel M. (2003): Trade and the Environment: A Survey of the Literature. In: Marsiliani, Laura/ Rauscher, Michael/ Withagen, Cees (eds.): Environmental Policy in an International Perspective. Dordrecht, pp. 119 - 149. http://personal.lse.ac.uk/sturmd/papers/Sturm-EPIP-2003.pdf

Swift, Tracey/Zadek, Simon (2002): Corporate Responsibility and the Competitive Advantage of Nations. London, Stockholm. Available at www.accountability21.net/uploadstore/cms/docs/CR%20and%20CA%20of%20N.pdf

Taistra, Gregor (2000): Die Porter-Hypothese zur Umweltpolitik. Wiesbaden.

Triebswetter, Ursula/ Wackerbauer, Johann (2004): The Impact of Environmental Regulation on Competitiveness in the German Manufacturing Industry. A Comparison with other Countries of the European Union. Frankfurt. Available at http://web.fu-berlin.de/ffu/akumwelt/bc2004/download/triebswetter_wackerbauer_f.pdf

Turner, R. Kerry (1992): Speculations on weak and strong sustainability, CSERGE Working Paper GEC 92-26, pp. 14-15. Available at www.uea.ac.uk/env/cserge/pub/wp/gec/gec_1992_26.pdf

Ulph, A.: (1996): Environmental policy and international trade when governments and producers act strategically. In: Journal of Environmental Economics and Management 30(3), pp. 265-281.

United Nations Conference on Environment and Development (UNCED) (1992a): Agenda 21. Chapter 8. Available at http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21toc.htm

United Nations Conference on Environment and Development (UNCED) (1992b): Rio Declaration on Environment and Development. http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm

Van de Ven, A.H. et al. (1999): The Innovation Journey. Oxford.

Voss, Jan-Peter/ Kemp, René (2006): Sustainability and Reflexive Governance – Introduction. In: Voss, Jan-Peter/Bauknecht, Dirk/Kemp, René (eds). Reflexive Governance for Sustainable Development. London, pp. 3-28.Wallace, D. (2001): Environmental Policy and Industrial Innovation. Strategies in Europe, the USA and Japan. London.

Walz, Rainer/Meyer-Krahmer, Frieder (2003): Innovation Systems and Development Strategies for the Third Millennium. http://redesist.ie.ufrj.br/globelics/pdfs/GLOBELICS_0068_tKrahmerWalz.pdf

WEF (World Economic Forum) (ed) (2006): The Global Competitiveness Report 2006-2007. Oxford.

World Commission on Environment and Development (WCED) (1987): Our common future. Oxford. Available at http://www.un-documents.net/wced-ocf.htm