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Martin Jänicke, Harald Mönch and Manfred Binder*

Ecological Aspects of Structural Change

Structural change in advanced industrialized countries has followed a very ambivalent course, with the resulting reductions in environmental stress in one area often being cancelled out by increases in another. What role has been played in this to date by industrial and economic policy? What options are open to policy-makers for the future?

In environmental policy two fundamental strategies can be distinguished: a remedial "end-of-pipe" strategy that does not revise existing problematic technologies, and a preventive strategy¹ that alters production and consumption ex ante towards ecologically better adapted forms. A similar distinction can be drawn between "additive" and "integrated" environmental protection. The term preventive (or integrated) environmental protection policy as we understand it refers to all forms of environmental policy or ecologically motivated economic policy that envisage structural change of the economy. Technological progress in the sense of "ecological modernization" forms part and parcel of this concept of structural change. It is after all a matter of the notion, covered nowadays by a variety of terms, of the transition to "sustainable development" or "eco-restructuring". We refer to the policy pursuing such aims as ecological structural policy. Integrated environmental protection of this sort requires not only an integrated technical solution but also an integrated political solution in the sense of well-developed cooperation between policy fields.

We call the subject of ecological structural policy "structural environmental stress". The extent of structural environmental stress does not depend on end-of-pipe environmental protection measures. Every economic act causes environmental stress in so far as, without additional cleaning technology, it would cause actual environmental damage. As a rule, however, structural environmental stress goes beyond this, characteristically also involving considerable residual pollution, even where remedial environmental protection measures are taken. In

the case of a coal-fired power station, for example, end-of-pipe cleaning technologies do nothing to eliminate subsequent environmental stress (partly even caused by cleaning measures) from:

- ☐ CO₂ emissions,
- ☐ residual emissions, which can increase again as a result of growth processes,
- ☐ extremely high water consumption,
- ☐ heavy transport commitment (fuels, limestone, gypsum and other waste),
- ☐ high waste production,
- ☐ waste water production from cleaning plants,
- ☐ detrimental impact on the landscape from coal extraction, limestone quarrying or power lines,
- ☐ considerable consumption of electricity by cleaning plants,
- ☐ the consumption of resources.

Nuclear power generation, even with a high level of environmental protection and safety, is also a large consumer of water and involves considerable risk in the operation of power stations and the transport and disposal of radioactive materials.

Existing pollution is, furthermore, often simply shifted from one region or medium to another by end-of-pipe

¹ Cf. Jürgen Gerau: Zur politischen Ökologie der Industrialisierung des Umweltschutzes, in: Martin Jänicke (ed.): *Umweltpolitik, Beiträge zur Politologie des Umweltschutzes*, Opladen 1978, pp. 114-149; Martin Jänicke: *Wie das Industriesystem von seinen Mißständen profitiert*, Opladen 1979; Udo Ernst Simonis (ed.): *Präventive Umweltpolitik*, Frankfurt am Main, New York 1989.

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environmental protection measures. Moreover, remedial environmental protection presupposes goods production that is detrimental to the environment.

Environmental protection, especially in the long term, will therefore necessarily be conceived in terms of structural policy. This is inevitable, not least of all because residual problems can rapidly return to their initial levels due to growth processes. This may also be formulated as an ecological/economic imperative: in a growing economy the ecologically detrimental impact of growth must constantly be compensated. Initially, remedial environmental technology appears appropriate. When this possibility has been exhausted, stress-reducing technological and structural change become essential.

At this point it is also decisive whether environmental policy overcomes its status as mere additive policy, to be integrated into other policy fields. At this stage the point of gravity in environmental policy thus shifts to other policy areas: energy policy, transport or industrial policy, farming policy etc.

This paper deals with industrial policy² as ecological structural policy. This is defined in the first place as the sum of all measures designed to reduce structural environmental stress by industrial production.

Environmental protection as sectoral structural policy may seek structural change in the sense of a change in the relative status of individual branches (intersectoral structural change). The change may be tackled politically by means of ecologically motivated shut-downs, branch agreements, environmental charges and so on. It may, however, also be the result of changing demands of all types, whether as a consequence of changes in values or of modernisation processes among industrial customers. It may arise because investors switch to other branches or relocate production (which amounts to shifting ecological problems). The shift of freight transportation from road haulage to rail transport can also be regarded as sectoral structural policy.

Ecological structural policy may, however, also envisage intrasectoral change within branches. In this case it is generally a matter of technological innovation in the sense of "ecological modernisation".³ Ecological modernisation as a programme recognises that, in view of

the problem of long-term destruction of the environment, technological progress should not be retarded but rather accelerated in order to achieve the switch to ecologically more appropriate production and products. Ecological modernisation involves both innovation in production processes and innovation in products. For example, changes in products and processes under the heading of "soft chemistry" have been discussed and implemented. In the field of electricity supplies, there have been relative reductions in environmental stress due to high efficiency power stations and combined heat and power production, and there has been transition to cleaner energy sources (water, gas, solar energy etc.) In the building industry, the transition to ecological building materials and building forms (e.g. zero-energy buildings with low space and water needs) represent a similar possibility. Intrasectorally oriented industrial policy will generally be aimed at lowering the intensity (per unit of value added) of specific parameters of production⁴, in particular:

- ☐ material intensity (especially that of non-renewable resources),
- ☐ energy intensity,
- ☐ water intensity,
- ☐ land use intensity,
- ☐ transport intensity,
- ☐ emission intensity,
- ☐ waste intensity and
- ☐ risk intensity.

In the case of intrasectoral structural improvement, the organizational framework and the social reality of the branch remain essentially unchanged. Change affects the form and content of production. For employment policy or regional policy reasons, it will thus frequently seem best to practise environmental structural policy initially in this innovation variant.

Much can be said in favour of inducing the process of ecologically beneficial intrasectoral change primarily by means of technological progress within sectors of the economy. On the one hand, ecological modernisation results in a high demand for tertiary pre-production activities (research, development, consultancy, qualification etc.), thus increasing the importance of services with little impact on the environment; on the other hand, production which is sparing in energy and materials

² Cf. Chalmers Johnson (ed.): *The Industrial Policy Debate*, San Francisco 1984.

³ Cf. Martin Jänicke: *Umweltpolitische Prävention als ökologische Modernisierung und Strukturpolitik*, Wissenschaftszentrum Berlin für Sozialforschung, IUG discussion papers 84-1; Klaus Zimmermann, Volkmar J. Hartje, Andreas Ryll: *Ökologische Modernisierung der Produktion, Strukturen und Trends*, Berlin 1990.

⁴ Cf. Martin Jänicke, *ibid.*; Marina Fischer-Kowalski et al.: *Verursacherbezogene Umweltindikatoren*. Abstract, Vienna 1991.

Figure 1

International Change Profile of Cement Production 1970/90

(Level and change 1970 / 1990 calculated as linear trend)

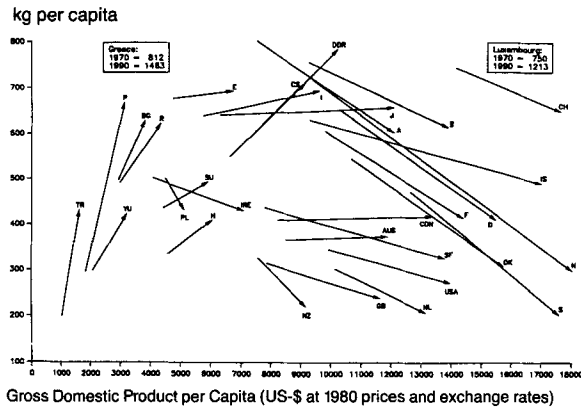


Figure 3

International Change Profile of Paper and Paperboard Production 1970/87

(Level and change 1970 / 1987 calculated as linear trend)

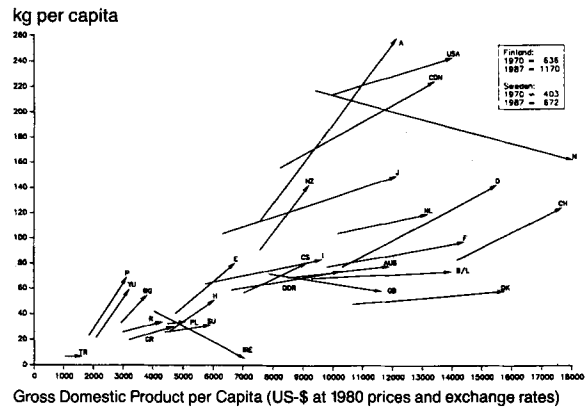


Figure 2

International Change Profile of Crude Steel Production 1970/90

(Level and change 1970 / 1990 calculated as linear trend)

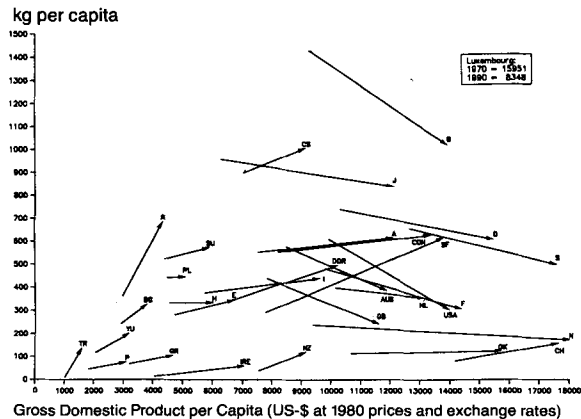
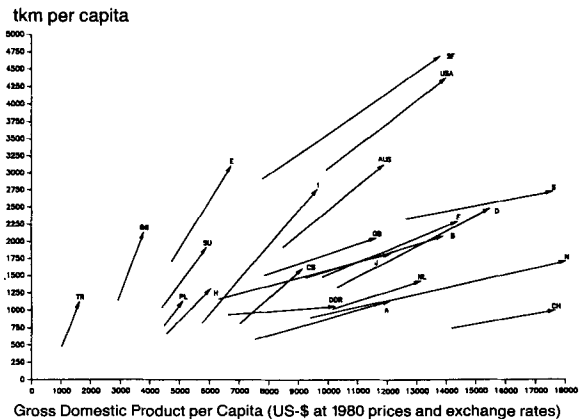


Figure 4

International Change Profile of Freight Movement 1970/88

(Level and change 1970 / 1988 calculated as linear trend)



leads to an (at least relative) decline in heavy industries which cause environmental stress.

Moreover, modern service industries generally imply production which is intensive in know-how and services. Sectoral structural change—in the form of “tertiarization”—may thus be ecologically significant. This is also true for the encouragement of corresponding shifts in demand from extensive goods consumption to intangible “goods” or services.

The overall impact of shifts between branches (as intersectoral change) may be to reduce environmental stress, but they may also disguise problem relocation in the form of adjustments in the division of labour in the world market. Technological change as ecological

modernisation, by contrast, tackles the problem directly. It improves the environmental situation not least by avoiding problematic substitutions or the relocation of problematic sectors of production.

Changes in Environmental Stress

How has structural environmental stress as we have defined it changed in the industrialized countries since 1970? The following treatment of this topic is based on an international comparative research project⁵ at the Free University of Berlin sponsored by the Volkswagen Foundation. A total of 32 industrialized countries were

⁵ Cf. Martin Jänicke, Harald Mönch, Manfred Binder et al.: Umweltentlastung durch industriellen Strukturwandel? Eine explorative Studie über 32 Industrieländer (1970-90), Berlin 1992.

examined for the period 1970 to 1990 with regard to seven production sectors evidencing a particularly high degree of structural environmental stress: crude steel, primary aluminium, cement, chlorine, pesticides, fertilizers, and paper and paperboard. These branches are representatives of the basic industries most detrimental to the environment. To these were added two branches from outside the manufacturing sector: electricity generation and freight transport, which can also serve as background variables for structural environmental stress (another important background variable dealt with is energy requirement). Selection of the nine branches causing structural environmental stress was made not only on an objective basis, but was also determined for practical research reasons by the availability of time-series permitting an additional comparison with eastern European industrial countries.

It proved that advanced industrialized countries in traditional sectors such as cement, crude steel and fertilizers evidenced at least a relative reduction in environmental stress in the form of the delinking of these production sectors from overall economic growth. A trend towards delinking in energy requirements and in the weight of freight moved by road and rail was also observed. The less advanced industrial countries in eastern Europe showed an absolute deterioration in the sectors mentioned at an already high level. The greatest degree of structural deterioration, albeit at a low initial level, was evidenced by southern European countries (cf. Figs. 1 and 2).

By contrast, structural environmental stress related to electricity generation and freight movement by road (measured in tonne-kilometres) is on average proportionate to economic growth in most of the advanced industrialized countries. No delinking has occurred in this respect, but rather a frequent increase at a high level. In a number of advanced industrialized countries this is also true for primary aluminium production, chlorine, paper and paperboard and (where figures are available) pesticides (cf. Figs. 3 and 4).

The significance of the reduction in environmental stress in traditional production sectors and the increase in more modern sectors is well illustrated by the example of the Federal Republic of Germany (cf. Fig. 5). The two peaks of the first and second oil crises (1973 and 1979) are particularly apparent.

Four aspects of this change are dealt with below in greater detail:

□ the significance of the energy prices, particularly industrial electricity prices;

Figure 5

National Change Profile FRG 1960-1990

(1960 = 100)

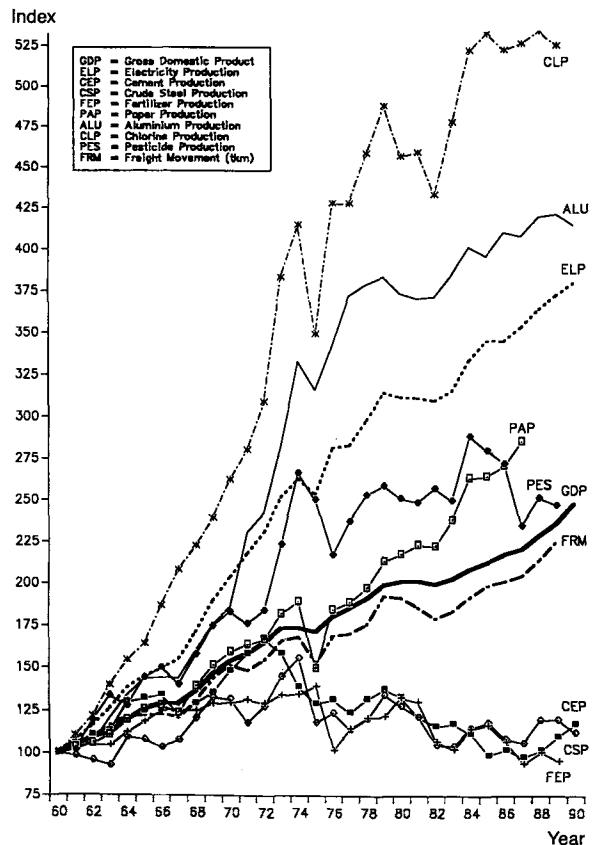
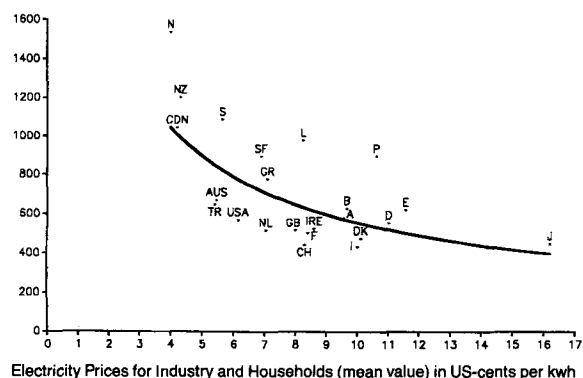


Figure 6

Electricity Price and Electricity Intensity 1989

Watt hours / US-\$
(Price basis 1985)

- the contrast between technological capability and reality, especially in relation to energy and transport;
- the considerable significance of technological change and the low significance of intersectoral change;
- the apparently low significance of sectoral structural policy for ecologically beneficial development.

Significance of Energy Prices

In northern Europe (Scandinavia and Iceland), North America (USA and Canada) and Oceania (Australia and New Zealand) – countries with particularly low electricity prices – energy requirements developed on a high level with atypical dynamism. This was especially true for electricity consumption: where a country charged electricity prices twice those prevailing in a second country, the former generally evidenced an electricity intensity rate a third lower (cf. Fig. 6). These countries also have industries causing a particularly high degree of environmental stress (aluminium, chlorine, paper and paperboard) – a doubly negative structural impact. It is thus hardly by chance that Japan, the country with the highest industrial electricity prices, also shows the highest degree of structural change.

Especially with regard to the discussion on the ecological impact of energy taxes, however, the massive price differentials necessary to obtain this result should not be overlooked: if the long-term relation between electricity price and electricity consumption established in international comparative terms were to exist also for short-term elasticity within individual economies, a country with an average annual rate of growth of 3% would need to double relative electricity prices every 16 years simply in order to keep electricity consumption constant. Persistent political intervention in price structures on this scale would doubtless be a politically risky undertaking.

Unexploited Technological Possibilities

The delinkage of energy requirement from the economic growth trend is common in the more advanced industrialized countries. Some of these countries evidence stagnation in per capita consumption of primary energy; the United States, Denmark, Britain and Luxembourg even experienced a decrease.

The majority of more advanced industrialized countries has at least exhausted some of the conservation potential which today can be regarded as the state of the art in energy research. But there is no development towards stagnation in electricity consumption parallel to that registered for energy requirement; in the course of time and with the rise in the standard of living there has hitherto

always been an increase in electricity generation. Some affluent industrialized countries (Norway, Canada, Iceland, Sweden) even exhibited an accelerated increase. As mentioned above, the countries concerned charge low electricity prices. In Sweden, for example, the advance of electricity into the heating market was questionable from the energy policy point of view. Because of the particularly large volume of waste heat produced by electricity generation, this strong trend towards electricity use is in conspicuous contradiction to the objective of conserving primary energy. In other words: if the "away from oil" policy had been less a policy of "towards electricity", a great deal more primary energy would have been saved. However, the discovery of significant technological conservation capacities in final electricity consumption entered public awareness only in the eighties.

In the field of freight movement the contrast between technological possibilities and reality was no less marked. If we consider the weight of cargo moved by rail and road, we find a trend towards stagnation in a series of advanced industrialized countries (in contrast to eastern Europe with its then prevailing "tonnage ideology"). In Sweden, Japan, France, Britain, Belgium and Luxembourg there has even been a reduction (per capita). This remarkable result seems to indicate that growth has incorporated a more distinctly "qualitative" component. The fact that the consumption of raw materials in the Federal Republic of Germany in 1990 was slightly below the level for 1978 (see below) is fully compatible with stagnation in the weight of cargo moved.

This is, however, in strong contrast to the marked increase in transportation activity in road freight (cf. Fig. 4). An apparently hardly increasing volume of goods was thus moved ever farther and ever more frequently by road. Increasing integration in the world market has certainly made an essential contribution to an ever larger proportion of goods produced being exchanged over ever greater distances. Precisely this development *could* have favoured rail transport as the cleaner alternative – but this did not occur.

Significance of Intrasectoral Change

We have hitherto dealt with intersectoral structural change and its implicit environmental impact. In brief, it brought no reduction in environmental stress in the southern and eastern European industrial countries. On the contrary: the industrial environmental situation in these areas deteriorated. In the highly advanced industrialized countries, too, there was no reduction in environmental stress in the above sense, despite a slight decline in traditional heavy industries (mineral products,

crude steel, fertilizers), because modern industries with high environmental consumption – especially the chemical industry – have experienced strong growth. This is also true for countries with strong structural change such as Japan.

If we also consider change within industrial sectors and enterprises, a somewhat different picture emerges. At least in the advanced industrialized countries, this intrasectoral change has hitherto been the most significant factor from the ecological point of view. We have – unfortunately only incomplete – figures for the highly advanced industrialized countries Japan, the Federal Republic of Germany and Sweden. A comparison will be drawn with the less advanced industrial country Portugal.

With regard to intrasectoral change, it can be assumed that technological change predominates. In fact, however, there are also changes – not technological in nature – in the relative weighting of product groups within industries that have to be taken into consideration. If, for example, products in the chemical industry that have always been relatively cleaner to produce than others gain in importance, this can no more be considered

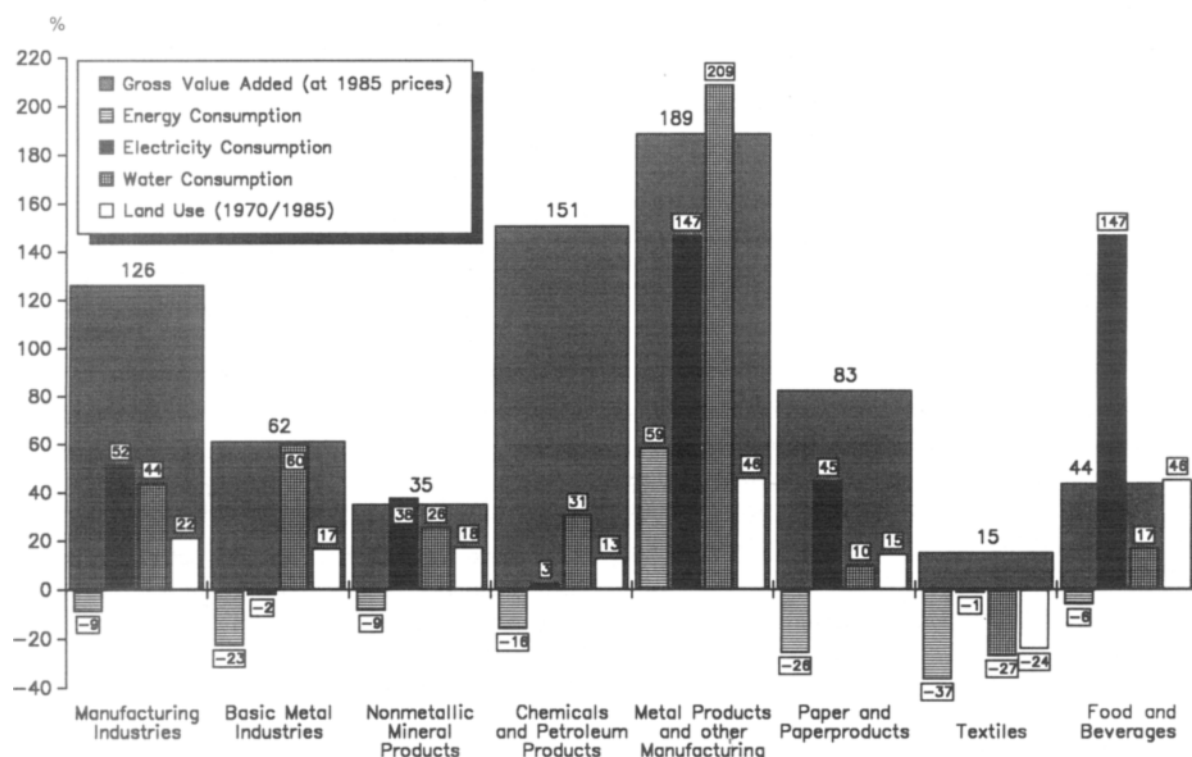
modernization than can the relocation of problematic preliminary production phases. We thus refer to intrasectoral change.

We measure intrasectoral change as an adjustment in a number of the above factors in industrial ecological structures, primarily changes in energy and water intensity. Figures are also provided on the usually marked, but differentiated, trend towards electricity use (electricity use is included at the same time in data on energy consumption). Data are also available on raw materials consumption and on waste production by the manufacturing sector in the Federal Republic of Germany and Japan; in addition there are industrial land use figures for Japan. We will proceed to describe intersectoral and intrasectoral change in the four countries mentioned, showing developments in Japan and the Federal Republic of Germany in Figs. 7 and 8.

Japan experienced considerable intersectoral change and incomparably greater intrasectoral change. The relative decrease in significance of mineral products, basic metal production and the paper industry, and an absolute downturn in special basic industries (aluminium,

Figure 7

Percentage Change by Indicator and Branch 1971 - 1987: Japan



Sources: OECD: National Accounts Statistics; OECD: Energy Balances Statistics; Japan Statistical Yearbook: Kogyo tokei-hyo (Industrial Statistics).

fertilizers) was accompanied by radical change in individual branches. Although the chemical industry experienced above-average growth, it nevertheless reduced energy consumption in absolute terms by 16 per cent. Metal production developed similarly. In the textile industry there were improvements throughout.

For the period 1977 to 1987 the picture is even more favourable: stagnation or an absolute drop in energy and water consumption and land use by metal production, the chemical industry (with the exception of a 4% increase in land use), the paper industry and the textile industry.

Intrasectoral change in Japan proved to be little less than dramatic: industrial final energy consumption in 1989 was no less than 58.6 per cent lower than it would have been without change – primarily technological – within branches since 1970. In the Federal Republic this stress-reducing effect of intrasectoral change made a difference (up to 1989) of 30.4 per cent, and in Sweden (1973-1988) of 27.6 per cent. In Portugal change within industrial branches tended to result in structural deterioration.

By contrast, the reduced significance of energy-intensive branches (intersectoral structural change)

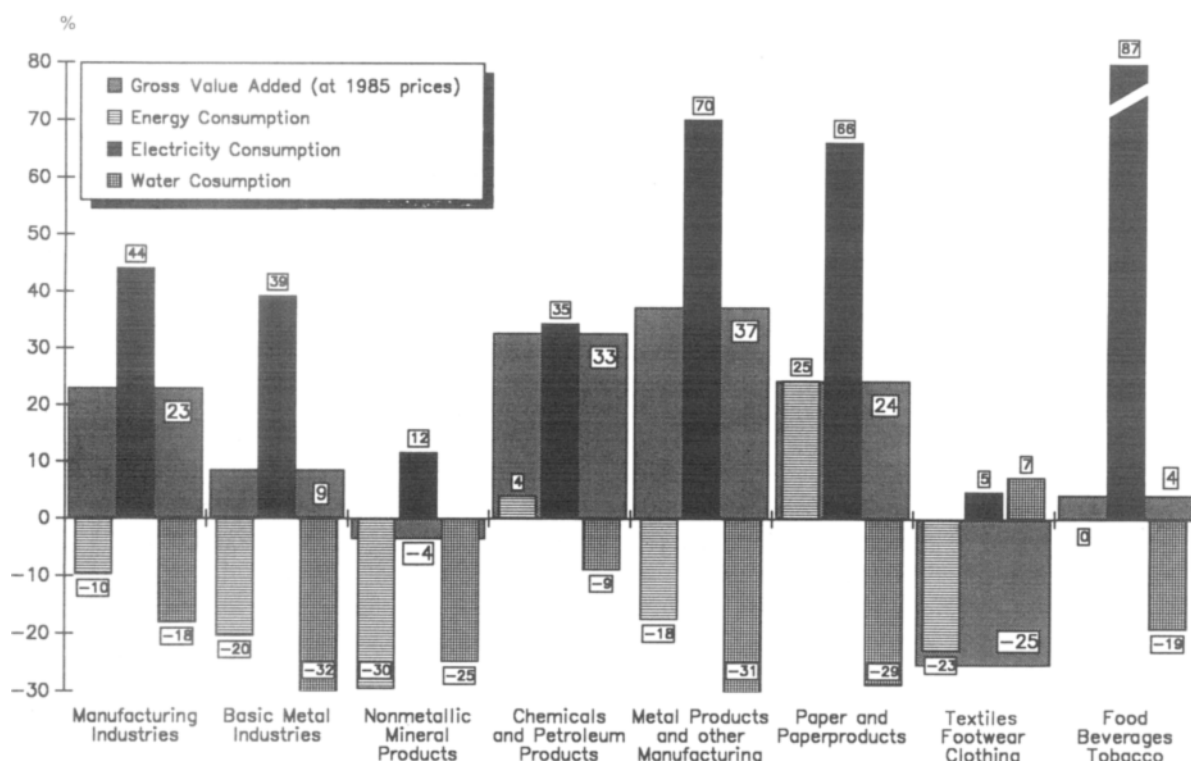
lowered energy consumption in Japan and West Germany from 1970 on balance only marginally (in each case by a good 13 per cent). In Sweden and Portugal this effect was quite unimportant.

In the case of industrial water consumption, too, technological change within branches was very much to the fore. Japan consumed 29.5 per cent less water, and the Federal Republic 36.9 per cent less (1971 to 1987) than they would have without intrasectoral change. In Sweden, where precise branch data on water consumption are not available, a marked reduction was also only possible because of conservation within industries. The intersectoral components in Japan, by contrast, produced a difference of only 8.2 per cent (1970-1987). In the Federal Republic it was of as little significance as it apparently was in Sweden.

With regard to waste produced by the manufacturing sector, intersectoral change brought a reduction in the Federal Republic (there was 10.4 per cent less waste than there would otherwise have been for the period 1977-1987). Intrasectoral change, however, resulted in a 19.8 per cent deterioration. The growth-related rise in industrial

Figure 8

Percentage Change by Indicator and Branch 1971-1987: Federal Republic of Germany



Sources: OECD: National Accounts Statistics; OECD: Energy Balances Statistics; Statistical Yearbook FRG.

waste production was thus not compensated, but – also as a consequence of environmental protection measures – aggravated, producing a 23.5 per cent increase. In Japan, too, industrial waste increased (1975-1985: 32 per cent) in absolute terms, but in contrast to the Federal Republic the rise was slower than that in industrial value added.

Reduction in Environmental Stress

What, then, was the impact of structural change on the four countries we have been looking at in detail in relation to ecologically significant criteria? The indicators used are industrial energy, water and raw materials consumption, production of waste and the volume of freight movement by rail and road (the latter concerned not only, but primarily, with industrial goods).

The greatest reduction was in industrial final energy consumption. The three highly advanced industrialized countries Japan, Sweden and the Federal Republic experienced an absolute reduction. Industrial water consumption also showed a relatively favourable trend. In the Federal Republic and Sweden there was also a drop in absolute terms. In respect of both indicators there was thus a real reduction in environmental stress. In Japan the specific reduction in both fields was much greater. Nevertheless, strong industrial growth led to an absolute increase in water consumption; from 1979 onwards, however, this stagnated.

The relative or absolute reduction in industrial energy and water consumption contrasts with the absolute deterioration in waste production (Japan, Federal Republic). Nearly the same is true with regard to freight movement (three countries), with the exception of Sweden, where transport activity was nearly stabilized after 1974. Japan evidenced at least a drop in intensity for all four indicators, thus achieving delinkage from economic growth. This was so substantial that for a long period there was no deterioration in the growth process. This observation also applies with regard to a further indicator: land use.

Data are also available on raw materials consumption in the Federal Republic of Germany for the period 1978 to 1990, according to which consumption – at constant prices – dropped slightly in absolute terms.⁶ In Japan there was an increase of about 50 per cent from 1970 to 1990⁷ but near stagnation between 1975 and 1985.

According to the five indicators selected, structural change in advanced industrialized countries has thus followed a very ambivalent course. This also became

⁶ Statistisches Bundesamt: Statistisches Jahrbuch für die Bundesrepublik Deutschland, Stuttgart 1992, p. 713.

⁷ Environmental Agency: Quality of the Environment in Japan, Tokyo 1992, p. 156.

Winfried Schmähl (Ed.)

The Future of Basic and Supplementary Pension Schemes in the European Community – 1992 and beyond

Concerning the future of old-age protection in Western Europe, basic statutory pension schemes are in the centre of most debates today. This volume focuses on the various types of supplementary pension schemes, especially occupational pensions, in the European Community. Two complex issues are discussed. What will be the role of supplementary pension schemes in the face of structural changes in demography, economy and society? Will e.g. tendencies to reduce replacement rates in statutory pension schemes increase the importance of occupational provision? Considering the completion of the Single European Market and the international mobility of labour, the question arises whether certain structural elements of supplementary schemes may impede the freedom of movement of workers. Does this field require harmonization or coordination at the Community level? Which ways could be taken without impeding the development of national supplementary schemes? Which influence has taxation of contributions, benefits and pension plan assets? These are some of the questions discussed in the contributions of scientists as well as experts from ministries, associations, industry and consultancies.

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apparent from the rough classification used for the nine polluting branches of the economy (see above). On balance we cannot speak of a reduction in environmental stress. However, without structural change this would have deteriorated dramatically from the ecological point of view. This is probably the most important result to be attributed to industrial change since the oil crisis.

The – relative – benefits of the alteration in the growth pattern after 1973 only become clear when the situation in Portugal is examined. Even with the unsatisfactory data situation there it is obvious that industrial energy and water

consumption rose not only in absolute terms, but also relative to economic performance. This also applies with regard to freight movement.

For Japan the development of industrial land use could also be taken into consideration. After 1975 it hardly increased at all. Industrial land in Tokyo between 1975 and 1985 even decreased in area by 23 per cent.⁸ On the other hand, changes in Japan, constituting the largest-scale reduction in environmental stress worldwide, were more strongly counteracted by more rapid industrial growth. From 1986 onwards energy consumption (especially in the form of electricity) once again increased conspicuously. The same is true for raw materials consumption and road and rail freight, which until 1985 had hardly risen above the 1972 level (cf. Fig. 9). The best-practice case Japan thus demonstrates two things:

□ Firstly, it becomes clear how extensive reductions in important input factors can be effected primarily by means of adjustments within branches. For a period Japan was almost a country with qualitative growth, sufficiently delinked from ecologically relevant input factors.

□ Secondly, however, it became apparent how difficult it is to sustain such stress-reducing delinking effects in the long-term growth process. The formulas of qualitative growth and sustainable development had hitherto hardly been associated with the notion that the reduction of environmental stress in the growth process has constantly to be renewed and extended.

The Portuguese growth pattern, representative for a large number of less advanced industrialized countries, but also for the growth pattern eastern Europe has hitherto experienced, would, if universalized, prove ecologically disastrous. But the Japanese growth pattern – with its partial relocation or export of environmental problems – does not yet offer alternative, environmentally appropriate goods production that is globally generalizable.

Industrial Policy

We also examined the role played by industrial and economic policy in possible ecological structural improvements in the four industrialized countries described. (We did not examine the part played by energy, transport and technology policy, to which structural policy effects could also be attributed in our context.)

We found that intersectoral change had been purposively influenced so far only by Japan. It is true that,

Table 1

Industrial Change by Ecologically Relevant Indicators in Selected Countries 1970-1987/89

(Intensity = relation to industrial value added, in brackets)

	Japan ¹	FRG ²	Sweden ³	Portugal ⁴
Energy consumption	decrease(-)	decrease(-)	decrease(-)	increase(+)
Water consumption	increase(-)	decrease(-)	decrease(-)	increase(+)
Raw materials consumption	increase(-)	decrease(-)	-	-
Freight movement	increase(-)	increase(+)	stability(-)	increase(+)
Waste	increase(-)	increase(+)	-	-
Land use	increase(-)	-	-	-

¹Waste: 1975-85; water consumption constant since 1980; land use: 1973/85; raw materials consumption: 1970-90.

²Waste: 1977/87; raw materials consumption: since 1978.

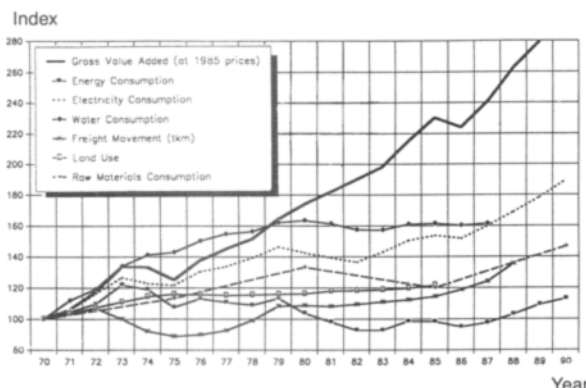
³Water consumption: official estimate.

⁴Water consumption: 1980/84; energy consumption: 1977/87.

+ = increase
- = decrease

Figure 9

Resources Use by Manufacturing in Japan 1970-90



Sources: OECD: National Accounts Statistics; OECD: Energy Balances Statistics; IRF: World Road Statistics; Japan Statistical Yearbook; Environmental Agency.

⁸ Tokyo Metropolitan Government: Second Long-Term Plan for the Tokyo Metropolis, Tokyo 1987, p. 283.

after 1973, energy policy in other industrialized countries also brought about factual reductions in the mineral oil industry. But ecological considerations generally played at best a subordinate role. Moreover, in a considerable number of countries (the United States, Britain, Canada etc.) any type of industrial policy is officially strictly rejected.

By contrast, Japan, the country which has experienced the farthest-reaching structural change, not only espoused industrial structural policy, but also gave it an ecological bias.⁹ The 1971 MITI concept of a "know-how intensive production structure", with its call for the rejection of material and energy intensive production, although primarily motivated by economic policy considerations, had distinct ecological implications – accompanied by forced-pace environmental policy. After the oil crisis, the MITI in 1974 called for the traditional growth model based on branches with a high material consumption to be abandoned. Increasing attention was paid to the environmental question. Finally, in 1978 legislation provided concrete measures dealing with economically/ecologically problematic economic sectors. Subsequently the production of primary aluminium was drastically reduced (aluminium was, however, then largely imported – with a high recycling rate). Fertilizer production continued to decrease in orderly fashion. Further regulation affected synthetic fibres, petro-chemicals, electro-steel, shipbuilding, paper and textiles – all branches with high rates of material, energy and environmental consumption. Overall priority was given to reducing dependence on imports. But the environmental question was not without significance as a further motive.

At the beginning of the seventies (even before the oil crisis) there was a certain amount of discussion in the Federal Republic of Germany on the relation between industrial structure and environmental stress. The 1971 Annual Economic Report issued by the Federal Government stated, "In its structural policy the Federal Government will seek improvements in environmental conditions to a greater extent than before".¹⁰ But a turnabout occurred at the latest in the period following 1975. And actual economic policy, in particular subsidisation policy, took the opposite direction under the banner of structural crisis: maintenance subsidisation

became quite clearly predominant. In the course of time it even increased (1987: one third of all federal subsidies;¹¹ 1992: more than 40 per cent¹²). In the late eighties, however, reporting on economic structural matters espoused the topic of ecology.¹³

Sweden, with its pronounced industrial and environmental policy,¹⁴ permitted the assumption to be made that a structural policy motivated, among other things, by ecological considerations, would be taken up at least within the field of economic policy. Initially this was indeed the case – at least as far as general statements of intention were concerned. But we find a cycle of discussion on ecological questions strikingly similar to that prevailing in the Federal Republic of Germany: in the early seventies long-term economic planning took the relation between environmental stress and industrial development into account. As in the Federal Republic, however, more than discussion was not on the agenda. After the oil crisis the question dropped out of sight in both countries. And only in recent years has the question of an ecologically more appropriate industrial structure received greater attention in economic structural policy.

The ecological effects of Swedish industrial development have thus been almost as ambivalent as they have been in the Federal Republic of Germany. Figures issued by the Central Office for Statistics show no favourable ecological balance for intersectoral structural change. But here, too, intrasectoral change (not least of all technological change) in polluting branches such as the paper industry has been of greater significance. Altogether in Sweden it was slow industrial growth that caused better ecological effects than in Japan, though the industrial change was less radical.

The question of ecologically influenced industrial policy in Portugal is not precluded from the outset, since this country on the southern periphery of Europe established environmental policy institutions at a relatively early date (protection of the environment was entrenched in the constitution in 1976, and as early as 1974 a ministry for social affairs and the environment was set up). Ecologically orientated structural policy was, however, not

⁹ Gesine Foljanty-Jost: Industriepolitik in Japan – Ansätze für einen strukturpolitischen Umweltschutz?, Berlin: Forschungsstelle für Umweltpolitik der FU Berlin 1990, FFU rep 90-6.

¹⁰ Jahreswirtschaftsbericht der Bundesregierung, Bonn 1971, section No. 77.

¹¹ Cf. Frank Stille: Umweltpolitische Auswirkungen staatlicher Subventionspolitik, in: Ulrich Petschow, Eberhard Schmidt (eds.): Staatliche Politik als Umweltzerstörung, Berlin 1990, p. 15.

¹² Deutsches Institut für Wirtschaftsforschung (DIW): DIW-Wochenbericht No. 46/92, Berlin 1992, p. 617.

¹³ Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI): Analyse der strukturellen Entwicklung der deutschen Wirtschaft (Strukturberichterstattung 1987), Schwerpunktthema: Strukturwandel und Umweltschutz, Essen 1987; HWWA Institut für Wirtschaftsforschung: Zusammenhang zwischen Strukturwandel und Umwelt, Spezialuntersuchung 2 im Rahmen der HWWA-Strukturberichterstattung 1987, Hamburg 1987.

¹⁴ Martin Jänicke: Conditions for Environmental Policy Success: An International Comparison, in: The Environmentalist, Vol. 12 (1992), No. 1, pp. 47-58.

on the government's agenda. The EC Regional Fund thus tended to have a structurally unfavourable impact (support for the paper industry). It was only in the environmental basic law of 1987 that ecological interests in industrial development were given a sort of general-clause mention. Nevertheless, in the 1987 energy plan lower growth rates in energy-intensive branches were scheduled. In 1988 economic structure reports gave programmatic status to the restructuring of the Portuguese economy to conserve resources and energy. Up to the present, however, Portuguese industry did not develop accordingly.

Conclusions

Although the topic of the relationship between environmental policy and industrial policy had been taken up in a number of advanced industrialized countries (Japan, Sweden, the Federal Republic of Germany) as early as the beginning of the seventies, this bore little real fruit except in Japan. Until well into the late eighties environmental policy was essentially special policy in the sense of the end-of-pipe variant. Only in Japan was attention given to the deliberate and socially cushioned reduction of polluting industrial sectors. And there, too – as elsewhere with the mineral oil industry – energy policy considerations were to the fore.

By contrast, autonomous structural change in the traditional heavy and basic industries in advanced industrialized countries (crude steel, cement, fertilizers) led to reductions in environmental stress. But from the point of view of environmental policy these were to be regarded more as chance bonus effects. And they were cancelled out – just as much by chance – by disproportionately high growth in industries causing high environmental stress such as chlorine, aluminium or paper and paperboard. However, in many places these industries have been under fire from public opinion, which does not preclude a change in demand behaviour. But this, too, would constitute a form of autonomous structural change.

The greatest environmental stress reduction effect in the advanced industrialized countries was caused by – primarily technological – changes taking place within branches and enterprises (intrasectoral change). But such changes, too, seem for the most part to be autonomous, triggered especially by alterations in price patterns. In this respect Japan is also the only country to show a certain degree of regularity in (relative) environmental stress reduction for parameters such as energy, raw materials and water consumption, land use and freight movement. However, Japan's high industrial growth rate appears to be the cause for the reductions achieved being cancelled out in the course of time.

Whatever general problems ecologically motivated industrial structural policy may present, the following conclusions are, in our opinion, justified:

□ *Energy taxes:* Our investigations lend support to demands that energy be made significantly dearer by imposing taxes (or in the case of innovation processes by levying charges to be ploughed back as fully as possible). This not only brings reductions in ecologically sensitive energy requirements; it also has structural effects that are to be classified as ecologically beneficial. A concentration of such taxes/charges on electricity seems to be particularly appropriate, since there is unexploited conservation potential in this field.

□ *Renouncing ecologically detrimental maintenance subsidisation:* This leads to industrial structural policy becoming taboo. The minimum recommendation would be that governments obeying this taboo ought also to waive every type of ecologically detrimental structural maintenance. "Ecological subsidy reduction" would probably be equivalent to an environmental stress reduction effect in many industrialized countries – not to mention fiscal relief.

The ecological restructuring of industrial societies will not be possible without structural policy. This, too, is a considerable penum in cooperation and integration for environmental policy and economic policy.

□ *Renouncing active promotion of growth:* The example of Japan shows that ecologically beneficial economic change tends to be neutralized by high growth. For growth rates are themselves an environmental problem. It is apparent that qualitative growth can in the long term only be limited growth, if ecologically negative growth effects are to be compensated by technological and structural change. If with an annual growth rate of one per cent we have a doubling in 70 years, with 5 per cent growth this factor would be attained in a mere 14 years; and in 70 years it would be thirtyfold. Such growth clearly cannot continue to be compensated by structural effects; except by relocation of production, which is no global or long-term solution.

For this reason the state must rethink its economic policy role as the engine of economic growth. The industrialized countries will not be able to afford the luxury of high growth rates for much longer. They will have to become accustomed to the universal problem-solver "economic growth" being increasingly superseded by political action (e.g. in matters of distribution). The transition from quantity (financial flow) to quality (political structuring) may be also a task for the state.