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2 Is there convergence of national environmental policies? An analysis of policy outputs in 24 OECD countries

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2.1 Introduction

One of the key issues of globalisation research in the social sciences is the question of whether globalisation leads to the convergence of political institutions, policies, the legal order and societal structures (Guillén 2001: 235). The environmental field is of particular analytical interest when addressing this question. For several reasons, pressures towards increasing homogeneity and similarity of domestic environmental policy repertoires are strongly pronounced. From its very beginnings in the early 1970s, the environmental field has been a highly internationalised area, with international regimes and organisations as well as supranational institutions, in particular the European Union (EU), playing a major role in identifying policy problems and developing respective regulatory solutions. This development was driven by the transboundary nature of many environmental problems and hence the need for intergovernmental cooperation. At the same time, increasing economic integration between countries drove the international harmonisation of environmental product standards in order to reduce potential barriers to trade and market distortions. Moreover, industrialised countries were confronted with rather similar levels and types of environmental problem pressures which went along with economic growth and its consequences for the pollution of air and water. In other words, environmental policy is a field in which trends towards policy convergence should be particularly pronounced. On the other side, the field of environmental policies is rather heterogeneous: part of the policy field has a regional or local character, or is not related to trade. This makes it a very good test case for the convergence thesis.

Against this background, this chapter investigates if and to what extent environmental policy convergence actually takes place. It summarises the main findings of the first phase of the ENVIPOLCON research

project (see Chapter 1) which analysed the development of forty different environmental policy measures in twenty-four member countries of the Organisation for Economic Co-operation and Development (OECD) from 1970 to 2000 (cf. Holzinger, Knill and Arts 2008; Holzinger, Knill and Sommerer 2008). Analytically, the chapter focuses on three different dimensions of convergence (Heichel, Pape and Sommerer 2005), namely homogeneity, direction and mobility. First, with respect to homogeneity, we are interested in the extent to which the domestic policy repertoires and levels of regulatory stringency have become more similar over time. Second, we look at the direction of domestic policy changes. Did the environmental policies become stricter over time and did the countries under investigation develop similarity in this respect? Third, we analyse if and to what extent laggard countries were catching up with leaders over time or even have overtaken former front-runners. The assessment of policy convergence along these different dimensions is based on an analysis of domestic policy *outputs* (the policies adopted by a government) because policy *outcomes* (the actual effects of a policy in terms of goal achievement) are only indirectly related to the causal mechanisms of convergence and are usually affected by many intervening variables.

We proceed as follows. In Section 2.2, we provide a more differentiated theoretical discussion of potential reasons and factors that affect the degree of environmental policy convergence across the countries under study. Based on this discussion, we develop expectations on the cross-national convergence of environmental policies with regard to the dimensions of homogeneity, direction and mobility. In Section 2.3 we then present empirical evidence on each convergence dimension. Section 2.4 summarises our findings and discusses the general implications of our study.

2.2 Expectations on environmental policy convergence

In this section we suggest several theoretically derived expectations regarding the homogeneity, direction and mobility of cross-national environmental policy convergence. For this purpose, we discuss various factors and concepts that have been identified in the theoretical literature on policy convergence. For each convergence dimension, we derive a set of expectations whose plausibility will be illustrated by the analysis of aggregate data in the subsequent empirical chapters.

2.2.1 Expectations on policy homogeneity

Policy homogeneity refers to the extent to which the environmental policies of the countries under study have become more similar to each

other during the observation period (sigma-convergence). Homogeneity changes are assessed by two measures. On the one hand, we analyse the extent to which the policy repertoires of the countries were converging. To what extent did the countries adopt the same policies? On the other hand, we analyse the concrete settings of these policies, i.e. the level of applied standards. To what extent do the countries regulate environmental problems not only by adopting similar policies, but also by similar levels of regulatory stringency?

There are several theoretical reasons that support the expectation of an overall increase in policy homogeneity over time (Bennett 1991; DiMaggio and Powell 1991; Drezner 2001; Hoberg 2001; Holzinger and Knill 2004, 2005; see also Chapter 1). First, convergence might be driven by growing activities of harmonisation of national policies through international and in particular EU law (Knill 2003). Countries are obliged to comply with international rules on which they have deliberately agreed in multilateral negotiations. Second, regulatory competition emerging from the increasing economic integration of European and global markets has been identified as an important factor that drives the mutual adjustment of policies across countries (Scharpf 1997; Holzinger 2003). Third, policy learning across countries may take place as a result of transnational communication (Rose 1991; Haas 1992; Dolowitz and Marsh 2000).

Notwithstanding the general convergence expectation that can be derived from the effects associated with the above-mentioned factors, the degree of homogeneity increases might vary with regard to the affected policy dimensions and policy types. Beginning with the policy dimension, we generally expect a higher degree of convergence when it comes to general policy adoptions and hence the similarity of the policy repertoire than for the dimension of regulatory stringency (the exact policy settings). We expect significant differences in the degree of convergence across the different dimensions, as they imply different requirements with regard to the classification as 'similar' or 'dissimilar' policy. For the dimension of policy adoptions, similarity is already given as soon as the countries in question adopt a political programme in response to a specific problem, regardless of the concrete instruments or goals defined in the programme. The similarity requirement is much more demanding, however, when it comes to the dimension of settings, implying not only that countries have adopted the same policies, but also that these policies are based on similar instruments and their similar 'tuning' (in terms of similar standard levels or tax rates).

The degree of convergence is also likely to vary across different policy types. In this regard, two distinctions are of analytical interest. On the one hand, we differentiate between policy items that are more or less likely to be affected by international trade (trade-related versus

non-trade-related policies). Convergence should be more pronounced for trade-related policies, as it is only this policy type that is subject to potential convergence pressures emerging from regulatory competition between the involved countries. Regulatory competition is expected to lead to cross-national convergence, as countries facing competitive pressure mutually adjust their policies (Oates and Schwab 1988). Regulatory competition presupposes economic integration among countries. Especially with the increasing integration of European and global markets and the abolition of national trade barriers, the international mobility of goods, workers and capital puts competitive pressure on the nation states to redesign domestic market regulations in order to avoid regulatory burdens restricting the competitiveness of domestic industries. The pressure arises from (potential) threats of economic actors to shift their activities elsewhere, inducing governments to lower their regulatory standards (Drezner 2001; Holzinger 2003).

On the other hand, we distinguish subgroups of obligatory and non-obligatory policies, i.e. policies for which legally binding requirements at the international or supranational level are existent or absent. It is obvious that convergence will be more pronounced in the former case, given the legal obligation for the signatory countries to adopt a certain policy or adjust respective standard levels agreed upon in international or European negotiations (Holzinger and Knill 2004).

Expectations on homogeneity

1 There is an overall increase in environmental policy homogeneity in the countries under study over time.
2 Homogeneity increases are more pronounced for the policy repertoire than for the exact policy settings.
3 Homogeneity increases are more pronounced for trade-related policies than for non-trade-related policies.
4 Homogeneity increases are more pronounced for obligatory than for non-obligatory policies.

2.2.2 Expectations on the direction of convergence

What are our central expectations with regard to the direction of convergence? To what extent do the expected increases in policy homogeneity coincide with upward or downward changes in levels of regulatory stringency? While factors such as technological progress (which reduces the economic costs of complying with stricter standards), increasing environmental awareness, as well as increasing environmental problems associated with economic growth generally suggest that regulatory stringency

might increase over time, several qualifications of this statement in light of different policy types apply.

The first qualification can be derived from theories of regulatory competition. In general, theories of regulatory competition predict that countries adjust regulatory standards in order to cope with competitive pressures emerging from international economic integration. There is an ongoing debate in the literature on the direction of convergence caused by regulatory competition. A distinction is made between product and production process standards (Scharpf 1997; Holzinger 2003). In the case of process standards, we find a widely shared expectation that policy convergence will occur at the lowest common denominator; states will gravitate towards the policies of the most laissez-faire country (Drezner 2001). If the regulation of production processes implies an increase in the costs of production, potentially endangering the international competitiveness of an industry, regulatory competition will generally exert downward pressures on economic regulations (Scharpf 1997: 524).

Expectations are less homogeneous for product standards. While industries in both low-regulating and high-regulating countries have a common interest in harmonisation of product standards to avoid market segmentation, the level of harmonisation can hardly be predicted without the examination of additional factors. Most important in this context is the extent to which high-regulating countries are in fact able to enforce stricter standards. If it is possible to erect exceptional trade barriers, as for example for health or environmental reasons, convergence at a high level of regulation is to be expected. If such exceptional trade barriers cannot be justified, by contrast, competitive pressure will induce governments to lower their standards (Vogel 1995; Scharpf 1997; Holzinger 2003: 196). As such exceptional trade barriers can usually be justified in the environmental sector under EU and WTO rules, we expect that a downward shift of the regulatory level will only occur in case of process standards. Based on the arguments presented above and in the previous sections, regulatory competition should lead to an upward shift of environmental regulation in the case of product standards.

The second qualification refers to effects of international harmonisation and is hence related to obligatory policies. The question of whether international harmonisation coincides with upward or downward shifts of the regulatory stringency levels basically depends on factors such as decision rules, interest constellations, the distribution of power between the involved actors (typically national governments and international organisations), and the type of regulation, e.g. total or minimum harmonisation (Holzinger and Knill 2008). With regard to environmental policy, several factors favour the expectation that harmonisation implies an overall

increase in the strictness of regulatory levels – i.e. a compromise that is closer to the strictest rather than the weakest regulatory level found in the member states of the international institution in question.

First, it has been argued that in certain constellations those countries preferring stricter levels of environmental regulation are more influential in international negotiations (Scharpf 1997; Holzinger 2003). This argument has been developed in particular for the case of product standards. In this case, all member states (regardless of their preference for strict or weak standards) share a common interest in international harmonisation in order to avoid market segmentation as a result of different national product requirements (Van Long and Siebert 1991; Oates 1998). While all countries share a common interest in harmonisation, those states with a preference for strict standards are in a stronger position to impose their preferences on others in international negotiations. On the one hand, the trade regimes of the EU and the WTO – for reasons of health and safety protection – allow high-regulating countries to ban the importation of products that are not in line with the strict domestic standards. Based on this argument, we should expect that for product standards international harmonisation implies an upward shift of the regulatory mean.

Second, especially for harmonisation at the level of the EU, additional structural features of the policy-making process might favour an upward shift for other policy types for which the above-mentioned interest constellation favouring harmonisation at the top does not apply. The fact that we observe European harmonisation at the top rather than the bottom of existing member state regulations also in these areas (cf. Knill 2003: 73–88) has been explained by the particular dynamics emerging from a regulatory contest to influence EU policies between the member states (Héritier, Knill and Mingers 1996). These dynamics emerge from the interest of national governments in minimising the institutional costs of adjusting domestic regulatory arrangements to EU policy requirements. Especially high-regulating countries with a rather comprehensively and consistently developed regulatory framework of environmental instruments might face considerable problems of adjustment if European policies were to reflect regulatory approaches and instruments that departed from domestic arrangements. As a result, these high-regulating countries have a strong incentive to promote their own concepts at the European level. In so doing, the most promising way is to rely on the strategy of the 'first move', i.e. to try to shape European policy developments already during the stages of problem definition and agenda setting. This requires that member states have to win the support of the EU Commission, which has the formal monopoly to initiate policies at the EU level. The Commission, in turn, is generally interested in strengthening and extending

supranational policy competencies. This specific interaction of national and supranational interests favours the development of innovative and ambitious policies at the EU level (Knill 2003: 131–4).

Third, even if we assume that the final agreement only lies in the middle between high-regulating and low-regulating countries, there is still a high probability that the mean of national regulatory levels becomes stricter over time. This can be traced to the fact that the bulk of environmental standards follow the principle of minimum rather than total harmonisation. In the case of minimum harmonisation, it is still possible for countries with a preference for higher regulatory levels to enact standards beyond the minimum level specified in international agreements. In contrast to total harmonisation, deviations to the top are therefore still possible, while countries with lower standards are obliged to raise their standards at least to the international minimum level. Given the dominance of minimum harmonisation, we thus assume that international environmental policy cooperation is likely to result in shifting the regulatory mean upwards. This expectation rests on the assumption that high-regulating countries do not lower their standards towards the minimum level.

The three arguments presented do not provide us with enough grounds to expect a raising of the regulatory strictness of standards through harmonisation in each case. However, they increase the likelihood that, overall, upward movements supersede downward movements.

Expectations on direction

5 There is an overall increase in the stringency of environmental standard levels in the countries under study over time.
6 Regulatory stringency of product standards will increase, while the opposite scenario is expected for process standards due to effects of regulatory competition.
7 Regulatory stringency increases will be more pronounced for obligatory standards than for non-obligatory policies.

2.2.3 Expectations on the mobility of countries

To what extent can we expect that laggard countries increase their regulatory standards faster than environmental leader countries, hence catching up with or even overtaking the front-runners? Or, by contrast, can we also conceive of exactly opposite scenarios in which leader countries are catching up with or overtaking the laggards in decreasing environmental standard levels?

According to theories of regulatory competition, both scenarios are conceivable. It is a constitutive element of regulatory competition theories that international economic integration leads to 'races' between the involved countries in attracting foreign capital and creating regulatory conditions that promote the competitiveness of domestic industries. Inherent to the notion of 'races' are patterns of mutual overtaking or catching up. If one or several countries lower environmental process standards to reduce the production costs for domestic companies, other countries will respond by adopting similar or even more far-reaching adjustments to safeguard their competitiveness. According to the theory, these mutual adjustments and hence processes of catching up and overtaking continue until an equilibrium is reached in which all countries have reduced their standards to the lowest possible level. As regulatory competition only applies to trade-related policies, for these regulations catching up and overtaking should be more pronounced than for non-trade-related items (Drezner 2001; Hoberg 2001; Simmons and Elkins 2003).

As argued above, the races induced by regulatory competition need not necessarily be directed towards the bottom (for empirical accounts, see, for example, Drezner 2001, Potoski 2001). While for process standards, the direction of catching up and overtaking between countries moves into a downward direction, we expect races to the top in case of environmental product regulation.

Overtaking and catching up, however, are driven not only by regulatory competition, but also by international harmonisation, implying that mobility dynamics should be more pronounced for obligatory than for non-obligatory policies. These effects emerge from the fact that the involved states are legally required to adjust their regulatory settings to the level specified in international or EU law. In the case of minimum harmonisation, the countries might still go beyond the specified level, while for total harmonisation, all countries have to implement the harmonised standard. In the latter case, it is obvious that compliance with international law coincides with a process of catching up; i.e. countries below the harmonised level have to increase their standards, while countries with stricter rules have to adopt less stringent arrangements. However, even in the case of minimum harmonisation, we can expect processes of catching up, assuming that harmonisation takes place at a level that is closer to the leader than to the laggard countries. This way, laggards are legally obliged to move closer to the leaders, at least up to the level at which the minimum standard has been set (Holzinger and Knill 2004).

Expectations on mobility

8 Processes of catching up and overtaking between countries with regard to the strictness of their environmental regulations are more pronounced for trade-related policies than for non-trade-related policies.
9 Processes of catching up and overtaking between countries with regard to the strictness of their environmental regulations move into a downward direction in the case of process standards and into an upward direction in case of product standards.
10 Processes of catching up between countries with regard to the strictness of their environmental regulations are more pronounced for obligatory than for non-obligatory policies.

2.3 Empirical findings

In this section, we will analyse the development of forty environmental policy items in the twenty-four countries under study between 1970 and 2000. The countries include the EU-15 (except Luxembourg), Bulgaria, Hungary, Norway, Poland, Romania, Slovakia and Switzerland as well as Japan, Mexico and the United States. The policy items cover a broad range of different environmental subfields, including different policy types (trade-related, non-trade-related, obligatory, non-obligatory) and referring to different policy dimensions (policy adoption, policy settings). The data are based on the ENVIPOLCON dataset which constitutes a highly encompassing and systematic collection of environmental output data. Whereas the data for all forty policy items are available at four points in time (1970, 1980, 1990, 2000), for seventeen of these items, which formulate metric goals, we are able to use a complete time series from 1970 to 2005. A list of the forty policy items is provided in Table 2.1. The data have been collected (a) through a standardised questionnaire that has been completed by environmental policy experts for all countries and (b) through the collecting and coding of the respective environmental laws by the research team.

2.3.1 Policy homogeneity

To assess whether the environmental policies of the twenty-four countries became more similar over time, we rely on three indicators. While adoption rates and adoption curves are applied to measure convergence on the dimension of adopted policies, the coefficient of variation gives information about convergence on policy settings.

Table 2.1 *Environmental policies: adoption rates (%) for forty policies, 1970–2000*

	Trade-related	1970	1980	1990	2000
Forest protection	NPP	79.0	95.8	100.0	100.0
Lead in petrol	P	29.2	**70.8**	**91.7**	**100.0**
Passenger cars CO emissions	P	**16.7**	**66.7**	**83.3**	**100.0**
Passenger cars HC emissions	P	**8.3**	**62.5**	**79.2**	**95.8**
Industrial discharges in surface water copper	PP	25.0	41.7	70.8	95.8
Industrial discharges in surface water lead	PP	25.0	41.7	70.8	95.8
Industrial discharges in surface water chromium	PP	25.0	41.7	70.8	95.8
Industrial discharges in surface water zinc	PP	25.0	41.7	70.8	95.8
Large combustion plants SO_2 emissions	PP	16.7	29.2	**66.7**	**95.8**
Large combustion plants dust emissions	PP	8.3	29.2	**62.5**	**95.8**
Environmental impact assessment	NPP	4.2	8.3	**62.5**	**95.8**
Large combustion plants NO_X emissions	PP	8.3	16.7	**58.3**	**95.8**
Coliforms in bathing water	NPP	20.8	**45.8**	**83.3**	**91.7**
Passenger cars NO_X emissions	P	–	**54.2**	**75.0**	**91.7**
Electricity from renewable sources	PP	4.2	8.3	41.7	91.7
Hazardous substances in detergents	P	8.3	**54.2**	**75.0**	**87.5**
Noise level working environment	PP	8.3	**25.0**	**70.8**	**87.5**
Industrial discharges in surface water BOD	PP	25.0	37.5	58.3	87.5
Sustainability: reference in legislation	NPP	–	–	25.0	87.5
Energy efficiency of refrigerators	P	–	4.2	–	**87.5**
Noise emissions standard from lorries	P	**37.5**	**66.7**	**79.2**	**83.3**
Sulphur content in gas oil	P	12.5	**54.2**	**70.8**	**83.3**
Contaminated sites policy	NPP	12.5	29.2	50.0	83.3
Precautionary principle: reference in legislation	NPP	–	8.3	25.0	79.2
Eco-labelling	P	–	4.2	20.8	**79.2**
Eco-audit	PP	–	–	8.3	**75.0**
Heavy fuel oil levy for industry	PP	20.8	25.0	45.8	**70.8**
Motorway noise emissions	NPP	8.3	12.5	41.7	70.8
Environmental/sustainable development plan	NPP	–	–	25.0	70.8
CO_2 emissions from heavy industry	PP	–	–	12.5	70.8
Waste landfill target	NPP	–	–	4.2	**66.7**
Soil protection	NPP	8.3	12.5	41.7	62.5
Recycling construction waste	PP	–	4.2	12.5	58.3
Waste recovery target	NPP	–	–	4.2	**54.2**
Promotion of refillable beverage containers	P	12.5	20.8	29.2	50.0
Efficient use of water in industry	PP	4.2	16.7	29.2	41.7
Electricity tax for households	NPP	–	8.3	8.3	37.5
Glass reuse/recycling target	NPP	–	–	4.2	37.5
Paper reuse/recycling target	NPP	–	–	–	37.5
Voluntary deposit system beverage containers	P	–	–	8.3	20.8

Note: P: Product standard; PP: Process standard; NPP: Non-trade-related policy; obligatory items in bold.

Adoption rates Adoption rates are the most common approach to investigate convergence with regard to the presence of policies. Adoption rates include information not only on the number of countries that have introduced a certain policy, but also on the extent to which the number of adopters changes over time.

Starting with the development for the whole sample of the forty policies under investigation, we find a continuous spread of environmental policies across countries. The average adoption rate grew continuously over time, with almost a doubling of the rate during each decade. From a modest average adoption rate of 11% in 1970, all of the forty environmental policies under study had already been adopted in 46% of all countries in the sample by 1990. By 2000, the average adoption rate had further increased to 78%, including several policies with an adoption rate of 100%.

A closer look at the different policy subgroups reveals, however, that average adoption rates vary across policy types. First, until 1990 adoption rates for obligatory policies (which are subject to international harmonisation) are more than twice as high as for non-obligatory policies. However, degrees of convergence for non-obligatory policies caught up considerably during the 1990s: whereas obligatory policies are on average adopted by 86% of the twenty-four countries under study, the respective rate for non-obligatory policies is already around 70%. Second, with the exception of the values for 1980, the spreading patterns for trade-related policies are rather similar, regardless of whether product or process-related measures are concerned. Third, and similar to the difference between obligatory and non-obligatory policies, we can observe a considerable, albeit less pronounced, gap in adoption rates between trade-related and non-trade-related policies, including a similar process of catching up of the latter from the 1990s onwards.

Table 2.2 offers an overview of the extent to which the twenty-four countries in our sample have adopted the forty policies over time (ranking the countries according to the number of policies adopted by the year 2000). While the table confirms the general findings of a rather broad policy spread, we find differences across the countries under study. First, the data reveal a difference in adoption rates between countries typically known as environmental leaders (Denmark, the Netherlands, the Scandinavian countries and Germany) and environmental laggards (led by the US, Bulgaria, Romania and Ireland).

Second, the data show that EU membership need not automatically imply that the respective countries adopt a high number of environmental policies. While a lot of the 'top adopters' are members of the EU, there are also several countries that – in spite of EU membership – rank rather

Table 2.2 *Policy adoptions over time by country, 1970–2000*

	1970	1980	1990	2000
Denmark	1	13	23	39
Netherlands	8	14	24	39
Finland	9	16	23	37
Sweden	14	20	25	37
Germany	5	12	24	36
Norway	2	9	24	35
Austria	3	9	23	34
France	6	11	22	33
Italy	4	18	21	33
Switzerland	5	13	25	33
UK	6	11	19	32
Greece	0	2	16	31
Hungary	9	18	22	31
Japan	13	20	20	31
Portugal	1	3	21	31
Spain	1	7	20	31
Mexico	1	1	11	28
Belgium	8	14	17	27
Poland	1	4	12	27
Slovakia	3	7	9	27
Ireland	1	8	13	26
Romania	0	1	4	26
Bulgaria	4	6	11	25
USA	4	13	13	17

low (including Spain and Ireland). This development can be traced to the fact that a considerable number of the policies under investigation are not subject to European harmonisation.

Third, we observe different dynamics regarding the change of adoption rates over time. Hardly surprising in this context are the strong increases in policy adoptions during the 1990s in the CEE countries and Mexico, which reflect the overall processes of economic catching-up and political transformation taking place in these states. An exception to this pattern is Hungary, which belonged to the group of 'top adopters' already during the first two decades of the observation period. In contrast to the pattern of strongly increasing adoption rates over time, we also find countries where policy adoption is characterised by rather low growth rates and even stagnation (examples are the US and Japan for the 1980s and 1990s) or a rather linear increase in policy adoptions over time (Denmark, the Netherlands, Finland, Sweden, Germany).

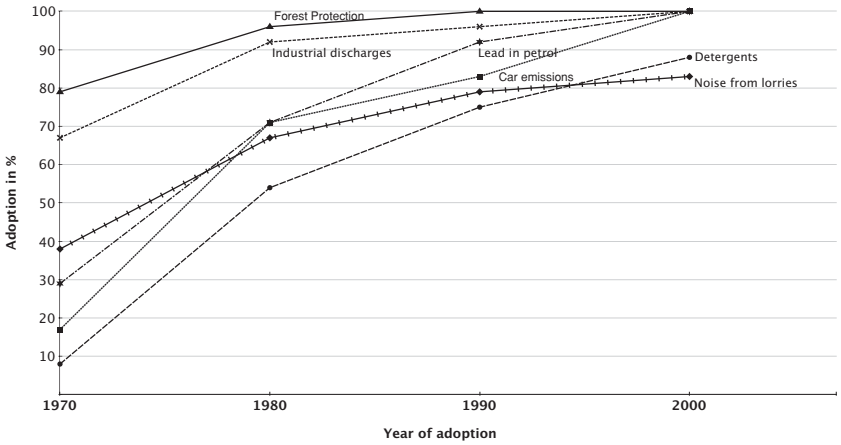

Figure 2.1 Environmental policies: early adoptions, 1970–2000

Adoption curves In addition to these general aspects regarding the adoption rate levels of the policies under study, distinctive patterns characterise the spreading of policies and countries over time. To illustrate the latter, we will have a closer look at adoption curves of selected policy items. More specifically, we differentiate between three general empirically observable adoption patterns, namely, policies characterised by widespread adoption in the beginning of the observation period, policies characterised by a rather linear spreading process over the whole observation period, and policies where adoption took off towards the end of the observation period. We chose six examples for each pattern, thus analysing the respective developments for eighteen out of the forty environmental policies.

Figure 2.1 shows the adoption curves for six policies which were spreading broadly across the countries already during the 1970s, including the regulation of passenger car emissions, forest protection, noise emission from lorries, hazardous substances in detergents, lead in petrol and sulphur content in gas oil. All these policies have in common that, while their adoption curves rise permanently over time, the numbers of adoptions were particularly high in the beginning of the observation period and, due to saturation effects, gradually decreased over time. Three policies (passenger car emissions, lead in petrol, forest protection) reach a spread of 100 per cent by the year 2000, implying full convergence in terms of policy presence. For the three remaining policies (hazardous

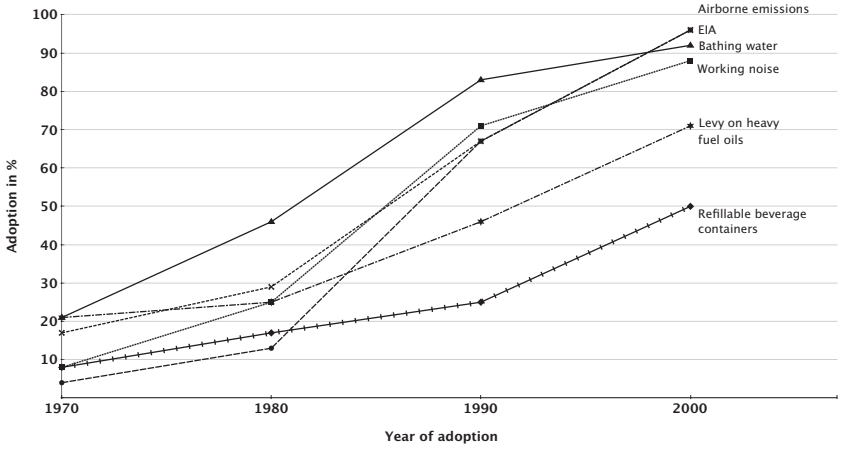

Figure 2.2 Environmental policies: linear adoptions, 1970–2000

substances in detergents, lorry noise emissions, and sulphur content in gas oil), the respective adoption rate is around 85 per cent.

Figure 2.2 shows adoption curves for six policies which are characterised by a relatively linear spreading pattern. A similar development can be observed for the policies on airborne emissions from large combustion plants and on the quality of bathing water. While only a few countries had adopted the respective policies by 1970, almost all the countries under investigation followed the early adopters over the observation period. The number of new adoptions is distributed rather equally over time, implying a linear shape of the adoption curve. Also the policies on noise emissions at workplaces and environmental impact assessments share a rather similar adoption path. In these cases, however, it becomes apparent that the spreading process took off only from 1980 onwards, nevertheless leading to a high adoption rate and hence high degree of convergence by the year 2000. Steadily increasing numbers of adoptions are also observed for policies on the promotion of refillable beverage containers and on the introduction of levies on the industrial use of heavy fuel oils, although in these cases, adoption rates and convergence remain at a lower level when compared to the other cases.

Finally, six environmental policies that are characterised by a late process of diffusion are presented in Figure 2.3. Notwithstanding their only recent emergence, they have been adopted by a large number of countries within a comparatively short period of time. For example, eco-labels,

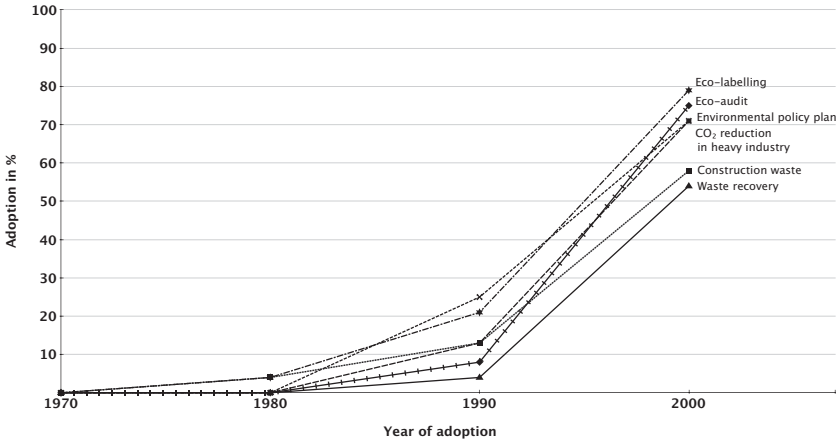

Figure 2.3 Environmental policies: late adoptions, 1970–2000

eco-audits and national environmental plans were reported for fewer than a quarter of the twenty-four countries by 1990. In 2000, they reached a spread of over 70 per cent. The same applies to policies on the reduction of CO_2 emissions in heavy industries which are found in seventeen countries by 2000. In the latter case, only Austria, Finland and Sweden had adopted measures in 1990. Similar figures are found for policies on construction waste and on waste recovery targets.

The aggregate analysis of policy convergence with regard to policy adoptions indicates several general developments. First, changes in rates of policy adoption reveal a picture of strongly growing policy similarity over time. Second, while this statement holds for the whole policy sample, convergence is particularly pronounced for policies that share one or more of the following characteristics: trade-relatedness, obligatory nature and early introduction. Third, three different patterns of adoption can be identified, including processes of early, linear and late cross-national spreading of policies. Fourth, differences exist with regard to countries. Our empirical findings confirm generally made distinctions between environmental leader and laggard countries.

Coefficients of variation Twenty-one of the forty policies of our sample specify limit values or similar metrical standards. For these items, changes in the policy similarity across countries can be assessed by using the variation coefficient (see Table 2.3). The coefficient of variation (CV)

Table 2.3 *Variation coefficients for twenty-one setting items, 1970–2000*

	1970	1980	1990	2000	No. of policies[a]
All settings	0.58	0.73	0.72	0.68	21
Countries with policy from 1980		0.73	0.85	0.67	21
Countries with policy from 1990			0.70	0.62	21
Product-related settings	0.20	0.38	0.69	0.72	6
Countries with policy from 1980		0.38	0.69	0.53	6
Countries with policy from 1990			0.69	0.64	6
Production-process-related settings	0.96	1.00	0.79	0.79	9
Countries with policy from 1980		0.84	0.88	0.68	9
Countries with policy from 1990			0.80	0.64	9
Non product-/process-related settings	0.38	0.72	0.63	0.48	6
Countries with policy from 1980		0.76	0.87	0.71	6
Countries with policy from 1990			0.65	0.63	6
Obligatory settings	0.10	0.43	0.64	0.66	3/8/11/12
Countries with policy from 1980		0.43	0.72	0.51	3/8/11/12
Countries with policy from 1990			0.67	0.52	3/8/11/12
Non-obligatory settings	0.72	0.97	0.84	0.71	18/13/10/9
Countries with policy from 1980		0.86	0.93	0.83	18/13/10/9
Countries with policy from 1990			0.82	0.85	18/13/10/9

Note: [a]The respective numbers for obligatory and non-obligatory policy items vary over the investigation period, as over time more and more policies became subject to international or supranational regulation. The respective numbers given in the outer right column refer in their order to the four decades distinguished in the table.

is defined as

$$CV = \frac{\frac{1}{N}\sqrt{\sum_{i=1}^{N}(X_i - \overline{X})^2}}{\overline{X}}$$

with N referring to the number of countries, X_i constituting the relevant policy setting of country i and $\overline{X}$ being the arithmetic mean across the country sample.

To assess the convergence of policy settings along these lines, two perspectives are distinguished. According to the first perspective, for each point in time, all available values are included (implying that the number of countries might change over time): regarding x countries in t_i and y countries in t_j, is there a decrease in variation over time? This way, it is possible to show how countries that introduced a policy in a certain period contributed to convergence or divergence (perspective 1). In the second perspective, by contrast, only those countries are included in the

analysis for which a value existed in t_i, that is, the number of countries is held constant throughout the observation period (perspective 2).

First, when looking at the average variation coefficient for all twenty-one setting items from perspective 1, the figures show that convergence only occurred during the period from 1990 to 2000. Moreover, the similarity increase remains rather low, with the variation coefficient shifting from 0.72 to 0.68. Perspective 2 reveals that those countries that had introduced a policy by 1980 further diverged during the following decade. Moreover, from perspective 2, the convergence development during the 1990s is more pronounced, indicating that countries which introduced a policy after 1990 converged to a lesser degree towards all others than those countries which had already adopted a respective regulation before that time. In combination with stable coefficients in perspective 1, this means that those countries adopting new policies during the 1980s oriented themselves more strongly towards the policy in specific countries (i.e. the front-runner states).

Second, we can compare the development of the variation coefficient for setting items that refer to trade-related policies (i.e. product or process standards) and policies that are not subject to competitive pressures emerging from economic integration. Our findings reveal patterns that are striking from the perspective of theories of regulatory competition. So, the variation coefficients indicate divergence rather than convergence for product standards. For process standards, weak convergence trends can only be observed during the 1980s. By contrast, increases of similarity are reported for policies that are not related to trade; the difference between perspective 1 and perspective 2 shows that this is mainly caused by countries that adopted a limit value after 1990. This finding is in contradiction with expectations derived from theories of regulatory competition, stating that convergence tendencies through mutual adjustment of national policies should be more pronounced in policies subject to competitive pressures through economic integration.

Third, variation coefficients for the subgroups of setting items can be compared for obligatory and non-obligatory policies. Also in this case, empirical findings seem to be contradictory with the expectation that convergence for obligatory items should be more pronounced than for non-obligatory items. While there is convergence for non-obligatory items since 1980, the picture looks quite different for obligatory items. While perspective 1 even suggests divergence, perspective 2 reveals convergence only for the period between 1990 and 2000 for those countries that had established a respective policy either in 1980 or 1990. This general statement holds regardless of the fact that absolute coefficient values

for obligatory items are generally lower than those for non-obligatory items.

These results are in striking contrast with the pattern of policy adoption shown above. It is important to note, however, that the variation coefficient has a number of problems as a measure of convergence. Most important, it is rather sensitive to outliers and to changes in N (see Holzinger 2006 for methodological problems of convergence analysis). A different approach to measuring homogeneity increases of policies based on pairwise comparison is presented in Holzinger, Knill and Sommerer (2008). It reveals that there was also considerable convergence for settings policies for all three decades.

2.3.2 Policy direction

To what extent have environmental policies in the countries under study become stricter during the observation period? Was increasing policy homogeneity on average accompanied by an increase or decrease in levels of regulation? To answer this question, we consider two indicators. On the one hand, we analyse the development of the regulatory mean over time. On the other hand, we count all policy changes either in an upward or a downward direction.

Mean changes Table 2.4 displays the changes in the regulatory mean

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$$

of twenty-one settings since 1970. Our empirical findings indicate a general trend towards increasing regulatory strictness over time. This pattern is most pronounced for product standards, for which an average strengthening of standards can be observed throughout the whole observation period. This development, with minor and periodical exceptions, also holds for process standards. Hence, our findings provide no support for the race-to-the-bottom scenarios developed in theories of regulatory competition. Whereas the picture is rather unclear for most of the non-trade-related policies, the regulation of coliforms in bathing water seems to reflect a case of a race to the bottom, with a weakening of the regulatory mean throughout the whole observation period. The level of strictness increases more strongly for obligatory policies than for non-obligatory ones, i.e. international harmonisation seems to go along with upward moves in the level of stringency.

Table 2.4 *Changes in regulatory mean for twenty-one settings, 1970–2000*

	Mean				
	1970	1980	1990	2000	Change
Passenger cars CO emissions	**38.65**	**30.81**	**7.31**	**2.80**	+
Passenger cars NOx emissions	Ø	**2.35**	**0.81**	**0.22**	+
Passenger cars HC emissions	**6.36**	**3.00**	**1.05**	**0.31**	+
Noise emissions standard from lorries	**90.38**	**88.75**	**85.95**	**82.90**	+
Sulphur content in gas oil	1.80	**0.73**	**0.35**	**0.35**	+
Lead in petrol	0.78	**0.44**	**0.22**	**0.06**	+
Large combustion plants SO_2 emissions	500.00	1,250.00	**527.82**	**372.47**	+
Large combustion plants NO_X emissions	Ø	Ø	**559.44**	**508.06**	+
Large combustion plants dust emissions	325.00	166.67	**55.56**	**62.11**	+
Heavy fuel oil levy for industry	3.25	7.49	37.82	**43.70**	+
Noise level working environment	75.00	**85.00**	**86.47**	**85.95**	−
Industrial discharges in surface water lead	5.05	2.38	0.52	0.36	+
Industrial discharges in surface water copper	12.60	5.92	0.95	0.93	+
Industrial discharges in surface water zinc	5.00	3.60	3.00	2.19	+
Industrial discharges in surface water chromium	25.25	11.80	1.67	0.95	+
Industrial discharges in surface water BOD	50.00	72.50	44.29	40.07	+
Coliforms in bathing water	1,000.00	**4,420.00**	**6,616.15**	**7,556.11**	−
Motorway noise emissions	40.00	50.00	53.56	52.07	−
Glass reuse/recycling target	Ø	Ø	Ø	69.38	0
Paper reuse/recycling target	Ø	Ø	Ø	66.38	0
Electricity tax for households	Ø	0.01	0.03	0.02	0

Note: Obligatory items in bold; Ø: no regulation in place; +: upward shift of the mean; 0: no mean change; −: downward shift of the mean.

2.3.3 Mobility changes

The mobility dimension addresses the question of if and to what extent laggard countries were catching up or overtaking the front-runners over time with regard to the strictness of their environmental regulations. To account for such dynamics, we apply two concepts. First, the concept of beta-convergence measures the extent to which processes of catching up

Table 2.5 *Beta-convergence, twenty-one settings, 1970–2000*

	Trade-related	1970s	1980s	1990s
Passenger cars HC emissions	P	**1.00**	**0.87**	**1.00**
Passenger cars CO emissions	P	**−1.00**	**0.69**	**1.00**
Passenger cars NO_X emissions	P	–	**0.47**	**1.00**
Lead in petrol	P	**−0.23**	**0.57**	**0.60**
Sulphur content in gas oil	P	**1.00**	**0.98**	**0.35**
Noise emissions standard from lorries	P	**0.66**	**0.44**	**−0.08**
Heavy fuel oil levy for industry	PP	0.60	0.13	**1.00**
Large combustion plants SO_2 emissions	PP	–	**−1.00**	**0.99**
Large combustion plants dust emissions	PP	1.00	**0.98**	**0.88**
Large combustion plants NO_X emissions	PP	–	–	**0.83**
Industrial discharges in surface water lead	PP	–	1.00	0.53
Industrial discharges in surface water chromium	PP	1.00	1.00	0.48
Noise level working environment	PP	–	–	**0.39**
Industrial discharges in surface water zinc	PP	–	0.32	0.38
Industrial discharges in surface water copper	PP	–	0.99	0.33
Industrial discharges in surface water BOD	PP	–	−0.03	−0.10
Coliforms in bathing water	NPP	–	**0.61**	**0.27**
Motorway noise emissions	NPP	–	–	0.04
Electricity tax for households	NPP	–	−1.00	−1.00
Glass reuse/recycling target	NPP	–	–	–
Paper reuse/recycling target	NPP	–	–	–

Note: P: Product standard; PP: Process standard; NPP: Non-trade-related policy; obligatory items in bold.

occurred. Second, the concept of gamma-convergence allows us to make statements on the extent to which processes of catching up coincided with actual overtaking of the front-runners by the laggards (Heichel, Pape and Sommerer 2005: 831–3).

Beta-convergence To provide an overview of the extent to which we can observe beta-convergence for the twenty-one policy settings under study (see Table 2.5), we estimate beta-convergence on the basis of the following bivariate regression:

$$\Delta s_{i,t_0-t1} = c + \beta(s_{i,t_0}) + e_{i,t_0}$$

where Δs_i refers to the change rate of a policy setting between t_0 and t_1, c is the constant, s_{i,t_0} is the initial level of regulation of the respective setting and e_{i,t_0} the error term. The standardised coefficients (scale from −1.00 to +1.00) are given in Table 2.5. A positive coefficient is equivalent to a process of catching up.

The findings reveal an overall pattern of beta-convergence. For most of the policy settings, a process of catching up can be observed. In these cases, countries with less stringent environmental regulations strengthened their policies to a higher degree than former front-runner countries. It is only for six items that we find beta-divergence, albeit not for the whole observation period. The latter process is indicated by a negative coefficient in Table 2.5. For CO emissions from passenger cars, for instance, a negative sign is given for the 1970s only. During this decade, two pioneer countries, the US and France, diverged. Compared to its initial level, the American standard was subsequently strengthened in a much stronger way than the respective French limit value.

Gamma-convergence While the concept of beta-convergence allows us to identify processes of catching up between leaders and laggards, we still have no information on the extent to which the countries actually changed their ranks in terms of regulatory strictness over time. This can be traced to the fact that catching up need not necessarily mean overtaking. To grasp the latter aspect, the concept of gamma-convergence has been developed. Gamma-convergence offers complementary information about the overall trend of observed sigma-convergence. We might interpret a process of growing together that coincides with a complete overthrow of country rankings differently than a situation in which national limit values become similar over time, but with pioneer and laggard countries holding their rank positions. Moreover, in addition to the identification of changes in country rankings (which are not covered by beta-convergence), gamma-convergence also allows us to detect policy changes which are not perceived when relying on sigma-convergence, as country rankings may change, for example, without a significant decrease in cross-country variation.

For the analysis of gamma-convergence, country rankings based on the strictness of domestic policies are compared over time. Gamma-convergence occurs if countries with strict environmental regulations in the first ranks fall behind over time. Policy change is assessed with the gamma coefficient, a simple measure of correlation for ordinal scales based on the calculation of rank concordance for two points in time. Thus, we speak of gamma-convergence if the ranking in t_0 is not associated with the ranking in t_1. The gamma coefficient is based on differences between concordant pairs (p) and discordant pairs (q) and computed as

$$\gamma = \frac{(p - q)}{(p + q)}$$

Table 2.6 *Gamma-convergence, twenty-one settings, 1970–2000*

	Trade-related	1970s	1980s	1990s
Passenger cars CO emissions	P	**0.95**	**0.76**	**0.33**
Lead in petrol	P	**0.56**	**0.69**	**0.36**
Passenger cars NO_X emissions	P	**1.00**	**0.70**	**0.45**
Noise emissions standard from lorries	P	**0.52**	**0.77**	**0.45**
Passenger cars HC emissions	P	**0.85**	**0.78**	**0.48**
Sulphur content in gas oil	P	**0.02**	**0.52**	**0.93**
Industrial discharges in surface water chromium	PP	0.87	0.83	0.22
Industrial discharges in surface water BOD	PP	0.96	0.64	0.37
Large combustion plants SO_2 emissions	PP	1.00	**0.47**	**0.43**
Industrial discharges in surface water zinc	PP	0.81	0.81	0.45
Industrial discharges in surface water lead	PP	0.87	0.82	0.52
Heavy fuel oil levy for industry	PP	0.79	0.59	**0.56**
Large combustion plants NO_X emissions	PP	1.00	**1.00**	**0.56**
Industrial discharges in surface water copper	PP	0.87	0.78	0.63
Noise level working environment	PP	**1.00**	**1.00**	**0.72**
Large combustion plants dust emissions	PP	0.96	**0.22**	**1.00**
Motorway noise emissions	NPP	1.00	0.77	0.72
Coliforms in bathing water	NPP	**0.60**	**0.96**	**0.73**
Electricity tax for households	NPP	1.00	1.00	0.78
Glass reuse/recycling target	NPP	1.00	1.00	1.00
Paper reuse/recycling target	NPP	1.00	1.00	1.00

Note: P: Product standard; PP: Process standard; NPP: Non-trade-related policy; obligatory items in bold.

with a scale from −1.00 to +1.00. The more values we find below 1.00, the higher the mobility of countries over time and hence gamma-convergence.

Table 2.6 shows the correlation of country rankings for all twenty-one setting items. First, it becomes apparent that there are only two policy items (the recycling targets for glass and paper reuse) for which no changes in country rankings occurred throughout the whole observation period. This can mainly be traced to the fact that in these cases no policy adoptions occurred during the first half of the observation period. For all other items, we observe in part far-reaching changes, including two policies with relatively high mobility for all decades, namely, limit values for lead in petrol (gamma between 0.36 and 0.69) and noise emission from lorries (gamma between 0.45 and 0.77). Second, the table reveals that mobility is considerably higher for trade-related policies, while gamma-convergence for policies that are not related to trade is rather low. This

statement holds for the whole observation period. Third, we find different convergence movements across the policies under investigation. For some policies, gamma-convergence occurred primarily at the beginning of the observation period (e.g. limit values for the sulphur content in gas oil). Other cases, by contrast, reveal an opposite pattern, with gamma-convergence being most pronounced throughout the 1980s and 1990s (e.g. the regulation of industrial discharges into surface water).

2.4 Conclusion

In terms of the increasing homogeneity of environmental policies in our country sample all four expectations have been confirmed. From the analysis of policy adoptions we saw that there is a general trend of convergence of environmental policies. Compared to the overall trend, the degree of convergence is lower with respect to exact policy settings. As expected, homogeneity increased more strongly for obligatory policies than for non-obligatory ones, and more strongly for trade-related policies than for non-trade related ones.

In terms of the direction of the movement we found a surprisingly clear pattern of upward movement. For those policy settings for which we were able to trace all regulatory changes over the whole period of observation, we observed that upward changes by far outnumber downward changes which amount to only 6 per cent of all changes. The level of protection has risen considerably over time, as has been shown by the development of the regulatory mean for policy settings. As expected, the rise in strictness is more pronounced for obligatory policies than for non-obligatory ones. It is also more pronounced for trade-related policies than for non-trade-related policies. However, in contrast to our expectations there is a general upward movement not only for product standards but also for process standards.

The picture is similar when it comes to the mobility aspect. There is a general trend of catching up by laggard countries for almost all policies. Moreover, mobility is clearly higher for trade-related policies and for obligatory policies than for those policies not related to international trade and not harmonised at the international level. This runs partly counter to our expectation: the theory of regulatory competition predicts upward mobility for product standards whereas downward mobility is expected for process standards. The latter is not confirmed, as there is an overwhelming trend of catching up and moving upward.

From these observations we can infer that processes of globalisation, and in particular increasing political integration through international

cooperation and harmonisation of policies, in general stimulate environmental policies, lead to their convergence, and drive the level of protection upwards. We clearly observe an increase in the number of individual environmental policies that countries apply, an increase in the homogeneity of individual policies across countries, an increase in the homogeneity of their policy repertoires, an increase in the strictness of regulations, and processes of catching up and overtaking among countries. The fear that economic globalisation leads to a downward competition in regulatory laxness is not justified, at least not for our sample of OECD countries. If these pressures exist at all, they are obviously counteracted by international cooperation.

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