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The Dimensions of Rights: A Classification of Environmental Rights and Production Rights

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Abstract

The literature on rights has paid much attention to the description of rights and the performance of systems of rights. Less has been published on identifying the underlying dimensions of rights, even though such identification seems important for understanding the different types of rights and for classifying them so as to facilitate the process of development that occurs when introducing rights (Miller, 1995). In this article a theoretical framework, which sheds light on the structure of rights, is developed. After examining the characteristics of rights, a correspondence analysis is carried out on existing rights and on a hypothetical ideal right in order to find similarities between them and to identify their underlying structure.

Keywords: environmental and production rights, classification, correspondence analysis

In the context of this article we define a right[1] as a permission from the government or public authority to take action that is otherwise prohibited by law. These rights are initiated by some government or supranational authority and are distributed to the affected firms. We do not consider intellectual property rights, public rights, or privately initiated rights such as a buy option on a particular house.

In the existing literature rights are often associated with environmental policy (Miller, 1995), but they are also very common in agricultural production policy (Burrell, 1990; Oskam, 1989). In this article we develop a general theoretical framework for rights to enable the many rights in today's world to be classified and therefore better understood.

It is important to note the difference between credits and rights with respect to environmental policy. A credit is created by a source causing less pollution than its allowable limit. To obtain such a credit, a polluter is required to show that the actual emissions, plus or minus any traded credits, are less than the allowable limit. Subsequently, the polluter is allowed to trade the credit or to bank it. In a credit program, the agency or authority responsible for it must certify the creation of credits and also record trades. In a rights system, however, trading in rights involves future pollution, the latter being illegal without

approval. In the case of environmental rights, the Environmental Protection Agency (EPA) has set an allowable limit for one source; the source can increase or reduce its allowable limit by trading rights.

The primary function of rights is to guide incentives to achieve internalization of externalities (Coase, 1960; Demsetz, 1976; Parisi, 1995). At first sight this function is less obvious for production rights than for environmental rights. Low prices for producers such as farmers may be socially unacceptable to the government because this group of suppliers and related groups would generate an income that is below the accepted minimum standard of living. Furthermore, the increasing divergence between social classes—for example, the low living standard of farmers and rural population compared with other groups—may be a more important consideration, which makes the option of low prices unacceptable to the government. To overcome this problem the government intervenes, by either buying the oversupply in the market or subsidizing, or both, to guarantee a price for farmers for their products. However, these subsidies may be a burden to the society at large and create a deadweight loss in welfare terms. Overproduction has become a negative externality; therefore, production rights are used as a guide to achieve greater internalization of that externality.

The way in which rights are assigned, enforced, and transferred affects the allocation of resources and hence the amount and distribution of output (Hahn, 1986b). Anderson and Hill (1975) argue that the social arrangements, laws, and customs that govern asset ownership are established on the basis of variables endogenous to the economic system. They address the question of how the rights structure is created (Anderson and Hill, 1975; Nelson, 1986; Nussbaum, 1992). We propose to pay attention to the right itself and to review its characteristics. By doing so we will be able to better understand, from both a business economic and policy perspective, how rights can be specified in order to be both attractive to the policymaker and the firms affected by the rights (Lewis and Sappington, 1995; McCarthy, 1992). The characteristics that we identify can be seen as controllable instruments of the policymaker. When specifying a right, the policymaker implicitly uses these characteristics to design the right. Knowing and understanding the characteristics and their implications, the policymaker will be able to combine these characteristics in an optimal way, from both a business economic and policy perspective, and hence to design an optimal right.

First, the various types of policy instruments available to cope with environmental and production problems are discussed. Second, we deal with the characteristics of rights. Some existing rights will be classified on the basis of these characteristics. The classification will be analyzed through correspondence analysis in order to examine the underlying dimensions of those rights. The article concludes with an evaluation.

1. Mechanisms for internalizing externalities: rights

Policymakers can choose from a variety of instruments for achieving specified objectives when implementing policies to solve environmental and production problems. Economists often distinguish between two broad categories of instruments. First, the command and

control mechanisms are effective but not always efficient; firms have relatively little flexibility to achieve their goals. The second type, called incentive-based or market-based mechanisms, provides firms with incentives to look for more efficient ways to internalize (negative) externalities (Opschoor and Vos, 1989; Tietenberg, 1990). The incentive-based mechanisms ensure that firms automatically make control efforts in precisely the manner and degree that will result in the cost-effective allocation of the overall burden of control. Moreover, approaches involving economic incentives generally provide firms with incentives to find less expensive solutions. One important criterion when selecting policy instruments is to minimize the overall cost of achieving prescribed objectives.

Economic behavior can be defined as the public at large being able to weigh up all the costs and benefits of such behavior (Pekelney, 1993). Rights are one instrument that can supply the appropriate incentives, at least in theory (Hahn, 1986a, 1994). Rights are rooted in the theory of externalities, which states that the public costs of certain economic behavior (pollution, production) are largely external to the private costs the agent faces.

Hahn (1986a) distinguishes two broad categories of incentive-based policy instruments for environmental problems: pricing mechanisms and quantity mechanisms. This distinction also holds for problems of overproduction. In contrast to the quantity mechanism, the pricing mechanism is unable to predetermine the amount of environmental damage or of production and is therefore less effective than a quantity mechanism. Subsidies and levies are examples of a pricing mechanism; they are widely used in environmental and production policy as an incentive for reaching the government's goal. A marketable rights scheme is an example of the quantity approach. Under such a system the overall tolerated level of externality is established and then allotted to firms in the form of rights. Firms that keep externality levels below the allotted level may sell or lease their surplus rights to other firms, or use them to offset excess externalities in other parts of their own enterprise. Examples of these rights are the SO_2 emission rights in the United States and the milk production quotas in the European Union and Canada (Lord, 1993; Pennings, Meulenberg, and Heijman, 1996; USEPA, 1990, 1992a, 1992b; Tietenberg, 1989a, 1989b).

Note that the right is efficient because it is transferable. If the authority does not allow any trade in rights, a rights system can still be effective but not efficient (Ledyard and Szakaly-Moore, 1994; Selwyn, 1993).

2. Characteristics of rights

We will construct a classification for rights that is based on their basic characteristics. Basic characteristics of both environmental and production rights can be deduced from the related production process. Each production process can generate externalities (Figure 1), which can be internalized by rights. The rights linked to input are mostly resource rights, whereas those linked to output are environmental and/or production rights. The classes presented in Table 1 do not pretend to be mutually exclusive. Some resource rights, such as fishery rights, may be seen as environmental rights or as production rights, depending on the goal of the authority that initiated them. In this article, only rights related to output are examined.

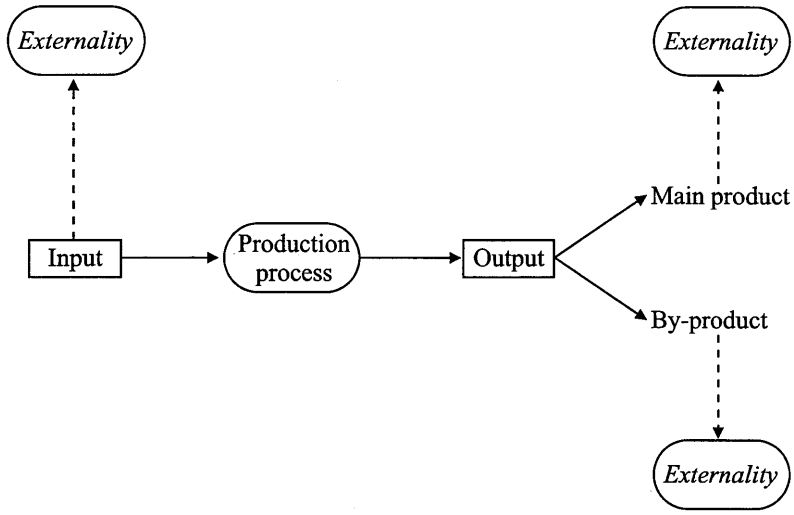

Figure 1. Flows in the Production Process.

The input for and output of a production process can be described in terms of amount, quality, time, place, and marketability (Naylor and Vernon, 1969). Because rights are related to input or output, they can be described in an analogous way.

For rights the following types of characteristics can be distinguished: quality, temporal, spatial, property and transferability characteristics, which will all be specified and analyzed. They will be used as inputs for the correspondence analysis.

2.1. Quality characteristics

Production and environmental rights interfere between the economic behavior of the firm. Most rights affect the production side of the economy and, indirectly the consumption side too. As far as production rights are concerned, this is obvious. A production quota is assigned to an agent: it defines how much output is allowed in production during a specified period. Overproduction is illegal and will be penalized. In most cases environmental rights also interfere between production. Pollution rights will have an impact on the production level. Rights directly affecting the consumption side of the economy are, for example, rights to consume a maximum of 20 gallons of gasoline per month. In the European Union such rights exist for some chemical materials.

Table 1. The classes used for classifying rights by input and output.

Input	Output	
Rights with respect to resources	Environmental rights	Production rights

The quality characteristics of rights reflect the objectives of an institution that initiated the right. They specify what action the possessor of the right may take. In general, the right is defined as the amount of pollution or production per area per time period. Note that in this respect time means the time period for which the amount of pollution or production is defined. The duration of the rights scheme—the period the rights will last—will be discussed in Section 3. In the case of environmental rights, not only the total quantity per enterprise but sometimes also the quantity per output (that is, the efficiency rate) is subject to the right; for example, the amount of SO_2 emission per kilowatt-hour energy, per time unit, and per unit of area. In the case of production rights, such rights based on efficiency rate are rarely present.

2.2. Temporal characteristics

The temporal characteristics of rights indicate the lifetime of the rights scheme and thereby the term of the rights. The rights scheme—that is, the right—may be perpetual or tied to a certain period, after which it lapses. The right's lifetime is important for the right's marketability. If a rights scheme lasts only for a particular period, the government will have to redistribute rights in order to continue its policy. The time period during which the agent can exercise his or her right may be specified or not. In the latter case banking is allowed. The exercise period of the right can be specified precisely as a date or be tied to the occurrence of an event. One example of the former is the right to drive on Mondays and Wednesdays in a city having smog problems. An example of the latter—the occurrence of an uncertain event—is an agent who may exercise the right until the pollution reaches a specified limit.

2.3. Spatial characteristics

The spatial characteristic indicates the geographic area in which the right can be exercised for environmental and production economic reasons. Except for global rights, such as those pertaining to chlorofluorcarbons rights,[2] rights are almost always tied to a specific geographic area. The spatial characteristic of environmental rights is linked to air, water, and ground pollution. It is extremely important in the case of pollution rights because pollutants are region-specific. In the European Union this characteristic of rights with respect to production rights is the subject of much discussion because regional use of rights is connected with the distribution of the rights among the member states (Burrell, 1990; Oskam, 1989).

2.4. Property characteristics

An environmental or production right is not necessarily a property right. Whether or not the government can limit, withdraw, or otherwise modify the rights in the future without

compensating the holders of rights is an important issue and is extremely important for the legal security of the agents affected by rights. If the right can be seen as an asset, then the government cannot reduce the rights that it has distributed because it will encounter constitutional problems with respect to the right of property. In most cases the government indicates explicitly that the allocated right is not a property right. For example, the acid rain program in the United States refers to SO_2 emission rights and not to property rights (see ARP, Title IV of the Clean Air Act Amendments of 1990).

2.5. Transferability characteristics

One of the first tasks to be carried out by a regulatory agency is to allocate the rights to firms. The national government or a supranational government will have to distribute the rights among the different economic agents. The first option, auction of the rights, implies a financial burden to the economic agents involved. The government must indicate which economic agents can purchase the rights. The second option, distribution on the basis of administrative criteria (for example, grandfathering), has been implemented in the European Union regarding production rights (for example, in the case of milk quotas). The criterion was the historical production in a certain year—the reference year—which was the basis for the distribution of the production rights. In the case of pollution rights, the above-mentioned distribution implies that environmentally unfriendly economic agents are rewarded for their behavior by being given pollution rights. The regulatory agency will face substantial pressure to allocate rights in proportion to existing behavior. This allocation, of course, favors existing firms that bear little risk or expenses when the program is created and creates a bias against new firms that have to change their behavior drastically (Dwyer, 1992).

Whether a right can be transferred or not will influence the perception of the right by the affected firms. Transferable rights can to some extent be perceived as an asset, whereas a nontransferable right can be perceived as a privilege.

Transferability is attractive to policymakers, since it has several theoretical advantages over other methods, such as a regulated redistribution of rights. The market price of rights will reflect the cost of abating the externality and will provide a signal to other potential sources of externality. In theory, agents creating externalities will purchase rights or sell rights, depending on their initial abatement costs, up to the point at which the unit right price equals the marginal cost of externality control in the case of environmental rights (assuming no fixed costs). In the case of production rights the agents will purchase or sell rights up to the net benefit (Varian, 1990). Rights will therefore lead to business decisions based on externalities, too. If agents causing externalities with different cost and benefit functions are given the opportunity to trade rights, the total cost to society of reducing externalities is minimized. The trade system also lowers administration costs, since once the rights have been allocated, a market in rights can be expected to develop independently of the regulators. However, in this case it should be clear who is monitoring the policy, which is especially relevant in environmental policy. Most rights are transferable because the government's rationale for introducing rights is to find an economically efficient solu-

tion for its problems, and the reason for the superior efficiency of rights compared with other policy instruments is that transferability causes the marginal cost of abatement to be equal throughout society in the equilibrium. This goal can only be achieved by having transferability. In a recent article, Ledyard and Szakaly-Moore (1994) show that using markets for trading rights can be quite efficient. Participants were always better off under a market of rights than when there was no such market.

The trade in rights can be limited by different factors, some of which we now discuss. The participants in the trade in rights may be restricted by the government in order to protect some groups. The question of who is allowed to participate in the trade is related to this issue. We can distinguish two kinds of participants: the affected and the unaffected agents. Agents who wish to enter a new market in which participants are affected by rights can enter this market only by buying rights.

The trade in rights can also be restricted by a government through approval procedures. A trade then has to be propounded to an authority, which will then use certain criteria to test the trade.

This kind of regulation can be an impediment to a liquid market in rights. The trade in rights may be linked to some item in such a way that trade is impossible without this item. This is a common phenomenon in the case of production rights. Trading milk quotas in the European Union must involve land, because milk quotas are linked to land this influences the transferability of the milk right negatively. Not only the right itself but also market conditions can cause an illiquid market.

Transaction costs consist of two elements: finding a trading partner and, if necessary, obtaining approval from the authorities (Klaassen, 1994). Searching for a seller is often a formidable task because of the general scarcity of market information. However, some improvements have been made such as in the case of milk quotas in Canada, where in a centralized market place price information can be obtained (Tallard and Curtin, 1991).

Other elements are costs and the length of the approval procedure. One advantage of trading rights over commodities is that they do not involve transport costs, grading costs, and so on.

For rights there are different kinds of trading systems. We can distinguish between those in centralized trade and those in decentralized trade. Auctions are a well-known system in centralized trade. At sealed-bid auctions, rights are sold, starting with the highest bid and continuing until all rights have been sold or no bids are forthcoming. This is how the SO_2 emission rights in the United States are traded. Electronic matching is another system, which involves all bids and offers being entered into a computer. At a particular price the volume of the right offered for sale will equal, or almost equal, the volume of the right being bid on. This unique price is referred to as the *market clearing price*. The Ontario milk quota exchange is an example of this system. In contrast to decentralized trading systems, which are characterized by the employment of many middlemen, the centralized trade is very transparent.

The trading behavior of agents affected by rights is not straightforward. Efficient firms will buy or sell their rights, depending on the contents of those rights. Agents affected by environmental rights will be encouraged to clean up at relatively low cost to reduce their emissions, so that they are able to sell surplus rights to agents that do not have low-cost

clean-up options (Hahn, 1994). Production rights will encourage firms to produce at relatively low cost, so that they are able to buy production rights from firms that are not so efficient. The agent's trading behavior reflects the interaction between the quality characteristics and the transferability characteristics. Now we have described the characteristics of rights in detail, we summarize them in the next paragraph.

2.6. Overview of rights characteristics

We have described the most important characteristics of rights, of which Table 2 gives an overview.

3. Environmental rights and production rights: commonalities and differences

Characteristics of rights as described in Table 2 seem relevant to both environmental and production rights. However, their point of impact differs. In the case of environmental rights, the direct point of impact is the pollution and thereby indirectly the production of the main product, whereas in production rights the point of impact is directly the production of the main product (see Figure 1). This means that environmental rights can affect the use of production rights if the environmental rights and production rights deal with the same production process but not vice versa. The background of environmental and production rights and their features are analyzed below.

Certain characteristics of the type of pollutant have a crucial impact on the implementation of environmental rights. The pollutants may be divided into assimilative and accumulative pollutants and into uniformly mixed and nonuniformly mixed pollutants. This division between pollutants is related to the quality characteristics. The capacity of the environment to absorb assimilative pollutants is sufficiently large relative to their rate of emission, and in any year the pollution level is independent of the amount emitted in previous years. In the case of uniformly mixed pollutants, the ambient concentration depends on the total amount of emissions but not on the distribution of these emissions among various sources (that is, locations). This contrasts with spatial nonuniformly mixed pollutants (Tietenberg, 1985, 1989a, 1992). Each of these characteristics (assimilation and degree of mixing) affects the quality characteristics of the right. Uniformly mixed assimilative pollution is a type of pollution that is relatively easy to fit into a rights trading system. For

Table 2. Framework for describing rights.

Characteristics	
Quality	Production or pollution per unit of time per unit of space
Temporal	Permanent or temporal
Spatial	Region specific, national, or global
Property	Property right or no property right
Transferability	Transferable or not transferable, linkage, to other item or no linkage

any geographic area this system allows ton-for-ton trades between all sources. In this case, the spatial characteristic may be relaxed. Nonuniformly mixed assimilative pollutants involve a relationship between emissions and the pollution target, for which the location of the sources is crucial. For these pollutants the right is specified in terms of a ceiling on the permissible ambient concentration of that pollutant measured at specific locations: the spatial characteristic. The rights system for nonuniformly mixed assimilative pollutants involves a separate market in rights that is associated with each receptor; each source would have to procure sufficient rights in each (location-specific) market to legitimize its emission rate (ambient rights system). Uniformly mixed accumulative pollutants involve pollution that accumulates in the environment because the emission exceeds the assimilative capacity. The rights designed for this kind of pollution do not have a temporal characteristic; the holder is free to choose when to emit. These rights do not regulate emission rates, they limit total emissions. In this market the rights are an exhaustible resource; once used they are withdrawn from circulation. The rights system for nonuniformly assimilative pollution is complex because of the location specificity. It shows the interaction between the quality and spatial characteristics. Different approaches can be considered, such as zonal rights systems.

Similar to environmental rights, the characteristics of products have a crucial impact on the implementation of production rights. There are many characteristics of products such as perishability, seasonality, and so on. Therefore, these characteristics are not elaborated on, and we limit ourselves to describing the background of production rights. In many countries state intervention in production policy is a normal procedure. Ever since the earliest days of the Common Agricultural Policy of the European Union, agricultural production has increased more rapidly than demand. This has led to structural surpluses and low prices for farmers, which can eliminated only through the increasing exercising of public intervention and storage measures, subsidized internal disposal schemes, and restitutions for an expanding volume of exports to the world market. These market-support measures could be sustained only at an ever-increasing cost to the Union budget. In 1984 the European Commission concluded that it was no longer economically sensible nor financially possible to give producers a full-price guarantee in the case of structural surpluses. The European Commission therefore decided that the principle of the guarantee threshold in the agricultural sector should be replaced by a quota system accompanied by a restrictive price policy. This principle forms the basis of the different kinds of quota systems in the European Union such as those for fishery, starch, sugar, and milk. Also, in many countries outside the European Union, governments introduce production rights to avoid overproduction. Most such rights are established within agriculture. The production right is defined in terms of the product volume per year that the producer in question is allowed to produce and for which in most cases he or she obtains a guaranteed price. We can conclude that the differences between environmental rights and production rights are caused by the fact that the point of impact differs. Environmental rights indirectly effect the output of the firm whereas production rights directly effect the output. The commonality of environmental rights and production rights lies in the fact that the implementation of a rights scheme depends on the underlying product in the case of production rights or polluter in the case of environmental rights.

4. Classifying existing rights

We use the characteristics of rights to classify some well-known rights. We use as an example of environmental rights: lead rights, SO_2 emission rights, chlorofluorcarbon rights in the United States, and manure rights in the Netherlands. As an example of production rights we use milk rights and fishery rights in the European Union. Note that we selected rights schemes that are mature—that is rights schemes that have proven to last for some years. Many rights schemes are not stable, meaning that the specification and the rules that apply to them change very often. However, our methodological approach also can be applied to other rights, such as the Swiss highway vignette, German trucking highway tax, and the power plant quota in Denmark.[4]

The characteristics described are defined dichotomously. The codes of these characteristics (in parentheses) are as follows:

D1 = Quality Characteristics

C1 = based on efficiency rate (1) or not (0);
C2 = point of input; consumption side (1) or production side (0);

D2 = Temporal Characteristics

C3 = the right may be perpetual (1) or not (0), (the rights scheme has not or has an expiration date);
C4 = the period of exercising may be specified (1) or not (0) (banking is allowed);
C5 = the use of a right may be tied to a specific time or a specific event whose time of occurrence is known (1) or unknown (0);

D3 = Spatial Characteristics

C6 = the right is restricted to a specific geographic area (1) or is global (0), for environmental or production economic reasons;

D4 = Property Characteristics

C7 = withdrawal of the right may or may not have consequences for legal security, (compensation in the case of withdrawal (1) or not (0));

D5 = Transferability

C8 = geographic limits to trading (1) or no limits (0);
C9 = allocation by the grandfathering system (1) or auction (0);
C10 = the participants are allowed to trade are solely affected agents (1) or include agents from outside (0);
C11 = trading is regulated by the government, permission is required from agency (1), or no such permission is required (0);
C12 = right is linked to some item (1) or is not linked (0);
C13 = trading system is centralized (1) or decentralized (0);

The figures in parentheses correspond with Table 3.

The design of this classification is objective in the sense that the scores can be assigned objectively. We have assigned the scores on the basis of information we have gathered from institutions and authorities involved in these rights. Note that the methodological approach could be applied to many more rights.

Table 3. Classification of existing rights according to their characteristics.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
Production rights:													
Milk right	0	0	0	1	1	1	0	1	1	0	1	1	0
Sugar rights	0	0	0	1	1	1	0	1	1	1	1	1	0
Fishery rights	0	0	0	1	1	1	0	1	1	1	1	0	0
Environmental rights:													
Lead rights	1	0	0	0	1	0	0	1	1	1	1	0	0
Chlorofluorcarbon rights	0	0	0	1	1	0	0	0	1	1	1	0	0
SO_2 emission rights	0	0	1	0	1	0	0	0	1	0	0	0	0
Dutch manure rights	0	0	0	1	1	1	0	1	1	1	1	0	0
Full right	1	1\0	1	0	1	0	1	0	0	0	0	0	1

Before we start our analysis we specify a *full right*, which is a hypothetical right that has optimal characteristics in the sense of efficiency—that is, implementing a policy that is efficient for the affected firms as well as for society. This means that the goal of internalization of externalities is reached at low cost to both the individual firm and society. This full right is based on efficiency rate, is perpetual, has no restrictions on transferability, and is a property right. In our analysis this right can be seen as a benchmark with which existing rights can be compared.

The rights (including the full right) that we examine are classified in Table 3. We carried out a correspondence analysis to identify the basic dimensions of rights. The primary purpose of correspondence analysis is data reduction and summarization. Broadly speaking, it addresses itself to the problem of analyzing the interrelationships among a large number of variables and then explaining these variables in terms of their common underlying dimensions. Correspondence analysis has several features that contribute to its usefulness in research. The multivariate nature of correspondence analysis can reveal relationships that would not be detected in a series of pairwise comparisons of variables. Correspondence analysis also helps to show how variables are related, not just that a relationship exists. The joint graphical display obtained from correspondence analysis can help in detecting structural relationships among the variable categories—in our case, the rights and the characteristics.[5] The analysis was carried out using the CORAN correspondence analysis computer package (Bagozzi, 1994; Carroll, Green, and Schaffer, 1986, 1987). The central objective of CORAN is to find a set of coordinates representing the rows of the two-way contingency table (such as Table 3), so that the Euclidean distances between the rows of the coordinates respond in a straightforward way to squared distances between rows.

Our primary aim was to identify (1) the similarities and differences between rights with respect to the various characteristics, (2) the similarities and differences between the characteristics with respect to the rights, and (3) the interrelationship between the rights and the characteristics. We also wanted to ascertain (4) if these relationships could be represented graphically in a joint low-dimensional space. This means that two rights are close if they share similar characteristics, and two characteristics are close if they occur in the same rights to the same degree. It also implies that a right is close to a characteristic if the right has that characteristic.

Table 4. Eigenvalues.

Factor	Eigenvalue	Percentage	Cumulative percentage
1	0.6467	59.51	59.51
2	0.1846	16.99	76.50
3	0.1398	12.87	89.37
4	0.0716	6.59	95.95
5	0.0355	3.27	99.22
6	0.0084	0.78	100

The histogram of the eigenvalues indicates that the fourteen characteristics can be explained by an underlying structure consisting of six dimensions (see Table 4). The eigenvalue represents the amount of variance accounted for by a factor. Note that three factors explain about 89 percent. Based on the well-known scree test criterion, the underlying structure of the data set can be represented by three factors (or dimensions).

In Figures 2 and 3 the rights are denoted by R1 for milk rights, R2 for sugar rights, R3 for fishery rights, R4 for lead rights, R5 for chlorofluorcarbon rights, R6 for SO_2 emission rights, R7 for Dutch manure rights, and R8 for the full right.

Figure 2 represents the configuration of the characteristics and rights formed by the first two principal axes; see the appendix for a detailed overview of the computational outcomes of the analysis. Each of the principal axes is associated with an eigenstructure that defines the projections on the axes, as well as the relative variance in the characteristics and rights explained by the axes. In this analysis the full right can be seen as the ideal point.

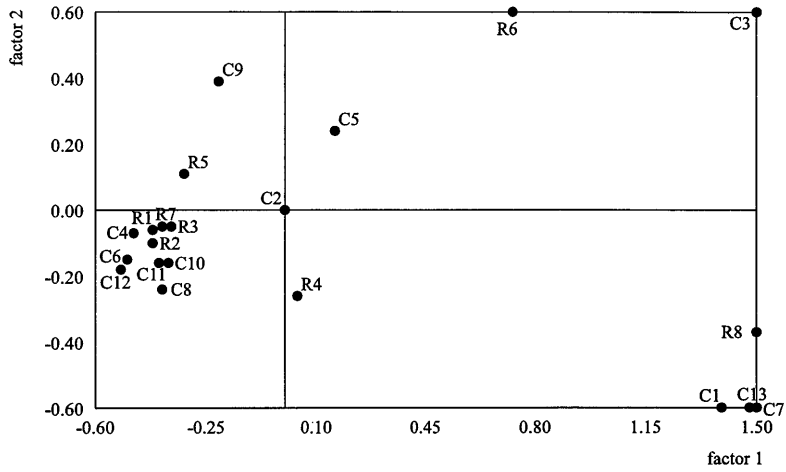

Figure 2. Plot of the first dimension on the horizontal axes and the second dimension on the vertical axes.

Figure 2 shows that there is a striking similarity within the group of production rights—that is, they are located close to each other. Within the group of environmental rights the similarity is less compared with the production rights. We can observe an interrelation between the production rights and the characteristics related to transferability (C8, C10, C11, and C12). Other rights and characteristics show no such interrelation.

From Figure 2 it can be concluded that the first dimension is able to discriminate between the full right and the existing rights, and the second dimension is able to discriminate between the existing rights. The first dimension describes the economic implications of the right from the point of view of both the affected firms and the society (dimension 1 has an absolute contribution of 77.6 to the full right—that is, the full right is mainly stretched by this dimension). This dimension can be labeled as the efficiency dimension because characteristics 1 (based on efficiency rate), 3 (perpetual or not), 7 (compensation in the case of withdrawal), and 13 (trading system) load heavily on this dimension. The government can now evaluate the economic aspects of actual or proposed rights by using the first dimension as a benchmark. Rights that load relatively heavily on this dimension are preferred from a firm's point of view but also from a welfare perspective.

The second dimension is able, to some extent, to discriminate between environmental and production rights. The upper quadrant contains the rights associated with the environmental rights, whereas the production rights are in the bottom left area of the plot. This dimension can be labeled as the content dimension because characteristics 3 (right is perpetual or not), 9 (grandfathering or not), and 13 (trading system) load heavily on it.

Figure 2 shows that the distance between existing rights and the full right is large, indicating that much work needs to be done from a economic point of view on the process of designing rights.

From Figure 3 it can be concluded that the third dimension is able to discriminate between the rights with respect to transferability. This dimension can be labeled as the marketability dimension because characteristics 10 (trade is only allowed with affected firms or not) and

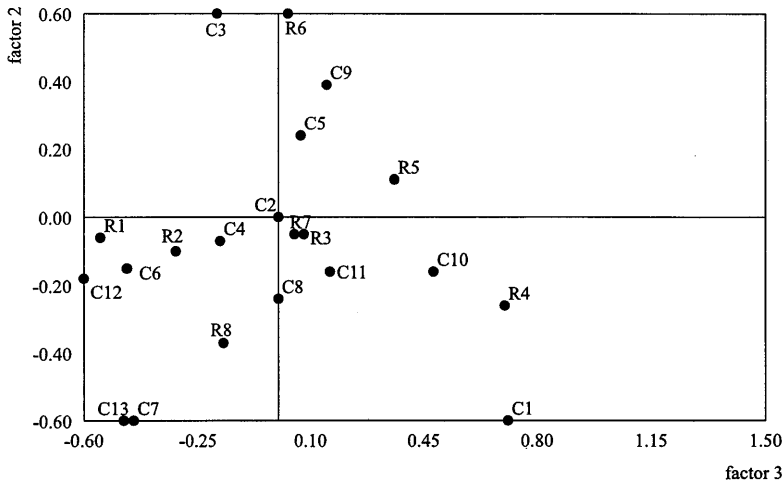

Figure 3. Plot of the third dimension on the horizontal axes and the second dimension on the vertical axes.

12 (right is linked to an item or not) load heavily on this dimension. The full right is located near the center because this ideal right is stretched mainly by dimension 1. This plot gives us less information on similarities and interrelationships because the characteristics and rights are equally scattered in the plot; hence on the basis of the second and third dimensions, the rights and characteristics are not alike. This is not unexpected because this technique tries to condense all information into the space with the fewest dimensions (see Figure 2).

5. Summary and conclusions

In this article a theoretical framework for rights has been developed. Both environmental rights and production rights have been considered. Both categories of rights are linked to the production process. The rights have been analyzed by characteristics deduced from the related production process. This theoretical framework makes it possible to classify existing rights and gives some insight into the many rights that are initiated in today's world. If applied to existing rights the underlying structure of rights can be determined empirically with the help of correspondence analysis. The benchmark in the correspondence analysis is a hypothetical right that has the optimal characteristics in the sense that such a right can contribute in the best way to reaching the goal of an authority and the affected firms in the sense of cost efficiency. The first of the three dimensions extracted, if using correspondence analysis, can be labelled as the efficiency dimension because it is able to discriminate between the existing rights and the full right. The distance between the full ideal right and the existing rights is relatively large, indicating that from a business economic point of view much attention has to be paid to and research needs to be done on designing rights. The second dimension can be labeled as the content dimension because it is able to discriminate between environmental and production rights, whereas the third dimension can be labeled as the marketability dimension. Our results should be interpreted with caution, because we used a small data set. We are continuing this line of research.

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Notes

1. The terms *allowances*, *permits*, *quotas*, and *rights* will be used interchangeably in this article to refer to the same phenomenon.
2. Note that chlorofluorcarbon rights, although we describe them as global rights, affect only the partners of the Montreal Protocol.
3. Note that although the stocks of agricultural products are almost depleted in the European Union nowadays, production rights are needed to counter oversupply and hence low prices for farmers.
4. We acknowledge the remarks made by a reviewer in this respect.
5. For a detailed description of correspondence analysis the reader is referred to Hoffman and Franke (1986).

Appendix: Statistical Results of the Correspondence Analysis

Coordinates and Contributions of the Columns

Names	Masses Dist.		Coordinates						Absolute Contributions						Squared Correlations					
			F1	F2	F3	F4	F5	F6	F1	F2	F3	F4	F5	F6	F1	F2	F3	F4	F5	F6
C1	0.42	3.40	1.39	-.73	.71	.66	.05	.06	12.4	12.0	14.8	25.5	.3	1.5	.57	.16	.15	.013	.00	.00
C2	.000	1.00	.00	.00	.00	.00	.00	.00	.0	.0	.0	.0	.0	.0	.00	.00	.00	.00	.00	.00
C3	.042	5.40	1.82	1.42	-.19	.08	-.13	-.09	21.4	45.5	1.0	.3	2.1	3.9	.61	.37	.01	.00	.00	.00
C4	.104	.45	-.48	-.07	-.18	-.39	.12	.08	3.8	.3	2.5	22.6	3.9	7.1	.52	.01	.07	.35	.03	.01
C5	.167	.09	.16	.24	.07	-.01	.05	.04	.6	5.0	.6	.0	1.1	3.1	.28	.62	.06	.00	.03	.02
C6	.083	.66	-.50	-.15	-.47	-.09	-.39	-.02	3.3	1.0	13.2	.9	35.9	.4	.39	.04	.34	.01	.23	.00
C7	.021	8.60	- 2.73	-.86	-.45	-.45	.02	-.00	24.0	8.4	3.1	5.8	.0	.0	.87	.09	.02	.02	.00	.00
C8	.104	.38	-.39	-.24	-.00	.28	-.30	.01	2.5	3.3	.0	11.7	25.9	.1	.41	.15	.00	.21	.23	.00
C9	.146	.23	-.21	.39	.15	.06	.05	.05	1.0	12.2	2.3	.7	1.2	3.6	.19	.68	.10	.01	.01	.01
C10	.104	.49	-.37	-.16	.48	-.20	.05	-.22	2.2	1.5	17.4	6.1	.8	61.6	.28	.05	.47	.08	.01	.10
C11	.125	.23	-.40	-.16	.16	-.03	.11	.08	3.0	1.7	2.3	.2	4.2	10.0	.69	.11	.11	.00	.05	.03
C12	.042	2.21	-.52	-.18	-1.15	.59	.46	-.13	1.8	.8	39.7	20.3	24.6	8.7	.12	.02	.60	.16	.09	.01
C13	.021	8.60	2.73	-.86	-.45	-.45	.02	-.00	24.0	8.4	3.1	5.8	.0	.0	.87	.09	.02	.02	.00	.022

Coordinates and Contributions of the Columns

Names	Masses Dist.		Coordinates						Absolute Contributions						Squared Correlations					
			F1	F2	F3	F4	F5	F6	F1	F2	F3	F4	F5	F6	F1	F2	F3	F4	F5	F6
Milk	.146	.55	-.42	-.06	-.55	.22	.07	.15	3.9	.3	31.1	9.8	2.2	38.1	.32	.01	.54	.09	.01	.04
Sugar	.167	.34	-.42	-.10	-.32	.10	.10	-.17	4.6	.9	11.9	2.2	4.6	59.1	.53	.03	.30	.03	.03	.09
Fishery	.146	.26	-.39	-.05	.08	-.20	-.23	.01	3.4	.2	.7	8.6	22.4	.1	.59	.01	.02	.16	.21	.00
Lead	.125	.78	.04	-.26	.70	.47	.02	.01	.0	4.5	43.5	39.2	.1	.2	.00	.08	.62	.29	.00	.00
Chloro-fluorc	.104	.60	-.32	.11	.36	-.43	.40	.04	1.7	.7	9.9	27.4	47.7	2.2	.17	.02	.22	.31	.27	.00
SO2	.063	3.10	.73	1.59	.03	.16	-.05	-.02	5.2	85.5	.0	2.3	.5	.2	.17	.82	.00	.01	.00	.00
Dutch manure	.146	.26	-.39	-.05	.08	-.20	-.23	.01	3.4	.2	.7	8.6	22.4	.1	.59	.01	.02	.16	.21	.00
Full Right		.104	5.00	2.20	-.37	-.17	-.12	.00	.00	77.6	7.7	2.2	2.1	.0	.96	.03	.01	.00	.00	.00

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