The Allocation of Scarce Resources in Miscellaneous Cases

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ABSTRACT

This book presents a number of papers that address different allocation problems. Each of them applies to specific situations, defined by the conditions assumed in the model. The papers appeared previously in different outlets and are reprinted by permission of the co-authors and publishers.

The first paper – 'Sustainability: a review of the debate and an extension'- argues that the current debate on sustainability is obscured by a number of misunderstandings. These relate, first, to the ongoing dispute between ecologists and economists holding different visions about the limits of economic growth and the carrying capacity of the Earth; and second, to the discrepancy between theoretical sustainability and practical sustainability. The paper concludes that the current vagueness surrounding sustainability may be reduced by reframing the debate. It demonstrates that the dispute between ecologists and economists can largely be considered as unproductive because the only sustainability concept supported by theory is that of 'strong sustainability'. The paper argues further that the gap between theoretical and practical sustainability may be bridged by distinguishing three concepts which properly account for informational inadequacies and human preferences in the design of sustainability constraints. These are: the 'sustainable EUS' (Environmental Utilization Space), the 'measured EUS', and the 'chosen EUS'.

In the second paper – 'Auctioning conservation contracts: a theoretical analysis and an application' - Auction theory is used to analyze the potential benefits of auctions in allocating contracts for the provision of nonmarket goods in the countryside. A model of optimal bidding for conservation contracts is developed and applied to a hypothetical conservation programme. The study shows that competitive bidding, compared to fixed-rate payments, can increase the cost effectiveness of conservation contracting significantly. The cost revelation mechanism inherent in the bidding process makes auctions a powerful means by which to reduce the problems of information asymmetry. The study also shows that strategic bidding behaviour, which may adversely affect the performance of sequential auctions, is difficult to address by means of auction design.

The third paper – 'Auctions as a means of creating a market for public goods from agriculture' - looks at the possibility of creating a market for environmental goods and services in the countryside by awarding conservation contracts to farmers on the basis of competitive bidding. Auctions have several theoretical advantages over alternative allocation mechanisms (such as standard-rate payments) because they allow the participants to deal with informational asymmetries and the uncertainty about the value of the (nonmarket) goods being traded. A formal model of bidding behaviour in 'green auctions' shows that bidding strategies are determined by the

individual farmers' costs of implementing the conservation contracts and their beliefs about the maximum acceptable payment level, making the auction an imperfect cost revelation mechanism. Auctions can reduce the information rents accruing to farmers and can increase the cost-effectiveness of public goods provision. Strategic bidding behaviour in multiple-signup auctions as well as high transaction costs are potential sources of reduced efficiency.

The fourth paper – 'The pivotal role of the agricultural land market in the Netherlands' - analyzes the allocation of space in the Netherlands. In particular the effect of the 'Town and Country Planning Act', government policies in respect of agriculture, nature, landscape, and the environment and developments in agricultural and non-agricultural sectors on the allocation and price of agricultural land. The study shows that viewed separately, the environmental, nature, and agricultural policies might be consistent with the goals they are supposed to achieve, but in interaction they are conflicting and preclude the simultaneous achievement of these very same objectives. The study also shows that the agricultural land market plays a pivotal role in this network of interactions. The EU market and price policy, with the exception of the milk quotas, caused the price of land to rise, and subsequently the land price rose again due to the environmental and nature policy needed to compensate for the negative effects of that agricultural policy. In addition, the economic boom of the late '90s created a great many 'red' claims on agricultural land, which in combination with an unsteady 'Town and Country Planning Act', drives up land prices along with the general increase in real estate prices. For farmers, the resulting extremely high land price was reason to make even more intensive use of land.

Finally, the fifth paper – 'The AMS in agricultural trade negotiations: a review' - reviews the role of the Aggregate Measure of Support (AMS) in the agricultural trade negotiations of the Uruguay Round. Contrary to expectations at the start of these negotiations, the AMS only occupies a subsidiary position in the final agreement. In order to explain this, first an economic analysis is presented of the Producer Subsidy Equivalent (PSE), the basic AMS concept in the GATT discussions. Secondly, the political AMS debate is described and analyzed, using information from unpublished GATT documents. Although the PSE concept is based on simple assumptions, its measurement already meets a number of difficult problems (policy coverage, product coverage, external references prices, currency). Once these are solved, the concept may offer a brief insight into actual governmental support in agriculture. However, the calculations do not provide a sound measure of the trade distortions caused by agricultural policies. Mainly for that reason, the idea of a pure aggregated approach - based on the AMS - proved unsuccessful in the negotiations. Instead, the Contracting Parties accepted the framework of making binding agreements on three separate areas: internal support, market access and export support. While important and very specific commitments were made in the areas of agricultural imports and exports, the AMS has only found application in the internal support area.

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1. Introduction

1.1 The allocation of scarce resources

Economics is about the allocation of scarce, alternatively usable, resources. These resources include the capital stocks (renewable and nonrenewable natural capital, manufactured capital, cultural capital) and the flow of goods and services they yield. Any good or service, either in consumption or production, and irrespective of its classification as a capital stock or flow, private or public, excludable or nonexcludable, territorial or nonterritorial, is shared by a club and therefore is a club good. A club is a voluntary group of individuals (or individual) who derive mutual benefit from sharing a good or service. Buchanan (1965) first introduced the term club in his seminal piece 'An Economic Theory of Clubs'. My usage of the terms club and club good is consistent with his pioneering work, but at odds with their usage in the traditional club literature, which defines a club good as an excludable impure public good and a club accordingly as a voluntary group deriving mutual benefit from sharing production costs, the members' characteristics or a good characterised by excludable benefits (Cornes and Sandler, 1996). Careful reading of Buchanan's work learns that this traditional usage is at odds with his original club concept. Buchanan uses the terms club and sharing arrangement interchangeably, since individuals who join a club also join in the sharing arrangement of the club. He shows that the optimal sharing group is one person for private goods and more than one person for public goods, which is equivalent to saying that both rival, partially rival and nonrival goods are shared by clubs[1]. In addition, he notes that if exclusion is not fully possible, individuals may secure benefits as free riders without really becoming full-fledged contributing members of the club and therefore may be reluctant to enter voluntarily into cost-sharing arrangements. The logic alternative to voluntary cost-sharing arrangements is an imposed arrangement or government, which Buchanan defines as one form of club organization, with co-operatives and firms representing other forms (1965: footnote 1, p7). Buchanan is therefore implicitly saying that nonexcludable goods are shared by clubs as well, be it a voluntary or imposed club.

Clubs are classified as consumer, producer or mixed clubs, depending on the composition of their membership. Consumer and producer clubs are defined as

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[1] In the literature goods and services are classified as private or public based on the (non)rivalry of benefits (Sandler, 1992). A private good possesses benefits that are perfectly rival between prospective users so that the consumption of a unit of the good by a person uses up all of the available benefits. Food, clothing and fuel are apt examples. In contrast, if a good does not display rivalry in its pure form, the good is called public or, synonymously, collective. A good is said to be purely public if it provides benefits that are nonrival or indivisible between users so that one unit of the good can be consumed by one individual without detracting in the slightest from the consumption opportunities still available for others from that same unit. Nonrivalry characterizes benefits derived from pollution-control devices, weather-monitoring stations, scientific discoveries, and disease eradication. A good is said to be impurely public if it possesses benefits that are partially nonrival. Examples include recreation facilities, national parks, and highways. Although these goods are nonrival at low levels of usage, they are partially rival because crowding occurs when they are more intensively used.

clubs whose membership consists of consumers and producers only, respectively. Mixed clubs are defined as clubs whose membership consists of both consumers and producers. Many if not most club goods are shared by producers, be it in consumption or production, including many common pool resources, such as water reservoirs, irrigation canals, fishing sites, and pastures (Ostrom, 1990). But also machines, buildings, labour services and technological developments are shared by producers, or are jointly used by consumers and producers, such as freeways, sewage systems, parking places, golf courses, and concerts.

Each club has a sharing arrangement, which can be defined as "the sets of working rules that are used to determine who is eligible to make decisions in some arena, what actions are allowed or constrained, what aggregation rules will be used, what procedures must be followed, what information must or must not be provided, and what payoffs will be assigned to individuals dependent on their actions" (Ostrom, 1990:51). Individuals who join a club also join in the sharing arrangement of the club, the reason why in this book, as well as in Buchanan's piece, the terms club and sharing arrangement will be used interchangeably. The sharing arrangement defines the organizational form or the working rules of the club, different clubs having different rules. Visitors to Walt Disney World (Florida) have a different sharing arrangement than visitors to Euro Disney, the firms that have the privilege of selling products within Walt Disney World's grounds or the shareholders of the Walt Disney Company[2].

For the enjoyment of any club good there is a rich array of sharing arrangements from which the individual can choose. As an extreme example, take a good normally considered to be purely private, say, a pair of shoes of given quality and brand. The individual may obtain the shoes at different sales outlets, each having their own sets of working rules including user's instructions, maintenance rules, guarantee conditions, and the time and terms of payment - cash, on account or deferred payment. The individual's choice for an outlet constitutes an agreement that the deed of sale or the terms of purchase of the outlet are accepted, the agreement being a tacit and unwritten contract between the individual and the owner of the outlet. The same rationale that holds for private goods, also applies to evidently collective goods, such as golf courses, concerts and recreation facilities. Visitors to a recreation site are tenants who have leases with rental prices with the owner of the site. The rental price, often in the form of user or entrance fees, is a charge paid to the corporation that owns or operates the site for the use of all the grounds and facilities during a period of time (Foldvary, 1994). The leases contain prescriptions that forbid, permit, or require the lessees to perform certain acts, different recreation sites offering different leases.

Following the definition, any good or service is shared by a club, including the subset of collective goods and services that are 'typically' provided by governments, the so-called 'civic goods' (Foldvary, 1994). Civic goods include lighthouses, fire protection, education, private property rights protection, safety, freedom of speech. In the literature the terms 'government' and 'public arrangement' are used for imposed governance, that is, one imposed on at least one adult, conscious, sane member of a community (Foldvary, 1994). This usage is at

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[2] Likewise, the co-owners of a co-operative have a different sharing arrangement than the residents of a community, the appropriators of a groundwater basin, or the users of a pair of shoes.

odds with voluntarism, a characteristic of the club definition, and with the very notion of sharing arrangements being a choice variable. In this view, a sovereign government has the authority to impose a sharing arrangement upon the people living or entering into its jurisdiction without their explicit agreement in the sense of signing a contract (Foldvary, 1994). But living in or even entering into a sovereign community is no different from joining a co-operative or purchasing a pair of shoes in a sales outlet – one implicitly agrees with all of its rules. Even if one is born a citizen, one can withdraw membership and (e)migrate to another sovereign community. 'Fiscal refugees' serve as an example, citizens and firms transferring among sovereign communities - municipalities, states or countries - in search of the most favourable tax environment. Hence, public arrangements are as voluntary as private arrangements, different sovereign communities using different sharing rules for the enjoyment of the same civic goods[3]. In addition, few if any civic goods are exclusively provided by government. The empirical literature contains many examples of civic goods provided by private actors as a substitute for or a supplement to government provision, including lighthouses (Coase, 1988[1974]), fire protection (Poole, 1988[1980]), education (High and Ellig, 1988), security[4], and common-pool resources, such as natural drinking-water reservoirs and fishing grounds (Ostrom, 1990). Even the provision of such 'commodities' as equitable distribution of wealth, is not the exclusive realm of government, judging by the many charities which intend to redistribute wealth from the fortunate to the less fortunate. Hence, also for the enjoyment of 'civic goods' there is a rich array of voluntary sharing arrangements, either private or public, from which the individual can choose.

A club good can refer to some physical good or service, or else to some aspect, property, attribute or feature of a good, qualities that are termed 'outputs' or 'characteristics' (Foldvary, 1994). Lancaster (1966), a founder of the characteristics approach, theorised that it is not the physical goods that are the direct object of utility, but that it is the properties or characteristics of these goods from which utility is derived. A club good that possesses more than one characteristic is termed a joint product; it jointly generates multiple characteristics. These characteristics are themselves goods and services (Auster, 1977) and, hence, can be classified into purely private, impurely public, purely public, excludable and nonexcludable sets, keeping in mind that we are referring to the properties of physical goods.

Few club goods, if any, are single-output goods. Lancaster (1966) even contends that any good or service, even the simplest consumption or production activity, is characterised by joint outputs. These outputs or characteristics may include the attributes of the club good itself as well as the by-products from its production and consumption. The qualities of a pair of shoes include colour, smell, size, shape, beauty and fabric, Walt Disney World (WDW) jointly provides numerous tourist attractions, the Fort Ellsworth Condominium jointly generates residential apartments, a swimming pool, landscaping and parking spaces, and a UNICEF postcard yields a card and the relief of child suffering. By-products from

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[3] Note that migrating from one sovereign community to another is voluntary indeed, yet may in some cases be so costly as to make it economically impossible or inefficient.

[4] Neely (1990; in Foldvary, 1994) notes that there are more security guards in the USA than full-time uniformed police officers.

production and consumption of a club good include all positive and negative effects of production and consumption activities on people and planet. The consumption of hardwood furniture, for instance, not only includes the furniture itself, but also the loss of tropical rainforest and its effect on biodiversity and climate change (planet) resulting from its production. Likewise, the purchase of footballs made by Pakistani children includes all social effects of child labour in addition to the balls themselves.

Our world is an economic world in which the motivation for joining clubs, participating in sharing arrangements, and sharing (characteristics of) club goods with or without a number of other agents is economic. Billions of mutually interacting consumers and producers make these interdependent choices on the basis of benefit and cost considerations so as to maximise individual net benefits in the specified time period and given the exogenous environment. The exogenous environment includes factors that are invariable for consumers and producers in the specified time period. An expansion or limitation of this period implies a 'reduction' or 'increase' of the exogenous environment, respectively, since formerly invariable factors become variable, or vice versa.

The outcome of this process is a Pareto-optimum; that is, a configuration of consumer, producer and mixed clubs, members, nonmembers and free-riders, and sets of excludable, nonexcludable, purely private, impurely public and purely public (characteristics of) club goods in which no reallocation of resources will increase someone's utility without decreasing the utility of at least one other person.

1.2   Allocation problems: four cases

In this book four specific allocation problems are discussed. Each of them applies to polar or extreme cases, defined by the conditions assumed in the model. So they can successfully predict strategies and outcomes in fixed situations approximating the initial conditions of the models, but they cannot predict outcomes outside that range. The conditions and outcomes of each model can be defined in terms of clubs, sharing arrangements, membership, and (outputs of) club goods, some of which are choice variables, while others are predetermined and exogenous to the model.

1.2.1 The allocation of the planet's capital stocks

'Sustainability' has risen high on the political agenda in recent years, yet no agreement has been reached as to what sustainability exactly means. Judging from the wide range of definitions - Pezzey (1989) collected some 190 different definitions - the answer to this question seems far from unambiguous. Probably the most widely quoted definition of sustainability is that given by the World Commission on Environment and Development in the so-called Brundtland report: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). This definition illustrates two key concerns also present in many other definitions, i.e. (Heal, 1996):

(1) recognition of the long-run impact of resource and environmental constraints on patterns of development and consumption;

(2) concern for the well-being of future generations, particularly insofar as this is affected by their access to natural resources and environmental goods.

While most people will readily agree with these concerns and the content implicitly referred to, a precise description of the goals to be achieved reveals the vast contradictions that linger below the surface of the concept (Latesteijn et al., 1994). We argue that these contradictions have emerged because of two issues that obscure the sustainability debate. The first concerns the still ongoing debate between economists and ecologists holding different visions about the limits of economic growth and the carrying capacity of the Earth, which is intertwined with, and logically steers, the discussion about sustainability. The second issue relates to the observed discrepancy between theoretical sustainability and practical sustainability. That is to say, it may not be possible, due to information deficiencies or acceptability constraints, to operationalise a situation that is considered sustainable from a theoretical, scientific point of view. It may therefore happen that a resource economist and a politician, who both attempt to address sustainability, talk at cross-purposes because the former implicitly refers to 'theoretical' sustainability, while the latter's benchmark concerns 'practical' sustainability. Both issues trouble the sustainability debate because people think they are addressing the same issue, when in fact they are not. In this book, we shall address both of these issues and analyze their implications for the sustainability debate.

In economics sustainability is defined as "the maximum amount that a community can consume over some time period and still be as well off at the end of the period as at the beginning" (Hicks, 1946 in Daly, 1994:23). Therefore, in Hicksian terms, Brundtland may be saying no more than that we, the present generation, should consume within our income (Heal, 1996). To achieve a sustainable development and consume within our income requires information about the limits of economic growth and the carrying capacity of the Earth.

The systems perspective in the field of ecological economics has proven fruitful in this respect. Ecological economists, but also others, distinguish three hierarchically ordered systems - the ecological, the social and the economic system – and adopt the view that the economy, in its physical dimensions, is an open subsystem of a finite, nongrowing, and materially closed ecosystem (Daly, 1994). Each system consists of a capital stock that yields a flow of useful goods and services into the future (Daly, 1994). The capital stock of the ecological system is Total Natural Capital, subdivided into Renewable Natural Capital (biodiversity) and Nonrenewable Natural Capital (oil and ore deposits). The capital stocks of the social and economic system are referred to as Cultural Capital (clubs and sharing arrangements, people's views about the limits of economic growth and the carrying capacity of the Earth) and Manufactured Capital (factories, buildings, tools). Traditional economic analyses are often concerned with the optimal allocation of club goods given the social and ecological system, which are considered exogenous to the allocation problem. This may be an appropriate approach if the specified time period is limited and natural resource stocks and configurations of clubs, sharing arrangements and memberships are known and given, reducing allocation problems

to allocating goods and services in the best interest of those *within* the given set of clubs. However, if the time period is extended several functional relationships and flows of club goods and services occur across the system boundaries and the choice of clubs and their organizational form becomes endogenous too. Likewise, improvements in the technological efficiency (a club good) of Manufactured Capital may ensure increased availability of flows from the Natural Capital Stock. For instance, better machines may enable the extraction of oil sources deep in the Earth's crust that were otherwise not available, thus changing the exogenous environment and, hence, the allocation problem.

The whole set of material and energy flows moving through the various systems and subsystems is governed by two essential biophysical laws, known as the law of conservation of matter/energy and the entropy law (Ehrlich et al., 1980). The fundamental lesson to be drawn from these laws is that the stock of Natural Capital is ultimately finite, that Natural Capital and Manufactured Capital are complements rather than substitutes, and therefore that sustainable development requires the maintenance intact of each of the capital stocks separately (Costanza and Daly, 1992; Daly, 1994). The vision that corresponds to this 'prudent course' is called the 'ecological economics vision' (Folke et al., 1994). However, despite this 'evidence' of the finiteness of the Earth's natural resources, economists and ecologists hold different visions. The 'conventional' economic optimistic view (Folke et al., 1994) or 'technological optimism' (Costanza, 1989), is based on the belief that technology is able to solve all our problems so that economic and population growth can continue forever (Costanza, 1995). The opposing line of thought, the 'environmental pessimist vision' (Folke et al., 1994) or 'technological pessimism' (Costanza, 1989), assumes that technology will not be able to circumvent fundamental energy and resource constraints and that over-expansion of the human economy will cause collapse of the ecological life-support system and ultimately of the economy which depends on it.

Note that the effect of consumption and production activities on the ecological system emerge in the economic system as outputs of club goods that are subject to benefits and costs. Our vision about the limits of economic growth and the carrying capacity of the Earth shape our utility functions and, hence, the way in which we value detrimental effects of our club activities on the ecological system. Different visions imply a different Cultural Capital stock and, hence, a different exogenous environment for allocation decisions in the economic system, generating different Pareto-optimal solutions in terms of configurations of clubs, sharing arrangements, memberships and club goods, including the way in which we use and exploit the biosphere.

Based on the analysis of Van der Hamsvoort and Latacz-Lohmann (1998) we conclude that the current vagueness surrounding sustainability may be reduced by reframing the debate. We demonstrate that the dispute between ecologists and economists can largely be considered as unproductive because the only sustainability concept supported by the laws of thermodynamics is that of 'strong sustainability'. We argue further that the gap between theoretical and practical sustainability may be bridged by distinguishing three concepts which properly account for informational inadequacies and human preferences in the design of sustainability constraints. These are: the 'sustainable EUS' (Environmental Utilization Space), the 'measured EUS', and the 'chosen EUS'.

1.2.2 The allocation of environmental goods and services in the countryside

Since the launch of the Agri-Environmental Regulation in 1992, environmental contracting has become a key instrument in rural environmental policy across the EU. The increased importance of agri-environmental policy has, to date, not been reflected in innovative policy design. It remains the norm in European agri-environmental policy to offer a single, fixed payment for compliance with a predetermined set of management prescriptions (Latacz-Lohmann and Schilizzi, 2005b). Innovative policies based on auctions have been proposed to improve policy performance by increasing the cost-effectiveness of public spending for the provision of countryside benefits. Auctions have the potential to reveal, at least partly, bidders' compliance costs, thereby reducing the information asymmetry on on-site costs and local impacts between landholders and the conservation agency (Van der Hamsvoort and Latacz-Lohmann, 1996). Despite this potential, the diffusion of auctions into the practice of agri-environmental management has been slow, for one reason because conservation auctions are complex incentive mechanisms with limited field evidence, implying a higher risk of failure than a simple fixed-rate payment. In addition, the scarce empirical evidence about the performance of conservation auctions is inconclusive (Latacz-Lohmann and Schilizzi, 2005b). Latacz-Lohmann and Schilizzi (2005b) reviewed case studies of conservation auctions covering the USA, Australia, Continental Europe and the UK, which differ in policy goals and auction design. They report efficiency gains from auctions relative to fixed-price schemes ranging from a few per cent to seven hundred per cent, but which come at the cost of likely higher transaction costs. Although empirical evidence about transaction costs is patchy so far, complaints from unsuccessful applicants for the Scottish Challenge Funds about high bid preparation costs in connection with uncertain outcomes, resulted in the auctions being replaced by fixed-rate payment schemes (Latacz-Lohmann and Schilizzi, 2005b).

Auction theory is not well developed for conservation auctions and thus offers little guidance for most policy design purposes. Researchers are only beginning to explore practical auction design issues through the use of controlled economic experiments (e.g. Latacz-Lohmann and Schilizzi, 2005a) or simulation studies, including the study of Hailu and Schilizzi (2004) and the second case study of Latacz-Lohmann and Van der Hamsvoort (1997, 1998) in this book. We simulate the efficiency gains of auctions in allocating conservation contracts, aimed at reducing nitrogen emissions and commodity surpluses, for various hypothetical situations. In each situation the demand for environmental goods in the countryside is centralised in a single government club acting on behalf of its resident members. To procure these goods, the government announces contracts in which the environmental goods and services are specified in terms of management prescriptions related to the agricultural production process, imposing only one restriction: an upper limit of 80 kilograms of nitrogen per hectare. It is further assumed that the programme is offered to 100 model farms of equal size (100 hectares of small grain), but different profit-maximizing fertilization levels due to differences in soil quality and other natural circumstances, implying different costs of programme participation. Farms adopting the reduced-nitrogen practice are

single-member producer clubs producing a club good for the government. The club good being traded is a joint product consisting of reduced nitrogen emissions and commodity surpluses (grains). These outputs are likely to be private and excludable for participating farms, but public and nonexcludable for nonparticipating farms. Farmers who participate in the programme receive compensation from the government for profits forgone through implementation of the reduced-nitrogen practice. The difference between conservation payment and profits forgone equals farmers' net benefit from programme participation and club good production, which exclusively accrues to producer clubs participating in the programme. On the other hand, it is likely that the benefits from club good consumption are not exclusively shared by the members of the government club, but also by people living outside the club's jurisdiction, who ride free on the efforts of the membership.

The government can choose between different contract allocation mechanisms and payment schemes to procure the club good in the best interest of the membership. Allocation mechanisms, payments schemes and management prescriptions (restricted fertilization level) design the sharing arrangement for the producer clubs, different schemes implying different sharing arrangements. Farmers who sign up for a conservation contract agree with the rules for awarding contracts and its stipulations offered by government, for if they do not agree, they would refrain from signing up. We simulate club performance (in terms of number of participants, total provision of club outputs, and cost effectiveness) for different auction types and other payment schemes under various assumptions about the level of information available to the government. Five different situations are distinguished: (i) information on average profit forgone of programme participation; (ii) information on average profit forgone and farm-level information on fertilization levels; (iii) information on forgone profits sufficient to cluster all farms into three homogeneous groups based on natural circumstances; (iv) as in (iii) plus farm-level information on fertilization levels; and (v) perfect farm-level information on both forgone profits and fertilization levels. In each situation a flat-rate offer system (a flat-rate payment, fixed by the government at the presumed average forgone profits of all farmers, is offered and all farmers who sign up are accepted) serves as a reference against which the other payment schemes are compared. In terms of Pareto-efficiency, we therefore compare club efficiency for a few discrete payment schemes relative to a reference scheme, none of which necessarily is the 'optimal' scheme.

The simulation results show that in the absence of transaction costs and except for the extreme case of perfect information under all auction schemes more of the club good is provided with the same government budget. The reason for these efficiency gains are twofold. First, the windfalls (difference between payments and forgone profits) accruing to farmers who enroll land with lower-than-average opportunity costs are reduced, because bid prices lie below the flat-rate payment. Second, farmers with forgone profits above the level of the flat-rate payment are encouraged to tender cost-covering bids and can be accepted to the extent of the savings provided by the low-cost participants. Efficiency gains are higher the larger the information asymmetry between farmers and the government. The bidding process reveals the individual farmers' forgone profits of programme participation, the marginal value of this information being higher, translating into high gains of

club performance, the smaller the information initially available to the government. Efficiency gains turn out to be highest when club outputs are targeted directly by ranking all bids for acceptance based on the ratio of club outputs to public cost of enrolling the land, although fewer contracts are awarded.

In addition to emission and commodity surplus reduction, payment schemes also affect the distribution of the government's conservation budget among farmers, rendering equity a third output of the club good. Different payment schemes 'produce' different income distributions, the fairness of which is evaluated in terms of club benefits and costs and should therefore be included in a full-fledged efficiency analysis of alternative payments schemes.

The benefits of auctions come at the cost of likely higher transaction costs on the side of the conservation agency and the landholders. Although these arguments lack empirical proof so far, the fact that most conservation schemes in the EU operate a flat-rate payment mechanism may be an indication that auctions involve high transaction costs, which reduce their efficiency.

1.2.3 The allocation of land in the Netherlands

One of the most significant problems confronting the Netherlands at the start of the 21st century is the use and organization of the limited land available. The high level of economic growth in recent years and the increasing prosperity have resulted in a greatly heightened demand for land for home construction, infrastructure, business premises, and nature and landscape. On the other hand, the amount of land is limited and most of it (69 per cent) is reserved for agriculture. The growth in demand and the limited availability of land is being translated into developments in the real estate market.

In the Netherlands, however, the real estate market is not a free market. The government regulates the use of space by means of the *Wet op de Ruimtelijke Ordening* (WRO; 'Town and Country Planning Act') and thus restricts the allocation options for the available space. Moreover, the development potential of various agricultural and non-agricultural sectors is influenced to a greater or lesser extent by sector-specific policy, such as agricultural policy, nature and landscape policy, and environmental policy. All these developments affect the supply of and demand for land in the Netherlands, which has important consequences for the developmental possibilities of different economic sectors.

In the third case study (Luijt and Van der Hamsvoort, 2002) we analyze the allocation of space in the Netherlands, in particular the effect of the 'Town and Country Planning Act', government policies in respect of agriculture, nature, landscape and the environment, and developments in agricultural and non-agricultural sectors on the allocation and price of agricultural land. The empirical relevance of this analysis is to be found in the crucial role played by the agricultural land market in the achievement of policy objectives for the environment, nature and landscape, and the developmental possibilities of agricultural enterprises. Moreover, a number of recent developments suggest the existence of conflicting policy in this area.

Two different allocation problems are distinguished, one with and one without the 'Town and Country Planning Act'. Via this Act, which is considered exogenous to the analysis in the specified time period, the government regulates the allocation

of land in the Netherlands. The Act lays down what allocation is or is not permitted at given locations, resulting in five segmented real estate markets and, hence, allocation problems: (i) business premises; (ii) housing; (iii) infrastructure; (iv) agriculture and horticulture; and (v) woodlands and nature areas. Within the separate real-estate market segments there are sub-segments, each with its own club good (land) and club good price, being the result of the interaction between the segmented demand for land and the artificially limited supply. Within the agricultural segment, for example, not all forms of agriculture and horticulture are permitted at every location. Combined with the immobility of agricultural entrepreneurs (producer clubs), this leads to regional sub-markets with permanent regional differences in agricultural land prices.

For various reasons, including the 'Town and Country Planning Act', in 1996 69 per cent of the Dutch terrestrial territory was allocated for agriculture, 14 per cent for 'green' activities such as woodlands and nature reserves areas and 16 per cent for 'red' activities such as business premises, housing, traffic and recreation. Land prices were highest in the business segment, followed by housing and agriculture/horticulture. Now imagine that the 'Town and Country Planning Act' disappears and that the allocation of land is left to free market processes. Real estate market segments will disappear and the allocation problem simplifies to one with a single club good and a unified club good price throughout the Netherlands. Under free market processes, the 'red' surface area will increase considerably at the expense of the agricultural acreage and the price of land will be higher than the price in the agricultural segment, but quite a bit lower than the prices in the business and housing segments under the 'Town and Country Planning Act'.

Note that the 'Town and Country Planning Act' itself is exogenous to the analysis in the specified time period indeed, yet the result of the Act in terms of the size of the real estate markets segments is not. Segment sizes are outputs of the government club as are government policies that affect the allocation of land within segments, including price support policies, production restrictions, manure legislation and restrictions on the intensity of land use. The government 'produces' real estate markets segments and policies that reallocate land in the best interest of its membership and therefore turn a presumed Pareto-inferior allocation into a Pareto-optimal allocation of land. The manure legislation from 1987 serves as an example. In reaction to the damage to the environment, nature and landscape caused by agriculture, the soil protection legislation and the manure legislation came into force in 1987 (Baarda, 1999). The manure legislation restricts the spreading of manure on agricultural land and sets requirements for its storage and the manner in which it is spread. Agricultural land and storage capacity therefore are complementary to the manure legislation, leading to an increase in the demand for these club goods, on balance resulting in an increase in the price of land and, hence, a reallocation of land within the agriculture and horticulture segment.

With a very strict application of the 'Town and Country Planning Act', the agricultural land price would primarily be the result of the expected future land yields (including the effect of government policies) in agriculture. Under such circumstances, the price of agricultural land is equal to the capitalised future net yield from an extra hectare of land in agriculture. However if the 'Town and Country Planning Act' is unsteady, in the sense that the distribution of land use among the real estate market segments is uncertain in the specified time period,

developments in other (sub-)segments will affect the agricultural segment. The agricultural land price then equals a weighted average of the expected marginal value of land in agriculture and in other (sub-)segments of the real estate market. Within agriculture, for instance, the price of land will be influenced by the expected chance of future expansion of forms of cultivation with higher added value per hectare, such as glasshouse horticulture and arboriculture. Outside agriculture, the expansion of the Ecological Main Structure and the ongoing urbanization put major claims on agricultural land. Polman et al. (1999) estimated the relative importance of the income from land in agriculture, the pressure from the horticultural sector, and the non-agricultural pressure from housing, work, and nature development on the price of agricultural land. The results show that, in the medium term, the effect of the joint non-agricultural claims on the price of agricultural land is roughly as great as the profitability of land in agriculture, approximately 47 per cent. The remainder, some 6 per cent, was accounted for by land-intensive horticulture.

1.2.4 The allocation of trade distortions

Under the auspices of the secretariat of the World Trade Organization (WTO) 149 Contracting Parties discuss and negotiate on the rules for international trade. The most recent round of talks was launched during the WTO summit in Qatar in November 2001 and resulted in drawing up the Doha-development agenda. Present WTO negotiations have the aim to improve access to international markets for developing countries. However, whether the Doha Round leads to effective increase of market access remains to be seen, given the binding overhang of tariffs and the option to exempt special or sensitive products from tariff reduction commitments (Van Berkum en Roza, 2005).

The Doha Round follows the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) negotiations, which started in Punta del Este, Uruguay, in 1986 and closed in 1994 when the final agreement was signed and ratified. For the first time trade in agricultural products was subject of the negotiations, aimed at reducing trade distortions caused by agricultural policies.

An analysis of the effects of the Uruguay Round Agreement on Agriculture (URAA) on agricultural trade and EU market shares shows that during the period 1993-2003 the EU's overall market share of total world trade in agricultural products remained 19%, although its share in the trade of grains (wheat), sugar, dairy and meat declined (Van Berkum en Roza, 2005). The analysis also shows that the reasons for declining market shares might be found in WTO support commitments and autonomous demand developments. For sugar, URAA measures seem more important than autonomous demand developments, while the reverse seems to apply for dairy and poultry meat.

During the GATT negotiations on agricultural trade interest in support measurement was also heightened. At the start of the negotiations in 1986, the Contracting Parties expressed their intention to develop an Aggregate Measure of Support (AMS) which could bring the wide range of existing agricultural support policies under one roof. The concept should be used not only for monitoring purposes, but also for making binding commitments. Ideally, such commitments could even replace the existing GATT concessions and regulations. In view of this,

the AMS was regarded as the central plank on which a new agreement could be based.

This was not realized. In the final GATT agreement, the AMS only appeared as one of a number of elements, not the key element. Questions about why and how that result was achieved have not been fully addressed in the literature. The final case study of Silvis and Van der Hamsvoort (1996) in this book aims to fill the gap by offering a review of conceptual and political issues. It analyzes the relative efficiency of various sharing arrangements, including different AMS concepts, for sharing the costs of reducing trade distortions from agricultural support policies among the Contracting Parties of the GATT during the Uruguay Round. The GATT is a supranational club with sovereign communities as members, who are themselves clubs with memberships. The Contracting Parties agreed to reduce trade distortions on three separate areas: internal support, market access and export support, being the nonexcludable collective outputs of the club's joint product 'reduced trade distortions'. The costs of 'producing' the joint product are shared by the sovereign members according to a set of cost-sharing rules, different rules leading to different burden sharing. At the start of the negotiations in 1986, the Contracting Parties expressed their intention to develop an AMS which should serve as the basis for making binding commitments. However, for conceptual, as well as political, reasons the role of the AMS in the final GATT accord reached in December 1993 did not correspond with the leading role alluded to by the Contracting Parties at the start of the negotiations.

Already, in April 1989, the pure aggregated approach to the negotiations was rejected. From then on, the AMS only served as the basis for cost sharing in the internal support area, while specific binding agreements were negotiated in the areas of market access and export support. Compared to the broad policy coverage of the Producer Subsidy Equivalent (PSE), many government measures were taken out of the AMS and freed from reduction requirements (the 'green' policies versus the 'amber' policies). Agreement was reached upon a general reduction of the AMS for all products together, creating great flexibility in reaching the commitment, but at the same time undermining its effectiveness. Further, the deficiency payments in the US farm policies and the conditional payments that had been introduced in the EC as part of the MacSharry Reform, were excluded from the reduction requirements. Thus, a role was assigned to the AMS, but only in the form of a slimmed-down version of the Total PSE for all products, and not covering the more crucial areas of agricultural imports and exports. The debate on the AMS between the Contracting Parties in the specified time period therefore shows that cost-sharing rules based on a pure AMS concept are Pareto-inferior to cost-sharing rules in which the concept plays a more modest role.

1.3   Reader's compass

In the remainder of the book, we shall address these allocation problems in more detail. The chapters appeared previously in different outlets and are reprinted by permission of the co-authors and publishers. Chapter 2 addresses the debate between economists and ecologists holding different visions of economic growth and the carrying capacity of the Earth, and the observed discrepancy between theoretical and practical sustainability, and analyzes their implications for the

sustainability debate. Chapter 3 and 4 look at the possibility of creating a market for environmental goods and services in the countryside by awarding conservation contracts to farmers on the basis of competitive bidding. Chapter 3 employs auction theory to analyze the potential efficiency gains of auctions in allocating conservation contracts. Chapter 4 analyses the potential benefits and possible drawbacks of auctions as a quasi-market mechanism for public goods from agriculture. Chapter 5 analyzes the effect of agricultural, nature, landscape, and environmental policies and developments in agricultural and non-agricultural sectors on the price and allocation of agricultural land in the Netherlands. Chapter 6 reviews the conceptual and political debate between the Contracting Parties on the role of the AMS in the agricultural trade negotiations of the Uruguay Round. The book concludes with a summary of the main results, including some policy recommendations, and some reflections on the allocation literature and suggestions for research directions.

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2. Sustainability: a review of the debate and an extension

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Summary

This paper argues that the current debate on sustainability is obscured by a number of misunderstandings. These relate, first, to the ongoing dispute between ecologists and economists holding different visions about the limits of economic growth and the carrying capacity of the Earth; and second, to the discrepancy between theoretical sustainability and practical sustainability. The paper concludes that the current vagueness surrounding sustainability may be reduced by reframing the debate. It demonstrates that the dispute between ecologists and economists can largely be considered as unproductive because the only sustainability concept supported by theory is that of 'strong sustainability'. The paper argues further that the gap between theoretical and practical sustainability may be bridged by distinguishing three concepts which properly account for informational inadequacies and human preferences in the design of sustainability constraints. These are: the 'sustainable EUS' (Environmental Utilization Space), the 'measured EUS', and the 'chosen EUS'.

Key words: sustainable development, natural capital, technological pessimism, technological optimism, ecological economics, environmental utilisation space

2.1 The fallacy of the current debate

'Sustainability' has risen high on the political agenda in recent years, yet no agreement has been reached as to what sustainability exactly means. Judging from the wide range of definitions (Pezzey, 1989, collected some 190 different definitions), the answer to this question seems far from unambiguous. Probably the most widely quoted definition of sustainability is that given by the World Commission on Environment and Development in the so-called Brundtland report: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

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(WCED, 1987). This definition illustrates two key concerns also present in many other definitions, i.e. (Heal, 1996):

(1) recognition of the long-run impact of resource and environmental constraints on patterns of development and consumption;

(2) concern for the well-being of future generations, particularly in so far as this is affected by their access to natural resources and environmental goods.

While most people will readily agree with these concerns and the content implicitly referred to, a precise description of the goals to be achieved reveals the vast contradictions that linger below the surface of the concept (Latesteijn *et al*., 1994). We argue that these contradictions have emerged because of two issues that obscure the sustainability debate. The first concerns the still ongoing debate between economists and ecologists holding different visions about the limits of economic growth and the carrying capacity of the Earth, which is intertwined with, and logically steers, the discussion about sustainability. The second issue relates to the observed discrepancy between theoretical sustainability and practical sustainability. That is to say, it may not be possible, due to information deficiencies or acceptability constraints, to operationalise a situation that is considered sustainable from a theoretical, scientific point of view. It may therefore happen that a resource economist and a politician, who both attempt to address sustainability, talk at cross-purposes because the former implicitly refers to 'theoretical' sustainability, while the latter's benchmark concerns 'practical' sustainability. Both issues trouble the sustainability debate because people think they are addressing the same issue, when in fact they are not.

In the remainder of the paper, we shall address both of these issues and analyse their implications for the sustainability debate. The following section reviews the current knowledge of the interrelationships between the ecological, social, and economic systems. Based on this system approach, the third section examines three different interpretations of sustainability as seen from the position of 'technological pessimism', 'technological optimism', and the 'ecological economics'. Subsequently, the fourth section analyses the discrepancy between theoretical sustainability and practical sustainability. Finally, the fifth section draws conclusions as to how the debate might be reframed. The paper is largely written as a review paper, drawing on the large body of literature that both social and natural scientists have produced on this issue.

2.2   Stocks, flows and their interrelationships: as systems view

In recent years, the adoption of the systems perspective in the field of ecological economics has proven fruitful in clarifying human-nature interrelationships. Ecological economists adopt the, by now, generally accepted view that the economy, in its physical dimensions, is an open subsystem of a finite, nongrowing, and materially closed ecosystem (Daly, 1994), as illustrated in Figure 2.1. The Figure distinguishes three hierarchically ordered systems: the ecological system (i.e., the biosphere or Earth), the social system and the economic system.

Each system can be characterised by three concepts: stocks, flows, and the organisation of these stocks and flows (Barbier et al, 1994). In Figure 2.1 stocks are called 'capital stocks'. Capital is defined here as "a stock that yields a flow of useful goods and services into the future" (Daly, 1994:30). The capital stock of the ecological system (or biosphere) is Total Natural Capital, and the flow it yields is 'natural income'.

Total Natural Capital is sub-divided into Renewable Natural Capital and Nonrenewable Natural Capital, the former being active and self-maintaining, using a flow of energy from the sun, while the latter is more passive and analogous to inventories. It neither maintains itself nor does it grow, instead it is subject to liquidation by use.

Both types of capital provide a flow of natural goods, such as oil, ore, fish, wood, or drinking water. Besides goods, the flow of natural income from Renewable Natural Capital also includes ecosystem services, such as the maintenance of the gaseous quality of the atmosphere and climate, operation of the hydrological cycle including flood control and drinking-water supply, waste assimilation, recycling of nutrients and generation of soils (Folke, 1991). Both the maintenance of the renewable capital stock and the production of ecosystem goods and services are generated by the continuous interactions between organisms, populations, communities, and their physical and chemical environment, the functional term of which is 'life-support environment' (Barbier et al., 1994; Odum, 1989). De Groot (1992, 1994a, 1994b) distinguishes 37 life-support functions classified into four main categories, i.e. regulation functions, carrier functions, production functions, and information functions. Among these, the regulation functions are of particular relevance to the sustainability debate. 'Regulation' relates to the capacity of natural and semi-natural ecosystems to regulate essential ecological processes and life-support systems. Their maintenance is essential for the proper functioning of all natural systems and indispensable to human life.

The self-organising ability of the biosphere may be best demonstrated by Holling's (1986) description of ecosystem behaviour as a sequence of four system functions, namely exploitation, conservation, release and reorganisation. Exploitation refers to those ecosystem processes that are responsible for rapid colonisation of disturbed ecosystems during which the species capture easily accessible resources. Conservation occurs when slow resource accumulation takes place that builds and stores increasingly complex structures. Connectedness and stability in the ecosystem increase during the slow sequence from exploitation to conservation, and a 'capital' of nutrients and biomass is gradually accumulated. As soon as the conservation phase has built structures that have become 'over-connected', release or creative destruction take place. The stored capital is then suddenly released and the tight organisation is lost. The abrupt destruction is created internally but triggered by an external disturbance such as fire, disease or human over-exploitation. This process of destruction creates the ground for the fourth stage, reorganisation, where released materials are mobilised to become available for the next exploitive phase (Barbier et al., 1994). We shall return to this model later.

Figure 2.1 also shows the capital stocks of the social and economic systems, referred to as Cultural Capital and Manufactured Capital, respectively. The latter
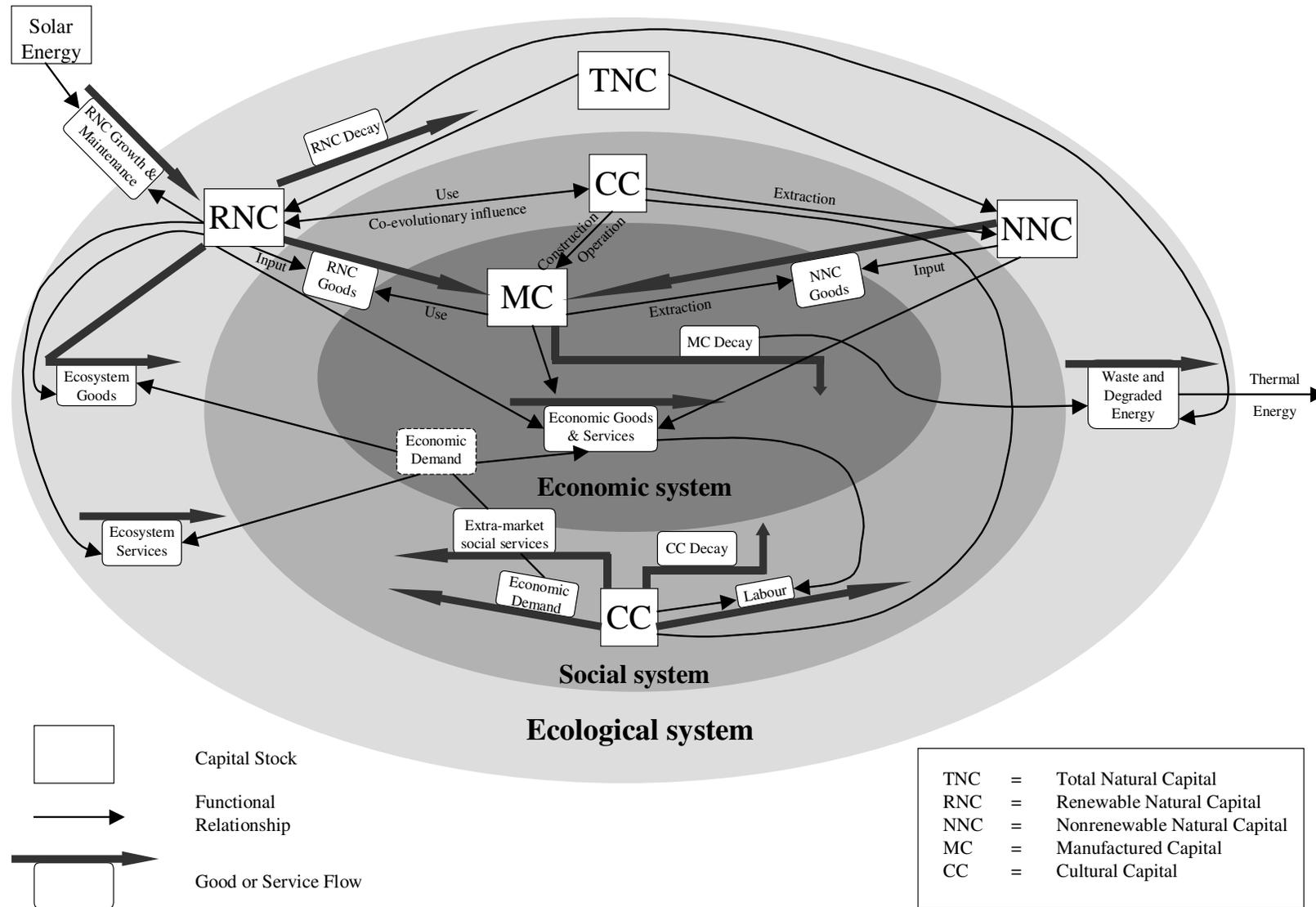
Figure 2.1   Relationships and goods and services flows between the ecological system, social system and economic system. Modified from Andersson et al. (1995), Costanza and Daly (1992), Tacconi and Bennett (1995) and Van der Hamsvoort and Luijt (1995).

stock can be defined as "the factories, buildings, tools, and other physical artifacts usually associated with the term 'capital'" (Costanza and Daly, 1992:38). Cultural Capital refers to factors that influence the behaviour of human beings and comprises, among other things, education, skills, institutional structure and organisations, philosophy, values, ethics, religion, and people's views of the natural world and the universe, including the three distinct views discussed earlier (Berkes and Folke, 1992, 1994). The flow of goods and services generated by these two categories of capital comprises marketable goods and services (from Manufactured Capital), labour services, social and juridical protection, and extra-market social services, such as charity and volunteer work (from Cultural Capital).

Several functional relationships and flows of goods and services occur across the system boundaries. Manufactured Capital, Renewable Natural Capital, and Nonrenewable Natural Capital interact with Cultural Capital and one of its specific flows, i.e. economic demand, to determine the level and structure of 'economic' (marketed) goods and services production. Economic demand, in turn, is determined by individuals' preferences which are steered and influenced by the Cultural Capital stock.

Figure 2.1 also shows that the functional relationship between Cultural Capital and Manufactured Capital on the one hand and Renewable Natural Capital on the other is characterised by *use*, while the relationship between the first two categories and Nonrenewable Natural Capital is featured by *extraction*. Harvesting of Renewable Natural Capital without exceeding regenerative capacity ensures a continuous flow of material and energy without reducing the capital stock. Any extraction of Nonrenewable Natural Capital, however, implies an equal reduction in the available stock.

Humans require a flow of Natural Capital goods to produce manufactured goods, while on the other hand, an increase in the stock of Manufactured Capital and improvements in its technological efficiency may ensure increased availability of flows from the Natural Capital stock. For instance, better machines may enable the extraction of oil sources deep in the Earth's crust that were otherwise not available.

Another important relationship between the three systems concerns the flow of waste products. As Figure 2.1 shows, the biosphere is the ultimate repository of waste products from the economic and social system and from the biosphere itself. The basic difference between the biosphere and economic/social systems is that the former tends to recycle its waste automatically through mineralisation, while waste from the economic system tends to accumulate in the biosphere (Pearce and Turner, 1990).

Probably the most fundamental functional relationship in Figure 2.1 concerns the role of Cultural Capital as the interface between Natural Capital and Manufactured Capital (Berkes and Folke, 1994). Our world view, values, knowledge, and institutions shape the way in which we use and exploit the biosphere. At the same time, Manufactured Capital is generated by an interaction between Natural Capital and Cultural Capital. Manufactured Capital, in turn, may cause an alteration of Cultural Capital. For instance, technologies which mask society's dependence on Natural Capital may lead people to think that they are above nature (technological optimism). Positive feedbacks between Cultural and Manufactured Capital are established which may enhance this belief. In these ways, Cultural Capital plays a crucial role in how we use Natural Capital to accommodate

our needs. This 'use' is never value-neutral, but is a product of evolving cultural values and norms. The interactions between humans and the biosphere in this respect can be viewed as a co-evolutionary interrelationship, i.e. a relationship in which the two sides affect one another continuously by mutual feedback.

The whole set of material and energy flows moving through the various systems and subsystems is governed by two essential biophysical laws, known as the first and the second law of thermodynamics (Ehrlich et al., 1980). The first law, also known as the law of conservation of matter/energy, was given prominence by Boulding's widely celebrated essay 'The Economics of the Coming Spaceship Earth' (Boulding, 1980). It states that energy and matter can neither be created nor destroyed, it can only be converted and dissipated. If energy in one form or one place disappears, the same amount must show up in another form or another place. However, different kinds of stored work (energy) are not equally convertible into useful applied work (Ehrlich et al., 1980). It is here where the second law of thermodynamics, better known as the 'entropy law' enters the picture. While Boulding drew attention to this law, it was Nicholas Georgescu-Roegen (1980a), who was the most forceful advocate of the law's relevance to economics. The second law of thermodynamics states that the throughput of material/energy from valuable natural resources to valueless waste equals a degradation from a state of low entropy to a state of high entropy.

The entropy law logically implies that man's biological existence depends on the amount of free energy to which man can have access. This free energy comes from two distinct sources: the flow of solar radiation intercepted by the Earth and stored in the Renewable Natural Capital stock; and the stock of free energy of the Earth's mineral deposits, i.e. the Nonrenewable Natural Capital stock. Georgescu-Roegen (1980b), however, estimated that these reserves contain energy comparable to only two weeks of sunlight on the globe. The fundamental lesson to be drawn from both laws of thermodynamics is very simply that the Earth is finite unless some revolutionary development in physics opens the way to circumvention of both laws.

If we accept our dependence on an (ultimately) finite stock of Natural Capital, and the assumption that Natural Capital and Manufactured Capital are complements rather than substitutes, then the one in shortest supply will be the limiting factor. Economic logic requires that we maximise the productivity of the limiting factor in the short run, and invest in increasing its supply in the long run (Daly, 1994). As far as Natural Capital is concerned, investing means 'waiting' or refraining from current consumption (Daly, 1994) and therefore determines our Environmental Utilization Space. However, whether investment in Natural Capital will take place, and how and to which extent, depends on what human society considers a sustainable stock and a sustainable use of Natural Capital, and how the sustainability concept is operationalised.

2.3   The sustainability debate among scientists

Are there limits to economic growth and the carrying capacity of the Earth? Although our current environmental problems suggest there are, no set of issues seems to be more controversially debated between economists and ecologists, as well as among economists. In essence, the dispute emerges from their different visions of the future. Generally, three positions may be distinguished. The first one,

called the 'conventional' economic optimistic view (Folke et al., 1994) or 'technological optimism' (Costanza, 1989), is based on the neo-classical economics assumption/belief that technology is able to solve all our problems so that economic and population growth can continue forever (Costanza, 1995). The opposing line of thought, called the 'environmental pessimist vision' (Folke et al., 1994) or 'technological pessimism' (Costanza, 1989), assumes that technology will not be able to circumvent fundamental energy and resource constraints and that over-expansion of the human economy will cause collapse of the ecological life-support system and ultimately collapse of the economy which depends on it. This debate, which started with Barnett and Morse's (1963) 'Scarcity and Growth' and which was boosted by Meadows et al.'s (1972) 'Limits to Growth', has been going on for several decades and is not yet at an end (see, for example, Myers and Simon, 1994). The ongoing debate is partly driven by the fact that measures of the future potential of technological progress are difficult to identify because of the counter-intuitive relationship existing between expectations about technology and its likely emergence (Victor, 1991). For instance, if owners of a natural resource are technological optimists, they will act in the belief that new technologies will be developed to substitute for their declining resource and therefore higher future prices for that resource will not materialise. As a result, profit-seeking resource owners will tend to exploit their reserves at a more rapid rate than without this belief. However, a high rate of resource exploitation today puts downward pressure on current resource prices which may undermine the very incentive for the development on new technologies on which technological optimists are relying. The reverse situation may occur if resource owners are technological pessimists (Victor, 1991).

Given the veil of ignorance about future limits to economic growth, the prudent course in this respect is to assume that they (the limits) exist, unless we can prove otherwise. Or, as Costanza (1989:5) verbalises it, "One does not run blindly through a dark landscape that *may* contain crevasses. One assumes they are there and goes gingerly and with eyes wide open, at least until one can see a little better". The vision that corresponds to this 'prudent course' and which represents a middle ground between the other two 'extreme' visions is called the 'ecological economics vision' (Folke et al., 1994). It emphasises that the physical dimensions of the economy should not exceed the ecological carrying capacity, yet encourages development and acknowledges uncertainty.

The essential differences between the three visions can be illustrated most vividly by a metaphor that originally draws upon Gowdy and McDaniel (1995), who used it to demonstrate the possible irreversible consequences of biodiversity loss. Consider a deck of 52 playing cards as representing the Earth's current resources, and let the human uses of, and the services provided by, those resources be represented by all of the card games that could be made up. We, *Homo sapiens*, have randomly been destroying cards at an increasing rate, but essentially no new cards have been made. As we play our card games, i.e. use our resources and benefit from their services, with fewer and fewer cards remaining, the games will become harder and more unpredictable to play (because we do not know which cards are missing). Eventually, it will be impossible to play some games because important cards, or too many cards, are missing. In the beginning, a few missing

cards are not noticed. Each additional loss, however, leads to an exponentially greater impoverishment of the possibilities.

Technological optimists would not consider this a problem as they assume that the human species will always be able to invent a technology that enables us to play all the games even if eventually all cards will be lost. Technological pessimists, on the other hand, have not so much faith in human technology and assume that the cards that are ultimately left are not sufficient to play any game at all. Finally, given the existing uncertainty (about the importance of one card over another and the number of cards needed), ecological economists try to determine the number of cards that should at least be left to make a reasonable number of games still possible and thus how many cards are allowed to be tossed out.

Three different interpretations of sustainability result from these three visions. As technological pessimism is a vision that is frequently adhered to by ecologists, their interpretation of sustainability will be called hereafter 'ecological sustainability'. The notions of sustainability attributed to technological optimism and the ecological economics vision, are known in the literature as 'weak sustainability' and 'strong sustainability', respectively.

Ecological sustainability, as the term indicates, refers to abundance and genotypic diversity of individual species in ecosystems subject to human exploitation or, more generally, intervention (Gatto, 1995). Weak sustainability and strong sustainability, on the other hand, both have their roots in economics, which incorporates the concept of sustainability into the standard definition of income as "the maximum amount that a community can consume over some time period and still be as well off at the end of the period as at the beginning" (Hicks, 1946 in Daly, 1994:23). Therefore, in Hicksian terms, Brundtland may be saying no more than that we, the present generation, should consume within our income (Heal, 1996). The Hicksian, or economic, definition of sustainability, which aims at having the same capacity to produce the same income (or to meet the same needs) each year, requires that the capital stock be maintained intact. However, there are two ways to maintain total capital intact, and they relate to the difference between weak and strong sustainability. Weak sustainability refers to the maintaining intact of the sum of Natural Capital, Manufactured Capital and Cultural Capital on aggregate. Strong sustainability relates to the maintenance of each of the three capital stocks separately (Costanza and Daly, 1992; Daly, 1994).

2.3.1 The fallacy behind the ecological sustainability concept and the weak sustainability concepts

A moment of reflection should lead to the insight that the notions of both ecological sustainability and weak sustainability are inconsistent, and that the concept of strong sustainability should be preferred.

Ecological sustainability, taking the viewpoint of sustaining the abundance of animal and plant populations, appears to contradict Holling's (1986) description of ecosystem behaviour as the dynamic interaction between four system functions, exploitation, conservation, release and reorganization. Holling's model provides evidence that the natural process consists of a sequence of species extinctions and recolonisations. Species diversity is therefore dynamic both in time and space, but never static.

Weak sustainability is reasonable if one believes that Manufactured Capital and Natural Capital are perfect substitutes, as does neoclassical economic theory. Technological optimists, holding this belief, are therefore preaching that technology can do away with all natural resource scarcity, thus implying that man is capable of defeating the entropy law, which is, as Ehrlich and Ehrlich state, roughly equivalent to saying "Fear not, we'll run the world with perpetual-motion machines" (Ehrlich and Ehrlich, 1980:40).

Examples where Natural Capital and Man-Made Capital appear to be near substitutes fuel this belief in technology. Consider, for instance, the idea of machines and chemical reactions that produce no waste or that ensure a perpetual recycling of waste, or breeder reactors that are said to produce more energy than they consume. Unfortunately, the illusion inherent to those 'innovations' is fed by scientists and politicians claiming that 'we have achieved great steps in solving our environmental problems'.

The fallacy of this argument is easily demonstrated. First, each substitution of Manufactured Capital for Natural Capital requires an increase in entropy. For instance, recycling requires an additional amount of low-entropy material much greater than the decrease in the entropy of what is recycled. Moreover, a breeder reactor, by transforming nonfissionable into fissionable material, transforms bound and inaccessible energy into free and accessible energy (zero-energy balance), while the transformation itself requires additional low entropy. A breeder reactor therefore consumes more useful energy than it produces, which makes it "in no way different from a plant which produces hammers with the aid of hammers" (Georgescu-Roegen, 1980b:62). The entropy law demonstrates that the basic relation of Manufactured Capital and Natural Capital is one of complementarity, not substitutability. Of course, one could substitute bricks for timber, but that is the substitution of one resource input for another (Daly, 1994).

Second, if Manufactured Capital were a near perfect substitute for Natural Capital, then Natural Capital would be a near perfect substitute for Manufactured Capital, which it is not. Moreover, Manufactured Capital is itself a physical transformation of a stream of goods from Natural Capital. Therefore, producing more Manufactured Capital physically requires more of the very thing being supposedly being substituted for (Daly, 1994).

These same arguments can be used to support the notion of strong sustainability as the ultimate relevant concept. Perhaps the strongest one is the entropy law which demonstrates that the relationship between Manufactured Capital and Natural Capital is one of complementarity, not substitutability. It may therefore be concluded that the ecological economics vision with its notion of strong sustainability emerges not only as the most prudent course in our world of ignorance but also as the most firmly supported concept given the information available so far.

2.4 Theoretical versus practical sustainability

Although strong sustainability appears to have firm support from a theoretical point of view, it suffers from a number of practical drawbacks. To see this, consider the requirements to make the concept operational, as defined by Costanza and Daly (1992):

(1) The human scale (i.e. the product of population level and average standard of living) should be limited to a level which is within the carrying capacity of the remaining Natural Capital stock.

(2) Technological progress should be efficiency-increasing rather than throughput-increasing. When technology is constant, keeping capital intact is the same as keeping physical capital intact. When technology increases the productivity of capital (natural or manufactured), then it is less clear what 'keeping capital intact' means. It may mean maintaining a smaller capital stock sufficient to produce the income stream before the productivity increase, or it may mean keeping the physical capital intact and enjoy a higher income. According to Daly (1994), we should avoid the error of consuming the benefits of increased productivity of Manufactured Capital by running down Natural Capital stocks. We argue that, given the complementarity of both capital stocks and the Earth's finiteness, a more prudent course would be to maintain the income level as before the productivity increase and to use the productivity increase to enhance the stock of Natural Capital and/or reduce the stock of Manufactured Capital, depending on the capital stock to which the productivity increase accrues.

(3) Renewable Natural Capital should be used such that:
   • harvest rates do not exceed regeneration rates;
   • waste emissions do not exceed the natural assimilative capacities of ecosystems;

(4) Extraction of Nonrenewable Natural Capital should not exceed the rate of creation of renewable substitutes. Strictly speaking, the Nonrenewable Natural Capital stock cannot be maintained intact short of nonuse. Daly (1990) therefore calls the stated extraction rule quasi-sustainable instead of sustainable. The rule requires that any investment in the extraction of a nonrenewable natural resource must be paired with a compensating investment in a renewable substitute (e.g. oil extraction paired with tree planting for wood alcohol). The idea is to divide the net receipts from the nonrenewable into an income component that can be consumed currently each year, and a capital component that must be invested in the renewable substitute. The division is made in such a way that the renewable will be yielding, by the end of the life of the nonrenewable, an annual sustainable yield equal to the income component of the nonrenewable receipts (Daly, 1990).

While the first requirement (human scale) is hard to accomplish due to current institutional structures, poverty, etc. (see, for instance, Opschoor, 1994; Opschoor et al., 1994; WWF, 1993), more important problems arise from the last two requirements.

2.4.1 Uncertainty and lack of knowledge

First, the search for correct threshold values for the use of the Renewable Natural Capital stock is hampered by substantial uncertainties and lack of knowledge. For example, in defining sustainable fish catches, one meets uncertainties about the impacts of fishery on the size and structure of fish populations. Similarly, in the case of global emissions of carbon dioxide, uncertainty and lack of knowledge about complex feedback mechanisms that are relevant to atmospheric warming, and about the role of sinks in relation to the atmospheric concentration of carbon dioxide, make the establishment of correct threshold values rather complex (Weterings and Opschoor, 1994). Therefore, what seems to be sustainable now based on information currently available, may prove to be unsustainable whenever new insights and knowledge become available.

2.4.2 Time preferences and willingness-to-pay

Second, even if humanity were able to determine appropriate sustainability constraints, the question arises whether human society is prepared to pay the price of transition to sustainability? (Caldwell, 1994). For instance, given the substitution possibilities between renewable and nonrenewable resources that are currently available, strong sustainability requires zero or at most negligible extraction of Nonrenewable Natural Capital in order not to reduce the entropic dowry. This is impossible unless mankind reverts to what Georgescu-Roegen (1980b:67) calls a berry-picking economy. However, it is far from realistic to assume that man will return to the trees for the sake of future generations. We argue that Georgescu-Roegen is much closer to reality when he states that "there is neither cynicism nor pessimism in believing that, even if made aware of the entropic problem of the human species, mankind would not be willing to give up its present luxuries in order to ease the life of those humans who will live ten thousand or even one thousand years from now" (Georgescu-Roegen, 1980a:58).

2.4.3 The 'ecosystem behaviour' of the human subsystem

Is not Georgescu-Roegen's statement in contradiction with the self-organising ability of systems according to which they automatically adapt to the changing circumstances in the natural environment? We believe it is not and may demonstrate this by applying Holling's (1986) model of ecosystem behaviour to that of the human subsystem. Human subsystems are continually running through Holling's sequential phases from exploitation, and conservation, to release, and reorganization. Conservation occurs when accumulation of Cultural and Manufactured Capital takes place that builds and stores increasingly complex structures. Connectedness and stability within the human subsystems increase during the slow sequence from exploitation to conservation, and a 'capital' of values, norms, institutions, organizations, and human artifacts is slowly accumulated. When the conservation phase has built structures that become over-connected, release or creative destruction take place. The stored capital is then suddenly released and the tight organisation is lost. The abrupt destruction may be caused by an external disturbance such as a disease (AIDS), the gap in the ozone

layer, or an earthquake. This process of destruction provides the ground for the fourth stage, reorganization. All parts of the human subsystems continuously run through this process. However, the time and space scale of this process depend on how critical the external disturbance is. For instance, when AIDS disturbed the social system and affected humanity acutely, the Cultural Capital stock, and consequently human behaviour, changed rapidly to bring the disease under control, thus preventing large-scale destruction.

However, many of the consequences of human actions that do not involve strong sustainability have a delayed effect on the environment and are not immediately felt by the current generation. It may take decades, for example, before nitrogen from manure and chemical fertilisers is washed from the topsoil into deeper layers, causing severe nitrate pollution of the groundwater (Dietz and van der Straaten, 1994). Similarly, the current population of humans enjoys the benefits of the depletion of nonrenewable resources, while the costs are shifted on to future generations. In other words, the phases of destruction and, consequently, reorganization are often delayed, which may lead the current generation to take fewer precautions.

2.5   Suggestions to reframe the debate

A number of conclusions can be drawn. First, the analysis supports the notion of strong sustainability. This suggests that the controversy between economists and ecologists can be largely considered as unproductive because their notions of sustainability are not sufficiently underpinned by theory. Assuming that we are correct, the logical question can be raised: why then is the debate not yet at an end? Costanza (1995) argues that the ongoing debate can be attributed to the general lack of interest among the majority of economists in problems of the environment, and a parallel lack of interest among the majority of ecologists in economic issues, combined with a lack of dialogue between the two groups.

The analysis also shows that the theoretical concept of strong sustainability is hard to put in practice because the setting of correct sustainability constraints is hampered by substantial uncertainties and lack of knowledge, and because it appears unlikely that the human society will be prepared to pay the bill for reverting to a path of sustainable development. It is important that these discrepancies between theory and practice are clearly recognised in order to avoid misunderstandings between scientists and policy makers trying to implement policies for sustainability. In response to these problems, advocates of strong sustainability now generally acknowledge that only some parts of the Natural Capital stock are critical, i.e. those in which replacement is impossible or unlikely. Practical application of strong sustainability then requires that these critical components of Natural Capital be identified and protected. Pearce and Atkinson (1995) suggest three criteria for identifying 'critical' Natural Capital, i.e. irreversibility, uncertainty, and loss aversion, but acknowledge the practical difficulties in identifying that part of the Natural Capital stock that provides critical functions. Although this may be considered a first step towards operationalisation of strong sustainability it is not sufficient to solve all of the observed problems.

We argue that some of the 'misunderstandings' could be avoided and the consensus-building process on the notion of sustainability could be boosted by

reframing the debate by the distinction of three concepts, originally developed by Musters et al. (1994): the sustainable Environmental Utilisation Space (EUS), the measured EUS, and the chosen EUS. The 'sustainable EUS' refers to a theoretical EUS defined by sustainability constraints set in an environment of perfect information, i.e. strong sustainability with full information. However, because the real world is one of uncertainty and lack of information, the 'sustainable EUS' can never be defined, not even by scientific research. Instead, the EUS as currently defined by scientific research, although often said to indicate the 'sustainable EUS', in fact is the 'measured EUS'. That is, it indicates the possibilities of the environment, known at a given moment and measured by means of a well-defined method (Musters et al., 1994). Finally, the 'chosen EUS' concerns that part of the 'measured EUS' that will actually be used, which is ultimately determined by the extent to which the human society is prepared to pay the price of transition from the current to the new state, and basically reflects the desired social goals. One way of viewing the chosen EUS is as a social contract with Earth, unilaterally agreed upon by the human society. The Earth will eventually signal its approval or disapproval through natural processes.

By reframing the debate as described above, it is hoped that some of the resources currently bound in the unproductive debate between economists and ecologists could be freed up and re-employed to bridge the gap between the 'sustainable EUS' and the 'measured EUS', and between the 'measured EUS' and the 'chosen EUS'. While the former may be accomplished by more and better research, the latter requires improved communication of scientific evidence to politicians and the general public. Narrowing the gap between the 'sustainable EUS' and the 'chosen EUS' should be a challenge to all of us, while closing it should be the ultimate goal.

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3. Auctioning conservation contracts: a theoretical analysis and an application

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Auction theory is used to analyze the potential benefits of auctions in allocating contracts for the provision of nonmarket goods in the countryside. A model of optimal bidding for conservation contracts is developed and applied to a hypothetical conservation program. Competitive bidding, compared to fixed-rate payments, can increase the cost effectiveness of conservation contracting significantly. The cost revelation mechanism inherent in the bidding process makes auctions a powerful means by which to reduce the problems of information asymmetry. Strategic bidding behavior, which may adversely affect the performance of sequential auctions, is difficult to address by means of auction design.

Key words: auctions, bidding for contracts, conservation contracting, cost effectiveness, information asymmetry, nonmarket goods.

The award of contracts on the basis of competitive bidding is a method frequently used in procuring commodities for which there are no well-established markets (Holt, 1980). The buyer announces a contract for the procurement of a specified item and calls for bids from potential market participants. Auctions have a long-standing tradition in government procurement contracting. Their usefulness in allocating environmental goods in the countryside has only been discovered relatively recently. Since 1986, the U.S. Department of Agriculture has been awarding land retirement contracts for the Conservation Reserve Program (CRP) on the basis of a competitive bidding mechanism. The applicability of auctions to

conservation contracting, however, is not limited to land retirement programs, but can be extended to intensive-margin incentive instruments as well. Farmers would indicate in their bids the amount of incentive payment (or the percentage cost-share) required to adopt the conservation practice in question.

Auctions are of particular interest for conservation contracting for at least two reasons. First, the item being traded, the provision of environmental benefits, is a public-type nonmarket good which has no standard value (Baneth, 1994). Second, there is a clear presence of information asymmetry in that the farmers know better than the program administrator how participation would affect their production plans and profits. Auctions in this respect enable the participants to deal with uncertainty about the value of the object being sold or purchased (McAfee and McMillan, 1987). Despite these theoretical advantages, the use of auctions in conservation contracting has, by and large, been limited so far to the CRP. Most practice-based environmental conservation and enhancement programs in farming, especially those in the European Union (EU), currently operate on the basis of predetermined fixed-rate payments.

In this paper we employ auction theory to analyze the potential efficiency gains from using auctions in conservation contracting, regardless of the type of conservation program under consideration. With this analysis we aim to demonstrate the broader set of possible applications in this field. Moreover, we intend to show that a bidding scheme with less than full information can achieve high levels of efficiency in the provision of environmental benefits.

The analysis begins with a brief essay on auction theory and its applicability to conservation contracting. In the third section, a model of optimal bidding behavior is presented and subsequently, in the fourth section, applied to a hypothetical conservation program. Program performance is simulated for different auction designs under various assumptions. An offer system of fixed-rate, posted-prices contracts serves as a reference. The analysis explicitly takes into account the presence of information asymmetry. With a focus throughout on the interaction of auction design and auction environment, issues like strategic bidding behavior in multiple-signup auctions, as well as the direct targeting of program objectives, are analyzed. Finally, conclusions are drawn as to the usefulness of auction theory in the practical design and implementation of green auctions.

3.1   Auction theory and conservation contracting

"An auction is a market institution with an explicit set of rules determining resource allocation and prices on the basis of bids from market participants" (McAfee and McMillan, 1987:701). Four basic auction types can be distinguished for a unique item being bought or sold: English, first-price sealed bid, second-price sealed bid, and Dutch, although many variations on the basic forms are used (McAfee and McMillan, 1987). In the English auction, which is often used for selling antiques and artwork, the price of the good to be sold is successively raised until only one bidder remains.[1] The Dutch or descending-bid auction is the reverse of the English auction. The seller announces an initial bid that he or she successively lowers until one bidder accepts. The Dutch auction is used, for

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[1] Also called the oral, open, or ascending-bid auction.

instance, for selling flowers in the Netherlands. In the first-price sealed bid auction, each potential buyer submits one bid and the highest bidder wins. The basic difference between this auction type and the English auction is that in the latter each participant can observe the rival bids and accordingly can revise his or her own bid. In the former auction type, on the contrary, each participant submits a bid in ignorance of the rival bids. The second-price sealed bid auction or Vickrey auction, exerts the same rules as the first-price sealed bid auction, except that the winning bidder who offers the highest price only pays the second highest bid. This auction type, developed and introduced by Vickrey (1961), is seldom used in practice.

Which of the four auction types should be chosen for allocating conservation contracts? It can be shown that under the same set of basic assumptions each auction form, on average, yields the same revenue to the auctioneer. This is known as the Revenue Equivalence Theorem (Myerson, 1981; Riley and Samuelson, 1981; Vickrey, 1961). The assumptions are that (McAfee and McMillan, 1987)[2] (a) the bidders are risk neutral, (b) the bidders have independent private values, (c) there is symmetry among bidders, (d) payment is a function of bids alone, and (e) there are zero costs to bid construction and implementation.

This model is referred to in the literature as the benchmark model. Relaxation of one or more of these assumptions violates the Revenue Equivalence Theorem and consequently leads to other conclusions about the optimal auction form. Most of the analytical literature on auctions deals with the benchmark model. Milgrom states that although this makes data collection, model construction, and solving the optimization problem easy, it may often "fail to portray the auction environment accurately" (Milgrom, 1989:4). Rothkopf and Harstad (1994) support Milgrom by pointing out that most of literature analyzes 'single isolated auctions' that sometimes lack realism. In this paper we intend to overcome these criticisms. Although the analysis starts with the benchmark model, in the remainder of this section some of the basic assumptions are relaxed, making the model more realistic for the specific case of conservation contracting with consequences for optimal auction design.

Although the benchmark model assumes risk neutrality among bidders, farmers are generally considered to be risk averse. Empirical studies assessing farmers' conservation attitudes in this respect, however, do not arrive at a unanimous judgment. Lynne, Shonkwiler, and Rola (1988), for instance, show that there is some degree of risk aversion involved in the conservation attitude. Works by Gasson and Potter (1988) and by Fraser (1991), on the other hand, conclude that risk aversion with respect to conservation is a phenomenon that is only marginally present among farmers. Assuming risk aversion has implications for the choice of auction form. The theoretical literature shows that with risk-averse bidders, the first-price sealed bid auction produces larger expected revenues to the auctioneer than the English or second-price sealed bid auction (Riley and Samuelson, 1981). In the case of conservation contracting, risk aversion translates into a higher level of cost effectiveness. The reason behind this is that the conservation payment, as a

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[2] In some game theory models of single auctions two additional assumptions are made: there is a single, isolated auction involving a fixed set of bidders; and the rules of the auction are commonly known, firm, and credible.

nonstochastic income component, decreases farmers' income uncertainty, which induces them to marginally lower their bids (as compared to the risk-neutral bidder) to increase the probability of acceptance.

The assumption of independent private values is one of two extremes. The 'independent private values model' assumes that each bidder knows precisely how much he or she values the item, or, in the case of bidding for conservation contracts, how the application of the contracts would affect profits. Moreover, the individual bidder does not know the value of the item by the competing bidders but perceives those valuations as being drawn from some probability function. Learning about the competitors' valuations will not cause the bidder to change his or her own valuation, although he or she is likely, for strategic reasons, to change the bid. This model applies, for example, to an auction for an antique with no resale, but also for government contract bidding (McAfee and McMillan, 1987). The other extreme is the 'common values model' in which the item being auctioned has an objective true value. The bidders' perceptions of this value are independent draws from a probability distribution that is known to all participants in the auction. An example of the common value model is an auction for an antique with resale in which the buyers make a guess about the value of the antique on the resale market. With the aforementioned in mind, it is reasonable to maintain the independent private values assumption for conservation contract auctions. Each farmer is assumed to know his or her opportunity cost of program participation, which, besides some other factors, determines his or her bid. Experiences with the CRP have shown that a common-value element can arise when the conservation contracts are sold in sequential auctions. Farmers then can analyze the results of the preceding rounds and update (often increase) their bids (Reichelderfer and Boggess, 1988).

The requirement of symmetry among bidders means that all bidders draw their valuations from the same distribution function. However, for conservation programs this should not necessarily be the case. Land quality may differ by location, resulting in systematic differences regarding forgone profits and the potential for environmental improvements. For the conservation program, this implies that even if bids are equal in monetary terms, the resulting provision of environmental services may differ. This is an asymmetric bidding situation, where each farmer draws his or her valuations from different probability functions. Theory suggests that in the case of asymmetric bidders the optimal auction system generally is the one in which the item being purchased is assigned to the lowest bidder (Myerson, 1981). In the case of conservation contracts, however, such auction design is unlikely to achieve its goals, because it favors the lower bidders with possibly a low ratio of environmental output per monetary unit of bid against higher bidders with a higher ratio. This problem arises because the environmental services considered are not well-defined items. Practical solutions to this problem are discrimination of bids, the establishment of eligibility criteria with respect to which farmers are allowed to participate (Reichelderfer and Boggess, 1988), or the a priori distinction of homogeneous classes of bidders based on natural circumstances (Baneth, 1994; Latacz-Lohmann, 1993).[3]

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[3] A solution used in the CRP.

The benchmark model further assumes that payments can only be a function of bids. Sometimes, however, it is in the seller's or buyer's interest to make payments conditional on some additional information about the winner's valuation of the item. McAfee and McMillan (1987) exemplify this approach with an auction of oil rights to government-owned land. After assignment of rights, the government observes the actual amount of oil extracted, which provides additional information about the winning bidder's true value of the oil right. The payment by the winning bidder now equals his or her bid plus a royalty payment based on the amount of oil extracted. A similar system may be applied to conservation contracting by linking the payment level to the environmental monitoring. The winning bidders receive part of their bids when the contracts are assigned and the remainder at the end of the contract period.

Although the benchmark model assumes the costs involved in bid construction and implementation to be zero, these costs may not be negligible. Especially in the case of practice-based conservation contracts, it may be costly for the farmers to acquire information about the relative profitability of the conservation technology. These costs imply a loss to the farmer if the bid is rejected and a reduction in the accruing economic rent if the bid is accepted. Therefore, bid preparation costs that are too high may diminish the number of bidders and thus violate the efficiency potential of the auction. Clarity and simplicity of the contracts and the bidding process are a virtue.

The theory described so far applies to a unique item. A specific feature of conservation contract auctions, however, is that, generally, multiple identical contracts are offered. To what extent does this change the conclusions drawn so far? For multiple contracts either a discriminatory first-price sealed bid or a uniform-price auction can be used. In the first case, the *n* lowest bidders are rewarded, receiving the payment stated in their bids. In the uniform-price auction the *n* successful bidders receive a payment at the amount of the lowest unsuccessful bid. The uniform-price auction consequently corresponds to the second-price sealed bid auction in the single unit case, and, in determining the optimal auction form, the conclusions set out for a single-item auction also apply for the multiple-unit auction considered here (McAfee and McMillan, 1987). According to the theory, in case of multiple contracts with no budget constraint, optimal auction design additionally requires the use of a reserve price - that is, a maximum acceptable bid - to induce farmers to reveal their bids honestly (Myerson, 1981; Riley and Samuelson, 1981). A reserve price, however, only proves to be effective when bidding competition is weak (McMillan, 1994).

3.2   A model of optimal bidding behavior

Suppose that farmers have private information about profits from farming, both under the conventional and the conservation technology, denoted by Π_0, and Π_1, respectively. Define profits from farming as per hectare net returns to land, not including the conservation payment. If conservation technology consists of land set-aside, Π_1 is zero (or even negative). For management practice-based

technologies, Π_1 is normally positive but smaller than Π_0.[4] If the farmer submits a bid *b* that is accepted, his or her utility will be $U(\Pi_1 + b)$, where $U(\cdot)$ is a monotonically increasing, twice differentiable von Neumann-Morgenstern utility function. If the bid is rejected, the bidder's utility is $U(\Pi_0)$, the reservation utility. Assume further that the farmer's bidding strategy is guided by the notion of a maximum acceptable payment level β, above which no bids will be accepted. This bid cap can be considered a reserve price, unknown to farmers in the bidding process. The farmer now will tender a bid *b* if the expected utility in case of participation exceeds the reservation utility, as follows:

(1) $U(\Pi_1 + b)P(b \le \beta) + U(\Pi_0)[1 - P(b \le \beta)] \succ U(\Pi_0)$

where *P* stands for probability. It is plausible to assume that each bidder forms expectations about β. These can be characterized by the density function $f(b)$ and distribution function $F(b)$. The probability that a bid is accepted, can then be expressed as

(2) $P(b \le \beta) = \int_b^{\overline{\beta}} f(b)db = 1 - F(b)$

where $\overline{\beta}$ denotes the upper limit of the bidder's expectations about the bid cap, i.e., the maximum expected bid cap. Substituting equation (2) into equation (1) yields

(3) $U(\Pi_1 + b)[1 - F(b)] + U(\Pi_0)F(b) \succ U(\Pi_0).$

A common characteristic of all bidding situations is the balance between net payoffs and the acceptance probability. A higher bid increases the net payoff but reduces the probability of winning, and vice versa. The farmer therefore faces the problem of determining the optimal bid, which is the one that maximizes the expected utility [on the left-hand side of expression (3)] over and above the reservation utility [on the right-hand side of expression (3)]. In the remainder of this section, the optimal-bid formulas will be derived for both risk-neutral and risk-averse bidders. For ease of analysis, both benchmark assumptions that there are no costs in bid preparation and implementation and that payment is only a function of the bid are maintained.

For a risk-neutral decision maker, who simply maximizes expected net payoff, expression (3) can be rewritten as

(4) $(\Pi_1 + b - \Pi_0)[1 - F(b)] \succ 0.$

The optimal bid b_{rn}^* is found by maximizing equation (4) through the choice of *b* which yields

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[4] The difference $(\Pi_0 - \Pi_1)$ is the opportunity cost of program participation.

$$(5) \quad b_{rn}^* = \Pi_0 - \Pi_1 + \frac{1 - F(b)}{f(b)}.$$

For quantitative analysis of b_{rn}^*, an assumption must be made on the type of distribution considered. For ease of analysis, it is assumed that the bidders' expectations about the bid cap are uniformly distributed in the range $\left[\underline{\beta}, \overline{\beta}\right]$, where $\underline{\beta}$ and $\overline{\beta}$ represent the minimum and maximum expected bid cap, respectively. This model specification is in fact a deviation from the mainstream auction model where the bidding strategy is determined endogenously by, among others, the number of participating bidders. In a conservation contract auction, however, the maximum acceptable payment level is determined not only by the number of bidders, but also by external factors such as the amount of money appropriated to the program or a projected enrollment goal. Therefore, it is realistic to treat the farmer's expectations about β as external to the bidding model. This allows us to simulate the impact of variations in the auction environment on bidding behavior.

The density and distribution functions of a rectangular distribution are given as follows:

$$(6) \quad f(b) = \begin{cases} 0 & if & b \prec \underline{\beta} \\ \dfrac{1}{\overline{\beta} - \underline{\beta}} & if & \underline{\beta} \leq b \leq \overline{\beta} \\ 0 & if & b \succ \overline{\beta} \end{cases}$$

$$F(b) = \begin{cases} 0 & if & b \prec \underline{\beta} \\ \dfrac{b - \underline{\beta}}{\overline{\beta} - \underline{\beta}} & if & \underline{\beta} \leq b \leq \overline{\beta} \\ 0 & if & b \succ \overline{\beta} \end{cases}$$

In analyzing optimal bidding behavior, it is important to note that it does not make economic sense for the farmer to submit a bid lower than the minimum expected bid cap $\underline{\beta}$. Furthermore, a bid will be submitted only if the (optimal) bid price at least covers the opportunity costs of implementing the conservation contract. Taking these arguments into account and substituting equation (6) into equation (5), the optimal-bid formula of a risk-neutral decision maker then can be written as

$$(7) \quad b_{rn}^* = \max\left\{\frac{\Pi_0 - \Pi_1 + \overline{\beta}}{2}, \underline{\beta}\right\} \qquad s.t. \quad b_{rn}^* \succ \Pi_0 - \Pi_1.$$

Expression (7) shows that the optimal bidding strategy of a risk-neutral decision maker is a linearly increasing function of both the bidder's opportunity costs of program participation and the expected bid cap. Notice further that a positive bid of $1/2\overline{\beta}$ (or at least $\underline{\beta}$) will be submitted by farmers who have already been applying

the conservation technology on their farms and therefore incur no additional costs when implementing the conservation contracts. This may be regarded as a free-rider problem if the program administrator is unable to identify those farmers and reject their bids.

For a risk-averse bidder it is important that the conservation payment is a nonstochastic income component. Moreover, in the decision whether to participate or not he or she also will take into account possible changes in the variability of the profits from farming (excluding the conservation premium) which may result from adopting the conservation technology. These aspects affect the risk-averse farmer's utility as introduced in equation (1). However, since utility as such is not tangible, it is replaced in the following mathematical exposition by the certainty equivalent (*CE*). Bearing in mind the definition of the certainty equivalent (expected income minus risk premium [*RP*]), equation (3) can be rewritten as

$$(8) \quad [\Pi_1 + b - RP_1(b)][1 - F(b)] + (\Pi_0 - RP_0)F(b) \succ \Pi_0 - RP_0$$

where the risk premium *RP* is a function of the expected value and the standard deviation of income (see Laffont, 1989). After rearranging terms, the equation is rewritten as

$$(9) \quad \{[\Pi_1 + b - RP_1(b)] - (\Pi_0 - RP_0)\}[1 - F(b)] \succ 0.$$

Expression (9) denotes, analogous to equation (4), the expected gain in certainty equivalent through participation in the conservation program. Maximizing equation (9) with respect to *b* yields the optimal-bid formula of a risk-averse decision maker. Again, take into account that no bids will be submitted below the minimum expected bid cap and that the (optimal) bid will be submitted only if it ensures a gain in certainty equivalent. Then,

$$(10) \quad b_{ra}^* = \max\left\{ \Pi_0 - \Pi_1 - [RP_0 - RP_1(b)] + \underbrace{\left(1 - \frac{\partial RP_1(b)}{\partial b}\right)}_{factor \prec 1} \cdot \underbrace{\frac{1 - F(b)}{f(b)}}_{premium}, \underline{\beta} \right\} \qquad s.t. \quad CE_1\left(b_{ra}^*\right) \succ CE_0.$$

From equation (10) it is clear that the optimal bid comprises forgone profits minus the difference in risk premiums plus a premium multiplied by a factor less than one. The greater the risk aversion, the smaller the factor and, thus, the lower the optimal bid price. In other words, risk-averse bidders try, *ceteris paribus,* to increase the probability of acceptance by lowering their bids. The analogy to the bidding strategy of risk-neutral bidders is clear by setting RP_0 and RP_1, equal to zero. Then expression (10) is reduced to the optimal-bid formula of risk-neutral decision makers as given in equation (5). From equations (5) and (10), we see that risk-averse farmers normally will tender lower bids than risk-neutral farmers, unless the variability of profits under the conservation technology (affecting RP_1) is significantly higher than under the conventional technology. This may be the case,

for example, when the conservation contracts require that farmers not apply pesticides.

3.3   Model application to a hypothetical conservation program

In order to gain some quantitative insights into the efficiency of auctions in conservation contracting, the above bidding model is applied to a hypothetical intensive-margin conservation program. The contracts being auctioned are assumed to impose only one restriction: an upper limit of 80 kilograms of nitrogen per hectare, aimed at reducing both nitrogen emissions and commodity surpluses. Assume further that the program is offered to 100 model farms of equal size (100 hectares of small grains) but different initial (profit-maximizing) fertilization levels, implying different costs of program participation. Farmers are asked to indicate in their bids the amount of incentive payment needed to adopt the low-nitrogen practice. For ease of analysis, assume that farmers can enroll their land in the program only on an all-or-nothing basis.

Each of the farms is characterized by a production function of the type $y(n) = a + bn + cn^2$, describing the technical relationship between nitrogen input (n) and grain yield (y) on a per hectare basis. Farms differ in soil quality and other natural circumstances. These differences are reflected in different values of the technological parameters *a, b,* and *c*, resulting in different initial levels of nitrogen application and grain yield.[5] Assuming a product price of *p* and a nitrogen per unit price of *r,* for each of the model farms the optimal level of fertilization, n^*, the corresponding yield, $y(n^*)$, and profit, $\Pi_0 = p \cdot y(n^*) - rn^*$, are calculated. Subsequently, individual nitrogen balances *(NB),* indicating the environmental impacts of the agricultural production process, are calculated as the difference between the optimal input level and the nitrogen removal with the corresponding crop yields: $NB = n^* - \gamma \cdot y(n^*)$, where *γ* denotes the amount of nitrogen removed per unit of crop yield. The economic, environmental, and supply control effects of adopting the conservation practice are now simulated by recalculating the model with the target nitrogen intensity $\tilde{n}$. The Table in the appendix illustrates this approach for a selection of model farms.

3.3.1 Assumptions and scenarios

The above farm-level model is linked up with the bidding model through the profit differential. Recall from expressions (7) and (10) that profit forgone is one of the main determinants of the optimal bid. Application of the bidding model additionally requires assumptions on the farmers' expectations about the maximum acceptable payment level. As explained earlier, the farmers' expectations are treated as external to the model. To begin with, we assume the bidders' expectations about β to be uniformly distributed in the range of minus 40% to plus

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[5] The technological parameters have been chosen in approximation to empirically estimated production functions, like those of Schindler (1990) and of Claupein (1994).

40% of the presumed average opportunity cost of program participation.[6] This strong assumption will be relaxed below. Moreover, it is assumed that each bidder faces the same density and distribution function, implying that all bidders have the same expectations about the bid cap. This conforms with the benchmark assumption of symmetry among bidders.

As theory is ambiguous about optimal auction design when benchmark assumptions are relaxed, program performance (in terms of number of participants, overall achievement of program goals, and cost effectiveness) is simulated for different auction types and other payment schemes. The variants chosen are as follows.

Reference: flat-rate offer system: A flat-rate payment $\overline{p}$, fixed by the program administrator at the presumed average forgone profits of all farmers with positive opportunity costs, is offered as incentive to adopt the reduced- nitrogen practice. All farmers who sign up are accepted. Most conservation programs in the EU framework employ this payment scheme. From the farmer's point of view, participation is worthwhile if $\Pi_1 + \overline{p} \succ \Pi_0$, for risk-neutral decision makers, and if $\Pi_1 + \overline{p} - RP_1(\overline{p}) \succ \Pi_0 - RP_0$ in the case of risk aversion. This payment scheme serves as reference against which the following schemes will be compared.

1. *Simple auction (uniform bid cap):* Farmers submit sealed bids to the government prompting the amount of payment needed for participation. The winning bidders receive the payment stated in their bids (discriminatory first-price, sealed-bid auction). Within this variant two scenarios are considered:

    1a. *Targeting enrollment:* The government accepts bids, starting with the lowest bid, until the budget is exhausted. This implies that the government's objective is to maximize enrollment with a limited amount of public money - a strategy that was pursued by USDA during the first nine signups of the CRP.

    1b. *Targeting program objectives:* It is assumed that the program administrator has information sufficient to estimate the prospective environmental benefits of enrolling each farmers' land. This allows him or her to rank all bids for acceptance based on the ratio of benefits to public cost of enrolling the land. This "cost-effectiveness targeting" was employed during CRP signups 10-12.[7] In our model we simulate the outcome of this mechanism by ranking all bids for acceptance according to the ratio of nitrogen reduction $\left(n_i^* - \tilde{n}\right)$ to the individual farmers' (optimal) bids.

In the following two variants, the benchmark assumption of symmetry among bidders is relaxed by distinguishing homogeneous classes of bidders based on natural circumstances. It is assumed that the government has information on foregone profits sufficient to cluster all farmers into three pools (j) of equal size: farms with low, average, and high opportunity costs of participation. Again it is

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[6] In the calculations made, the average cost is ECU 67 per hectare. Consequently, the range of expectations is bordered by $\underline{\beta} = ECU\,40.2$ and $\overline{\beta} = ECU\,93.8$ per hectare.

[7] CRP bids are ranked for acceptance according to the ratio of an environmental benefit index (EBI) to the government cost of the contract. The EBI is a parcel-specific estimate of the potential contribution to each of the seven program goals that the land would provide if enrolled (USDA-ERS, 1994).

assumed that the bidders' expectations about the maximum acceptable bid level are uniformly distributed in the range of minus 40% to plus 40% of the presumed average foregone profits of the pool. All farmers within one pool face the same density and distribution function. By doing this, we relax the symmetry assumption only between the pools, but maintain this assumption within the pools. The different variants chosen are as follows.

2. *Offer system with differentiated payment rates:* Pool-specific, preannounced payments $\overline{p}_j, j = 1,2,3$, are offered as incentive for the farmers to adopt the conservation practice. Similar to the reference variant, the payment rate for pool j is fixed at the presumed average of forgone profits of all pool j farmers with positive opportunity costs.

3. *Bidding pool auction system (differentiated bid caps):* Similar to variant 1, farmers tender sealed bids to the government. Each bid received is assigned to a bid pool. As in variant 2, there are three pools of different opportunity costs. Every farmer knows to which bidding pool his farm is assigned. As above, the two bid selection mechanisms, (3a) targeting enrollment and (3b) targeting objectives, are analyzed.

4. *Perfect- information offer system:* This variant is intended to serve as 'best-case' reference regarding program cost-effectiveness. It is assumed that the government has perfect information about each farmer's opportunity costs and potential contribution to the program goals and therefore can offer each farmer a payment equal to or marginally above his or her opportunity cost. The farmers are accepted in the order of their benefit-cost ratios within the overall budget.[8]

To assure comparability among the various variants, the budget of each of the variants is assumed to be restricted to the amount of the flat-rate offer system (reference). With a flat-rate offer system and a perfect- information offer system as reference points, we are now able to assess the efficiency potential of auctions within the range of these two extremes.

3.4   Results

The quantitative results of the model calculations are listed in Table 3.1 for risk-neutral bidders.[9] The columns indicate the various payment schemes and the rows indicate the variables that measure program performance. All measures are depicted in relation to the flat-rate offer system which is set to 100.

Implementation of the various bidding schemes enhances program performance significantly. Under all bidding scenarios considered, more of the program goals are achieved with the same amount of public money. The reasons for these efficiency gains are twofold. First, the windfalls (difference between payments and costs - row F) accruing to farmers who enroll land with lower-than-average opportunity costs are reduced. Their bid prices lie below the fixed-rate offer. Second, producers with opportunity costs above the level of the fixed-rate payment (who would not participate under the offer system) are encouraged to tender cost-

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[8] Benefits are again measured as $n_i^* - \tilde{n}$.

[9] The results for risk-averse bidders do not differ significantly, although the level of the absolute performance is slightly higher in all variants.

covering bids. Given the same budget for all variants, those farmers can be accepted to the extent of the savings provided by the low-cost participants.

As expected, the cost-effectiveness indices are higher when program objectives are targeted directly (variants lb and 3b compared to la and 3a), although fewer contracts are awarded. This is because, in the targeted variants, mainly farmers with higher- than- average contributions to the program goals are selected, while the reverse is true for the variants that target enrollment. Notice further from Table 3.1 that a bidding pool auction with cost-effectiveness targeting (var. 3b) almost measures up to the 'best-case' reference of a perfect- information offer system (var. 4).

3.4.1 Auctions and information asymmetry

The results presented in Table 3.1 can be re-examined from another angle. Each of the variants and scenarios in the Table implies a different level of information available to the program administrator. In the reference variant and in variant 1a information is limited to the average opportunity cost of program participation. In variants 2 and 3 it is assumed that the program administrator has information on opportunity costs sufficient to cluster all farms into three groups. Variants 1b and 3b assume the availability of farm-level information on the level of fertilization, and variant 4, finally, assumes perfect farm-level information on both forgone profits and fertilization levels. Therefore, the numbers in Table 3.1, except those for variant 1a, represent the combined effects of two events: the implementation of an auction scheme and the utilization of different levels of information. It stands to reason that increasing information results in better program performance and lower windfalls for farmers. It is obvious that in the extreme case of perfect information, the implementation of a bidding scheme would not yield any benefits. Conversely, the benefits of auctions are higher when there is less information available to the program administrator, that is, the larger the gap between the farmers' and the government's information. The italic numbers in Table 3.1 furnish evidence of this. The efficiency gains of replacing a three-pool offer system (variant 2 - implying some information) by a bidding pool auction (var. 3a and 3b) are substantially lower than the benefits of switching from the flat-rate offer system (implying very limited information) toward a simple auction (var. la and lb).[10] The reason for this phenomenon is that the marginal value of the information provided with the bids is higher, translating into high gains of program performance when less information initially is available.

With the aforementioned in mind, the windfalls (row F in Table 3.1) may be regarded as returns to private information on farm-level relationships earned above the payment needed to encourage participation. The more information the government acquires, the less farmers will be able to extract high information rents because the program administrator can identify and discriminate applicants with 'unreasonably' high bids. However, acquiring information is a costly venture. In this respect, it is important to note that the implementation of an auction reduces information asymmetry inherently (and at almost zero cost), as the bidding process

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[10] Here the three-pool offer system is set equal to 100.

	Variants					
	1a	1b	2	3a	3b	4
Performance Measures	Simple Auction, Targeting Enrollment	Simple Auction, Targeting Objectives	Offer System with Differentiated Payments	Bid Pool Auction, Targeting Enrollment	Bid Pool Auction Targeting Objectives	Perfect Information Offer System
A. Number of participants	111	98	98	117	102	147
B. Total emission reduction	116	129	117	138	143	182
C. Total output reduction	129	171	180	200	217	266
D. Total program outlays	100	100	88	100	100	100
E. Total profits foregone	133	184	203	221	246	295
F. Net income Transfer[a]	83	57	32	38	25	0
G. Emission reduction per unit of program outlays (B/D)	116	129	134 *(100)*	138 *(104)*	143 *(107)*	182
H. Output reduction per unit of program outlays (C/D)	129	171	205 *(100)*	200 *(97)*	217 *(106)*	266
I. Average bid or payment (D/A)	90	102	89	86	98	68

[a] Total program outlays minus total profits foregone, i.e., overcompensation of profits foregone.

Table 3.1   Simulated Performance of the Conservation Program for Risk-Neutral Decision Makers Under Different Payment Schemes (Flat-Rate Offer System = 100).

reveals, though imperfectly, the individual bidders' opportunity costs of program participation. Since the optimal bid is, among others, a linear function of the profit foregone, a high bid indicates high opportunity costs and vice versa. This cost-revelation mechanism makes auctions a valuable tool for governments to use in coping with information asymmetry and deficiencies in allocating contracts for the provision of nonmarket goods.

3.4.2 A note on bidding competition in sequential auctions

Green auctions are normally designed as multiple-signup auctions. Bids for the same contracts are invited in a sequence of several years or, as in the case of the CRP, several times per year. CRP bidding behavior gives evidence of decreasing bidding competition in multiple-signup auctions through the presence of Bayesian learning. During the first four signups, the mean value of the bids increased (Osborn, Llacuna, and Linsenbigler, 1990), while the distribution of the bids declined (Reichelderfer and Boggess, 1988), implying that the farmers had learned the bid caps. By the ninth signup, the majority of the bids were almost exactly equal to the bid caps (Osborn, pers. comm.). In the language of the bidding model, learning the bid caps narrows the range $[\underline{\beta}, \overline{\beta}]$ of expectations about the maximum acceptable bid level. According to the optimal-bid formulas (7) and (10), this encourages farmers wishing to enroll low-cost land to bid at least $\underline{\beta}$, while high-cost farmers are discouraged from tendering bids, because $\overline{\beta}$ would not cover their costs of implementing the conservation contracts. In the extreme, when the bidders know the bid cap with certainty ($\underline{\beta}$ equals $\overline{\beta}$), the bidding scheme degrades to a fixed-rate offer system. On the other hand, a very wide range $[\underline{\beta}, \overline{\beta}]$, which may occur in the first signup due to lack of bidding experience, may encourage the farmers to tender "unreasonably" high bids. We have employed the above model to simulate the impact of the degree of uncertainty about the maximum acceptable bid level on the performance of the auction (Figure 3.1). All performance measures in the Figure are depicted in relation to the flat-rate offer system which is set to 100. The degree of uncertainty about the acceptable bid level is depicted on the horizontal axis as percentage deviation of $\underline{\beta}$ and $\overline{\beta}$ around the average opportunity cost of program participation. It has so far been assumed that the bidders' expectations about the bid cap were distributed in the range of minus 40% ($\underline{\beta}$) to plus 40% ($\overline{\beta}$) of the average opportunity cost. This assumption is now varied between 0% (certainty) and 100% (high uncertainty).

The Figure shows that the full efficiency potential of auctions is mobilized when the bidders expect the bid cap to be set in the range of plus/minus 30% of average cost. A higher degree of certainty (to the left of this point) causes the performance of the auction to decline due to strategic bidding behavior (learning the bid caps). Increased uncertainty (to the right of the 30% mark) also diminishes the efficiency of the auction because of increasing (optimal) bid prices in combination with a fixed budget. Performance measures may even fall below the level of the offer system. These relationships call for the auctioneer, on the one hand, to keep farmers in the

Index

Per cent deviation of $\underline{\beta}$ and $\overline{\beta}$ around the average cost (AC) of program participation

$$\underline{\beta} = AC \cdot (1 - c/100); \qquad \overline{\beta} = AC \cdot (1 + c/100)$$

————————— Number of participants

– – – – – Total emission reduction

················· Total program outlays

— ·· — · Average bid
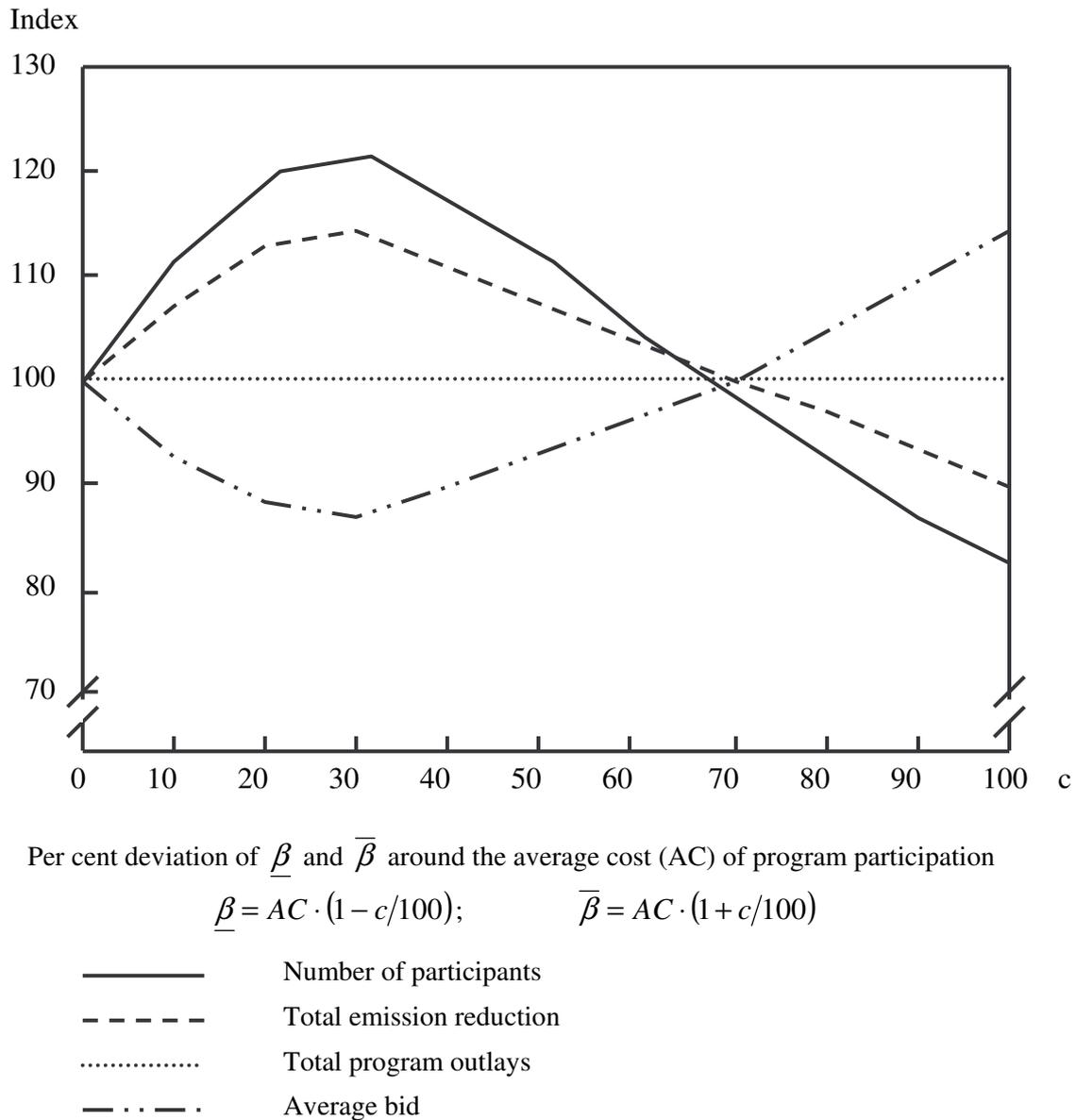
Figure 3.1   The effect of uncertainty on the performance of a green auction with a uniform bid cap (variant 1a).

Dark about the maximum acceptable payment rates. One possibility to maintain a reasonable degree of uncertainty would be to conceal the functional form of the bid acceptance mechanism. On the other hand, in the first signup, inexperienced bidders should be given some guide as to the range of realistic payment levels.

3.5   Conclusions

In this paper we show that auctions are a valuable tool for governments in allocating conservation contracts among farmers. Auctions are generally superior to a posted-price offer system for providing low-cost solutions to the provision of environmental benefits, because they introduce an element of competition between farmers.

Bidding reveals information about the farmers' costs of program participation and enables the government to discriminate positively between the competing

claims. Moreover, the government is able to control the allocation of funds by setting up rules under which the tenders offered by the farmers are selected. This mechanism, however, requires information on site-specific environmental impacts of farming which may not be consistently available. The high efficiency gains, which can be achieved by directly targeting the program objectives in the bid selection process, may in fact call for increased investment in agro-environmental data collection.

These conclusions apply irrespective of the conservation policy tool employed (land set-aside or management prescriptions). Programs that could benefit from applying a bidding mechanism include the Environmental Quality Incentive Program in the United States as well as the large number of environmental incentive programs offered under EU regulation 2078/92.

The major contribution of this paper is that it makes auction theory applicable to the specific case of conservation contracting. Some of the benchmark assumptions have been relaxed to portray the auction environment as accurately as possible. Nevertheless, some simplifying assumptions remain, both with respect to the model and auction theory. For example, the farm-level model considers only one input and one output. A more elaborate model with multiple inputs and outputs, which allows for substitution, may produce a more moderate effect on program performance. Another simplification is the assumption of independent private values, which requires that farmers know precisely their opportunity costs of program participation. In practice, however, there is often an element of uncertainty among farmers as to the consequences of adopting conservation practices, resulting in affiliated values instead of independent private values. Also, farmers in the EU have proved to be reluctant to participate in conservation programs because they fear that the government will not allow them to remove the management changes after the contracts have expired. All this may have unforseeable implications for bidding behavior, which, consequently, could affect the results presented here.

Bearing this in mind, how useful is auction theory in assisting practical auction design? Because of its shortcomings, the theory cannot provide us with a cut-and-dried solution in most real-world settings. In our opinion, it can, however, and should play an important role in considering auction design and bidding behavior so as to avoid drawbacks that might otherwise occur. In this respect, the analysis in this paper suggests that had auction theory been consulted in devising the CRP bidding process, it might have been able to predict some of the problems of that bidding process (e.g., declining bidding competition after multiple signups; problems resulting from pursuing an enrollment target) in advance.

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Appendix

Characteristics		Model Farm Number				
		1	25	50	75	100
Production	a	2.49	3.24	3.83	4.24	4.46
Function	b	0.0249	0.0332	0.0393	0.0427	0.0436
Coefficients	c	-0.00014	-0.00013	-0.00012	-0.00011	-0.0001
Conventional technology						
n^*	(kg/hectare)[a]	75	113	150	182	207
$y(n^*)$	(mt/hectare)	3.57	5.34	7.07	8.48	9.38
$\Pi_0 = \Pi(n^*)$	(ECU/hectare)	327	489	647	775	855
$NB(n^*)$	(kg/hectare)	10.5	17.0	22.4	28.9	38.3
Target technology	($\tilde{n}$ =80 kg/ha)					
$y(\tilde{n})$	(mt/hectare)	3.57	5.07	6.26	6.97	7.33
$\Pi_1 = \Pi(\tilde{n})$	(ECU/hectare)	327	475	590	665	701
$NB(\tilde{n})$	(kg/hectare)[b]	10.5	-11.2	-31.9	-45.5	-51.9
Differences:						
Yield	(mt/hectare)	0	-0.27	-0.79	-1.47	-2.05
Nitrogen balance	(kg/hectare)[c]	0	-17.0	-22.4	-28.9	-38.3
Profit	(ECU/hectare)	0	-14	-57	-110	-154

[a] At p = ECU 100 per rut grain and r = ECU 0.4 per kg nitrogen.

[b] At γ = 18 kg nitrogen per metric ton (mt) yield (Source: Hygro Agri Dümen, 1993).

[c] Only reductions of nitrogen emissions are considered environmental improvements. If under the low-input technology the nitrogen balance is negative, only the initial nitrogen balance surplus over and above zero, not the entire difference between $NB(n^*)$ and (negative) $NB(\tilde{n})$, is taken into account.

Characteristics of selected model farms under the conventional and the conservation technology

4. Auctions as a means of creating a market for public goods from agriculture

Uwe Latacz-Lohmann and Carel P. C. M. Van der Hamsvoort[♦]

The paper looks at the possibility of creating a market for environmental goods and services in the countryside by awarding conservation contracts to farmers on the basis of competitive bidding. Auctions have several theoretical advantages over alternative allocation mechanisms (such as standard-rate payments) because they allow the participants to deal with informational asymmetries and the uncertainty about the value of the (non-market) goods being traded. A formal model of bidding behaviour in 'green auctions' shows that bidding strategies are determined by the individual farmers' costs of implementing the conservation contracts and their beliefs about the maximum acceptable payment level, making the auction an imperfect cost revelation mechanism. Auctions can reduce the information rents accruing to farmers and can increase the cost-effectiveness of public goods provision. Strategic bidding behaviour in multiple-signup auctions as well as high transaction costs are potential sources of reduced efficiency.

4.1   Introduction

Recent decades have seen a continuous increase in the demand for public goods and services from agriculture, most of which relate to the ecological, recreational and cultural functions of the rural environment. During the same period, the supply of such goods and services has been seen to be in decline. It has been argued with increasing vigour that many of the non-productive functions of the rural environment have been subjected to growing threats through increasingly intensive land use and mechanisation.

People have very limited opportunity to express their concerns over, and demand for, the quality of the rural environment in the market place. Markets in countryside benefits do not exist or are underdeveloped because of the public-goods character of most of the environmental goods and services concerned.

It is therefore widely accepted that some institution other than a conventional market is needed to stimulate the provision of public goods from agriculture.

Auctions are the main quasi-market institution used in other sectors of the economy to arrange the provision of public-type goods by private enterprises. Government procurement contracts, for example, are normally allocated on the basis of competitive bidding. The advantages of auctions are widely recognised and well documented, especially in cases where no well-established markets exist (Holt, 1980).

This paper analyses the potential benefits and possible drawbacks of auctions as a quasi-market mechanism for public goods from agriculture. We argue that a 'green' auction market for public goods in the countryside could be created by, say, putting Management Agreement contracts up for tender, instead of offering them at pre-determined prices. Farmers, as potential suppliers of the goods and services, would indicate in their bids to a central agency the amount of payment required to implement the contracts.

The analysis begins in the second section of the paper with a brief essay on the characteristics of the 'market' for countryside benefits, highlighting some of the properties of the goods being traded, and the specific features of the relationship between the parties involved in the trade. In the third section, theoretical evidence is provided, demonstrating the strengths of auctions in handling these market characteristics. Subsequently, in the fourth section, a formal model of optimal bidding behaviour is presented, supplementing the theoretical considerations with some quantitative insights into price formation in green auctions. The fifth section analyses possible limitations and drawbacks of green auctions. The final section summarises the findings and draws some conclusions.

4.2 Characteristics of the 'market' for public goods in the countryside

This type of 'market' occupies a middle ground between two extremes: monopolistic state provision on the one hand[1] (which evidently has little in common with the notion of a market), and a conventional market on the other. It therefore appears appropriate to use the term 'quasi-market'.[2] It is a 'market' because producers meet would-be buyers in a fictitious market place. It is 'quasi' because it differs from a conventional market in a number of key ways which are discussed here.

4.2.1 Market Structure and competition

Firstly and most obviously, it is not the direct user or consumer who exercises the choices concerning purchasing decisions. Instead, demand is centralised in a single body acting on behalf of the consumers or beneficiaries. In most cases, this is a

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[1] The main characteristics are state ownership and state management of land. For example, apart from a limited number of exceptions, most of the world's National Parks are state owned (lUCN, 1992).

[2] The term 'quasi-market' was first used by Williamson (1975) in the context of provision of welfare services through private firms. Le Grand and Bartlett (1993) shaped the term further and developed a theory of quasi-markets. Although the term will be used in a slightly different way in this paper, much of the following has been inspired by the reading of Le Grand's and Bartlett's book.

state organisation, but this central agency could also be a private organisation such as a nature conservation trust.

On the supply side, as with conventional markets, farmers as decentralised producers offer their services based on marginal cost considerations. Marginal costs are measured in terms of both farming income forgone through the implementation of the environmental contracts concerned (such as opportunity costs) and possible direct costs (for example, for restoring a degraded environment). However, competition between producers may be more or less restricted because most environmental benefits are site-specific, such as inputs to, and outputs of, the provision process are immobile. Also, opportunities for environmental improvements may depend upon a co-ordinated effort by all farmers in a particular area. The provision of sufficient habitat for some species, for example, may require that a large enough number of hectares from several independent land holdings be put under conservation agreement. These "non-separabilities in benefit functions between firms" (Hodge, 1991:183) put the suppliers of countryside benefits in a favourable bargaining position, counterbalancing the powers of centralised demand.

4.2.2 Uncertainty about the quality of the product

Another key difference from conventional markets arises from the impossibility of specifying clearly the final product, such as the environmental output to be produced. Because of problems in measuring the state of the environment and quantifying possible changes, policy must rely on suitable proxies that are observable and measurable. Typically, the goods and services to be produced are specified in terms of design standards, such as a set of management prescriptions related to the agricultural production process. The environmental output resulting from those management changes is not determinable in many cases and may vary widely from producer to producer, depending on natural circumstances, initial farming practices and land use intensities. If the central agency has only limited information on these factors, an element of uncertainty may arise as to the *quality* of the commodity being traded.

4.2.3   Uncertainty about the value of the product

In conventional markets, the direct interplay of demand and supply establishes prices which act as a guide for efficient resource allocation and, at the same time, provide an economic valuation of the product. The lack of this mechanism on quasi-markets may give rise to uncertainty on both sides of the market as to the *value* of the commodity being traded. Environmental goods and services have no standard value, and there is a lack of experience in trading them. The difficulties of determining quality may add to the problem, and a further complexity arises from the fact that countryside benefits are typically site-specific, depending, among others things, on the preferences and size of the local population (Hodge, 1991). Hence, there may be uncertainty about what price to post or to ask for both for the seller and the buyer.[3] This may give rise to transaction costs which add to the

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[3] Existing environmental schemes give evidence of this uncertainty. For example, Environmentally Sensitive Area (ESA) payments in the UK are based on opportunity costs to farmers, while

overall costs of public goods provision. As Le Grand and Bartlett (1993:24) put it, "Costing activities that have never been properly costed before can itself be a costly activity."

4.2.4 Information asymmetry

Probably the most salient feature of quasi-markets for countryside benefits is the uneven distribution of information between farmers and the central agency. The information economics literature distinguishes two types of information asymmetry: hidden information and hidden action (Kreps, 1990; Rasmusen, 1989).

Hidden information refers to situations in which the agent (farmer) possesses certain characteristics that may adversely affect the value of the transaction to the other party. The farmer may conceal this information from the agency with which he/she contracts or may disclose it only in a selected and distorted manner. For example, farmers hold private information on pre-contractual farming practices, land use intensities, and opportunity costs of completing the conservation contracts. A farmer who has already been using a low-input technology may conceal this information from the environmental agency, which will result in comparatively small additional environmental benefits and an overcompensation of the farmer's opportunity costs. This type of opportunistic behaviour on the side of the better informed party is referred to in the information economics literature as *adverse selection.* It occurs *before* an agreement is signed (Williamson, 1985).[4]

The second type of information asymmetry, *hidden action,* comes into play *after* a transaction has been agreed. Hidden action refers to situations in which the agency is unable to observe perfectly and without cost the agent's actions with regard to the provisions of the contract. This may give rise to a *moral hazard* problem in the sense that farmers may put less effort into the provision of the services than is consistent with the terms of their contracts (Williamson, 1985; Rasmusen, 1989; Hanf, 1993). Again, this results in the generation of lower-quality public goods or generates a requirement for compliance monitoring, the cost of which would have to be accounted for in an overall assessment of the quasi-market.

In these ways, information asymmetries can give rise to persistent difficulties in setting up and operating quasi-markets. Farmers can transform their informational advantage into an economic rent earned over and above the payment required for co-operation. "Safeguarding transactions against the hazards of opportunism" (Williamson, 1985:1213) is therefore a major challenge in the mechanism design of quasi-markets for public goods.

Problems of information asymmetry would not arise in markets where the quality of output is readily observable. Producers who behaved opportunistically and provided low quality output would have difficulties renewing their contracts or maintaining their share of the market in the face of competition from more reliable producers (Le Grand and Bartlett, 1993).

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payments for a similar scheme in Sweden are informed by the value of the non-market goods generated.
[4] Note that under fixed-rate payment schemes, adverse selection is explicitly tolerated as a cost for administrative simplification. No effort is made to eliminate adverse selection.

4.3   The benefit of green auctions: theoretical evidence

There are essentially two types of auctions that can be used to arrange the provision of public goods in the countryside, depending on who is considered the buyer and who the seller (Table 4.1). The first type is the government procurement auction where the commodity being traded is the public good (specified in terms of management prescriptions), the central agency is the buyer and the farmers are the sellers. Farmers submit financial bids to the agency indicating the amount of money they would require for implementing the management agreements. Contracts for the US Conservation Reserve Program (CRP) are awarded on the basis of this model (Reichelderfer and Boggess, 1988; Shoemaker, 1989).

	Government Procurement Auction	Auction of Certificates	Fixed-Rate Payments (Reference)
Conditions	fixed	variable (bid)	fixed
Payment	variable (bid)	fixed	fixed
Bid	financial	management plan	n/a
Example	Conservation Reserve Programme (USA)	Countryside Stewardship Scheme (UK)	Environmentally Sensitive Areas Scheme (UK)

Table 4.1   Auction types for the provision of public goods in the countryside.

The second model is an auction of certificates where the commodity being traded is the property right to receive pre-determined financial rewards for the provision of countryside benefits, the central agency is the seller of these rights (certificates), and the farmers are the buyers who 'pay' by making environmental commitments. The bid takes the form of a management plan in which these commitments are specified. In other words, farmers offer variable environmental outputs for a fixed payment, and only competitive proposals are accepted. Such a model, which could be considered the dual of the procurement auction, is used to allocate management agreements for the Countryside Stewardship Scheme in the UK. These two auction types are compared with a system of pre-determined fixed-rate payments (Table 4.1, right-hand column), which is the most frequently used payment scheme for agri-environmental schemes in the EU. Management agreements in Environmentally Sensitive Areas (ESAs), for example, are based on fixed-rate payments.[5]

A distinctive feature of auctions for countryside benefits is that *multiple homogeneous* contracts, rather than a *unique* contract, are auctioned. Consequently, there is more than one winner, which requires the operation of a sealed-bid mechanism in which potential suppliers submit written tenders in ignorance of the bids of their rivals. After a stipulated time, the bids are opened and compared.

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[5] Strictly speaking, payments in ESAs are tiered rather than fixed, as is the level of environmental change expected. Within each tier, however, payment rates and levels of expected change are fixed.

Multiple homogeneous contracts can be auctioned in a *first-price* scaled-bid tender in which the *n* lowest bidders are rewarded, receiving the payment stated in their bids.[6]

Auctions have at least two theoretical advantages over fixed-rate conservation payments because they relate well to the characteristics of the 'market'. Firstly, auctions enable the participants to deal with the *uncertainty about the value of the commodity* being traded. It is the better informed party who makes the first move in determining the price for the non-market goods in question, while the less well informed party retains the bargaining power by setting up rules under which the competing claims are compared and selected. In other words, prices are determined through a decentralised process which takes into account private information held by the bidders. Therefore, compared to a centrally decided, fixed-rate payment, auction prices are more likely to reflect the marginal value of the resources being used to produce the goods or services concerned. However, the degree to which auction prices actually reflect marginal opportunity costs depends on whether farmers bid honestly. This is discussed further later.

Secondly, auctions explicitly introduce an element of *competition* between producers. Producers facing competition are likely to compete away, at least partly, their informational rents. In other words, an auction reduces the scope for opportunistic behaviour resulting from informational asymmetries. As the optimal bid depends, among other things, on the bidder's true opportunity costs, an auction functions, at least in part, as a cost revelation mechanism, mitigating the informational imbalances between farmers and the agency.

4.4   The benefit of green auctions: a formal analysis

Additional insights into the benefits of green auctions can be gained by modelling bidding behaviour. The model presented here analyses bidding behaviour in the government procurement type auction as this auction type is used on a large scale for the CRP and is more intuitive than the auction of certificates.

The starting point of the analysis is the assumption that the bidders' strategies are guided by the notion of a maximum acceptable payment level β, a reserve price above which no bids are accepted. The actual β is set *ex post* by the auctioneer dependent on the budget available and the actual bids received. It is assumed that the bidders form expectations about β in the bidding process, which are determined by a number of factors such as the bidders' perceptions of rival bids, budget appropriations or enrolment goals.[7] These expectations can be characterised by the

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[6] There are other auction forms such as the English, Dutch, second-price sealed-bid, and double auction. From a theoretical point of view, the second-price sealed-bid auction is the most efficient one to be used for conservation contracting, but its application is hampered with practical problems. The first-price sealed-bid auction therefore serves as the second-best alternative. The applicability of the various auction forms to conservation contracting, and the factors determining the choice of the optimal auction form are discussed in greater detail in Van der Hamsvoort and Latacz-Lohmann (1996).

[7] The assumption of a maximum acceptable bid level is a deviation from mainstream auction theory which assumes that bids are determined endogenously by the number of bidders, their valuation of the item and the valuation of the item by rival bidders (McAfee and McMillan, 1987; Milgrom, 1989; Rothkopf and Harstad, 1994). This deviation is necessary to portray the auction environment in green auctions as accurately as possible.

density function *f(b)* and distribution function *F(b)* over the range of possible outcomes. The latter is assumed to be bordered by $\underline{\beta}$ and $\overline{\beta}$, the minimum and maximum expected threshold level, respectively. The probability that a given bid, *b*, is accepted can then be written as

$$(1) \qquad P\big(b \leq \beta\big) = \int_b^{\overline{\beta}} f(b)db = 1 - F(b)$$

A common characteristic of all bidding is the balance between net pay-off and the probability of acceptance. A higher bid increases net pay-off but reduces the probability of winning, and vice versa. The (risk-neutral) bidder therefore faces the problem of determining the optimal bid, which is the one that maximises *expected* net pay-off. Expected net pay-off is the product of the additional income from securing the conservation contract and the acceptance probability:

$$(2) \qquad \max_b \big(\Pi_1 + b - \Pi_0\big) \cdot \big(1 - F(b)\big)$$

where Π_0 and Π_1 denote profits from farming (exclusive of conservation payments) without and with conservation agreement, respectively. The solution to (2) yields the optimal bid:

$$(3) \qquad b^* = \Pi_0 - \Pi_1 + \frac{1 - F(b)}{f(b)}$$

Assuming that the bidder's expectations are uniformly distributed in the range $\big[\underline{\beta}, \overline{\beta}\big]$, the optimal-bid formula becomes:

$$(4) \qquad b^* = \max\left\{ \frac{\Pi_0 - \Pi_1 + \overline{\beta}}{2}, \underline{\beta} \right\} \quad s.t. \, b^* \geq \Pi_0 - \Pi_1 \quad \big(\text{participation constraint}\big)^8$$

Expression (4) reveals important information about optimal bidding behaviour and, thus, price formation in an auction market. First of all, it demonstrates that the optimal bid increases linearly in the bidder's opportunity costs of implementing the conservation contract, $\big(\Pi_0 - \Pi_1\big)$. This implies that the bid conveys information about the bidder's cost type. A high bid signals high opportunity costs, and vice versa. This cost revelation mechanism reduces the degree of information asymmetry and, thus, diminishes the informational rents accruing to producers. However, cost revelation is imperfect because the equilibrium bid is determined not only by the bidder's opportunity costs but also by his or her prior beliefs about the maximum acceptable bid level. Expression (4) demonstrates that the optimal bid increases linearly in $\overline{\beta}$ and $\underline{\beta}$, implying that optimistic expectations lead to higher

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[8] The participation constraint ensures that only cost-covering bids are submitted.

bids, and vice versa. In other words, farmers will attempt to offer bids which they consider appropriate to secure the contract without necessarily offering their true valuations. This results in bids above true opportunity costs, implying that producers still earn informational rents.

Figure 4.1 provides a graphical representation of price formation in an auction market. The horizontal axis indicates the number of hectares available for the conservation scheme, and the vertical axis represents costs and payments (bids) on a per-hectare basis. The curve labelled *S* is the industry supply curve for the public good concerned, depicting for each individual hectare of land the costs of implementing the conservation contracts. Participation in the scheme is assumed to be offered at increasing marginal costs as it becomes increasingly costly to put higher-quality land under conservation agreements. The optimal-bid curve in Figure 4.1 has been calculated based on equation 4, on the assumption that the bidders' expectations about the maximum acceptable payment rate are distributed in the range of minus 30 per cent ($\underline{\beta}$) to plus 30 per cent ($\overline{\beta}$) of the average opportunity
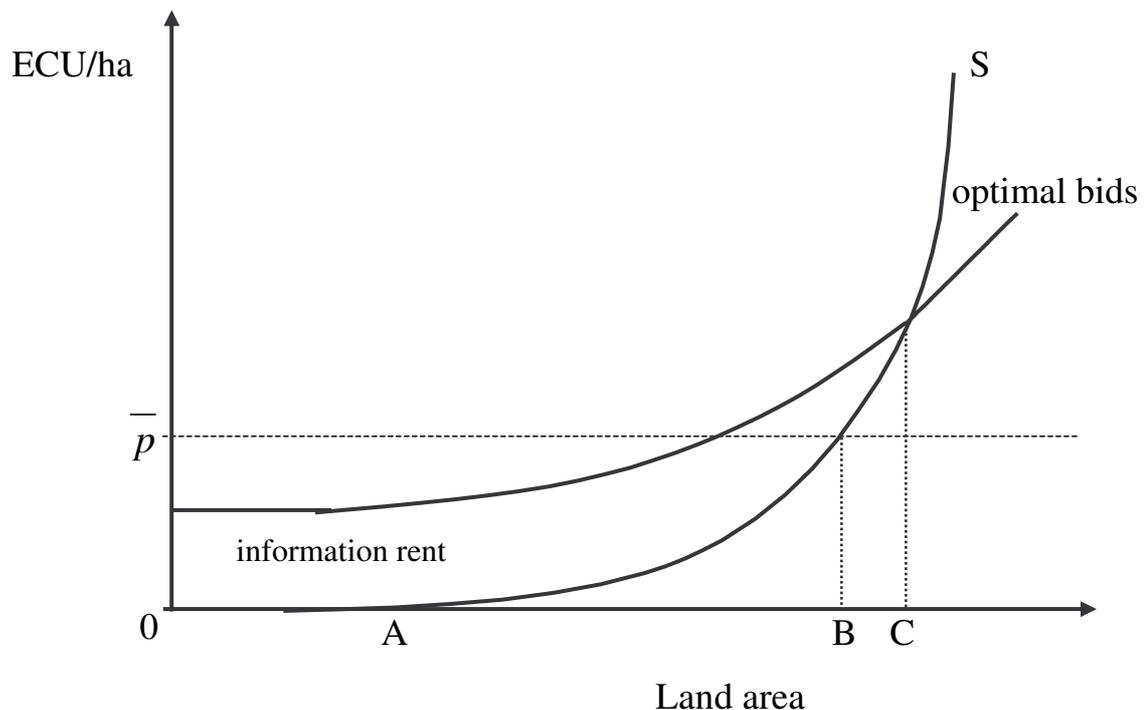
Figure 4.1   Price formation in an auction market for countryside benefits.

cost of adopting the conservation practices in question.[9] If, for example, the average cost is ECU 100 per hectare, the farmers will expect the threshold for bid acceptance to lie somewhere between 70 ($\underline{\beta}$) and 130 ($\overline{\beta}$).

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[9] This number has been chosen arbitrarily and only serves illustrative purposes.

The relationships displayed in Figure 4.1 emphasise the observation that auctions are an imperfect cost revelation mechanism: the bids signal the producers' cost type, but producers do not reveal their *true* opportunity costs with their bids. Bids are strictly above opportunity costs, except for the marginal bidder (at point *C*) where bid and cost are equal. The area between the two curves between points *0* and *C* depicts the informational rents accruing to successful bidders.

Finally, the broken line in Figure 4.1 depicts a fixed-rate payment set at a level such that total conservation payments to farmers are the same under the auction and the fixed-rate scheme.[10] The Figure shows that with approximately the same amount of public money (in terms of total conservation payments) more land (between points *B* and *C*) is attracted into the scheme when an auction mechanism is employed. Moreover, the informational rents accruing to producers under an auction are lower than under the fixed-rate mechanism (area between line $\overline{p}$ and curve *S* between points *0* and *B*), implying a higher cost-effectiveness of public good provision.

4.5 Limitations and possible drawbacks of green auctions

Green auctions differ from the standard auction model in a number of ways, which makes them more susceptible to failure. This section analyses specific features of green auctions that may give rise to inefficiency, and considers appropriate remedies.

4.5.1 Bidding with a common-value element

Most standard procurement auctions can be classified as private-value auctions, meaning that each bidder knows his or her own production costs with certainty, but can only estimate the other bidders' costs by means of a probability distribution (McAfee and McMillan, 1987). Private-value bidding normally ensures sufficient bidding competition. In principle, the private value model also applies to the bidding for conservation contracts. However, experiences with the CRP have shown that, in sequential auctions, a common-value element may arise as to the maximum acceptable bid level, making the auction susceptible to strategic bidding behaviour. Green auctions are normally designed as multiple-signup (sequential) auctions where bids for the same contracts are invited over a sequence of several years or, as in the case of the CRP, even several times per year. In the CRP auction, farmers had analysed the results of preceding bidding rounds and had used this information to update (increase) their bids (Reichelderfer and Boggess, 1988). After a few signups, the average bid was almost exactly equal to the maximum acceptable payment level (Shoemaker, 1989), implying that the farmers had learned the bid caps. In the language of the above bidding model, this process of Bayesian learning narrows the range $[\beta, \overline{\beta}]$ of expectations about the maximum acceptable bid level. According to the optimal-bid formula (4), this encourages low-cost

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[10] Total conservation payments under the auction scheme are represented by the area underneath the bid curve between points *0* and *C*. The corresponding figure for the fixed-payment scheme is the area under the price line $\overline{p}$ between points *0* and *B*.

producers to bid at least $\underline{\beta}$, while high-cost farmers are discouraged from tendering bids, because $\overline{\beta}$ would not cover their opportunity costs. Such distorted bidding behaviour can cause the benefits of auctions largely to disappear.

This problem can be addressed by the choice of the auction type. In the procurement auction, the common-value element is concentrated in a single number, the highest successful bid, which is likely to spread quickly throughout the farming community. In the auction of certificates, on the contrary, the bid (in the form of a management plan) comprises a number of restrictions and commitments relating to the use of inputs, tillage systems, cropping plans, rotations and various other aspects of the agricultural production process. In other words, the common-value element is hidden in the management plan and is more difficult to uncover than a single number. This reduces the scope for Bayesian learning and resulting strategic bidding behaviour.

4.5.2 Transaction costs

Transaction costs are an important element of the economic costs of public goods provision. Williamson (1975) distinguishes two kinds of transaction costs: ex *ante* and *ex post* exchange. *Ex ante* transaction costs are the costs incurred in preparing, negotiating and safeguarding a conservation agreement. These include, among other things, the costs of devising the conservation scheme, the costs of agri-environmental data collection, and the time and resources used in operating the quasi-market. *Ex ante* transaction costs incurred by farmers comprise the costs of estimating the technological and financial consequences of the proposed management changes (for example, consultancy costs), the costs of connecting and interacting with the central agency and, in the case of auctions, the costs of bid preparation and implementation. *Ex post* transaction costs include the costs of monitoring the farmers' compliance with the terms of their contracts, and any costs of conflict resolution if the terms have not been complied with (Le Grand and Bartlett, 1993). Note that transaction costs mainly arise from the need to deal with informational deficiencies and asymmetries.

Although quantitative figures on transaction costs in the context of public goods provision are not available, it seems fair to assume that the operation of an auction may be administratively more difficult than the operation of a fixed-rate payment scheme, implying higher *ex ante* transaction costs. A similar argument may hold for transaction costs incurred by farmers, who may be inexperienced with bidding and may feel uncomfortable with this kind of market institution. *Ex ante* transaction costs being too high may deter farmers from considering co-operation.

Moreover, from a social welfare point of view, transaction costs may raise another, more fundamental, question: To what extent is it justifiable to 'buy' improvements in the effectiveness of public spending (which is just a transfer) with an increase in transaction costs (which are real economic costs)? The answer to this question and, thus, the choice of the socially most desirable quasi-market mechanism, depends on the way society balances equity and efficiency goals, such as the social welfare function society adopts.

4.5.3 Problem of spatial targeting

Another possible problem arises from the need to auction large numbers of homogeneous contracts. This makes spatial targeting of conservation policies difficult. Auction theory suggests that it is virtually impossible to establish an auction market for small scale, local environmental goods and services which require tailored management prescriptions and involve only a limited number of potential producers. The smaller the group of potential bidders, the lower the level of bidding competition and the higher the risk of collusion and strategic bidding. Many environmental demands, however, are local in nature. In such cases, auctions cannot serve as an efficient quasi-market mechanism, and an alternative mechanism, preferably individual negotiations *à la* SSSI, should be chosen.

Similar problems arise when farmers have the choice to enter different tiers of an agri-environmental scheme. Again, this reduces the number of bidders per tier, possibly resulting in reduced bidding competition. This problem could be addressed by implementing a bid selection mechanism which ranks all bids (from all tiers) on the basis of an environmental benefit index to the public cost of the contracts. Such a mechanism would allow the environmental agency to compare and select bids on a common denominator across tiers, effectively increasing the pool of bidders.

4.6 Conclusions

The analysis in this paper suggests that green auctions can be a powerful means for conservation agencies to increase the effectiveness of public spending for large-scale environmental improvements. Probably the most outstanding feature of auctions is their inherent potential to reduce some of the informational imbalances between the two parties to an environmental agreement. Auctions, as compared to fixed-rate payment schemes, yield the highest benefits when the informational basis is weak, the number of potential participants is large, the contracts offered are homogeneous, the farms are heterogeneous, and the production of the environmental good or service in question is separable between farms. The fewer of these conditions apply, the higher the relative preferability of fixed-rate payments or individually negotiated payments.

The benefits of auctions come at the cost of likely higher administration costs and possibly higher transaction costs on the side of the farmers, although both arguments lack empirical proof so far. Also, strategic bidding behaviour in multiple-signup auctions is a potential source of operational difficulties and reduced efficiency of the auction market.

The use of auctions in conservation contracting fits in well with the general trend towards a 'value for money approach' that policy has adopted in the provision of public services. Bidding is perceived to be fair, which is politically important, making a transfer publicly legitimate. By holding an auction, the public agency avoids being confronted with questions about the level of pre-determined payments or the choice of negotiation partners (Rothkopf and Harstad, 1994). The fact that most conservation schemes in the EU operate a fixed-rate payment mechanism may be an indication that auctions, in fact, involve high transaction costs. Environmental agencies are inexperienced in holding auctions, implying a high risk of 'implementation failures', and the majority of farmers still appear to prefer an

'equal payment for equal output approach' with which they are so familiar from the agricultural commodity markets.

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5. The pivotal role of the agricultural land market in the Netherlands

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5.1 Introduction

One of the most significant problems confronting the Netherlands at the start of the 21st century is the use and organization of the limited land available. The high level of economic growth in recent years and the increasing prosperity have resulted in a greatly heightened demand for land for home construction, infrastructure, business premises, and nature and landscape. On the other hand, the amount of land is limited and most of it (69 per cent) is reserved for agriculture. The growth in demand and the limited availability of land is being translated into developments in the real estate market.

In the Netherlands, however, the real estate market is not a free market. The government regulates the use of space by means of the *Wet op de Ruimtelijke Ordening* (WRO; 'Town and Country Planning Act') and thus restricts the allocation options for the available space. Moreover, the development potential of various agricultural and non-agricultural sectors is influenced to a greater or lesser extent by sector-specific policy, such as agricultural policy, nature and landscape policy, and environmental policy. All these developments affect the supply of and demand for land in the Netherlands, which has important consequences for the developmental possibilities of different economic sectors.

The central theme in this chapter is an analysis of the effect of both government policies in respect of agriculture, nature and landscape, and the environment and developments in agricultural and non-agricultural sectors on the price of agricultural land. The empirical relevance of this analysis is to be found in the crucial role played by the agricultural land market in the achievement of policy objectives for the environment, nature and landscape, and the developmental possibilities of agricultural enterprises. Moreover, a number of recent developments suggest the existence of conflicting policy in this area. A couple of examples will illustrate this point.

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Since the mid-nineties, the necessary expansion of acreage of continuable agricultural enterprises has been stagnating due to numerous non-agricultural claims and the ensuing resettlement of farmers who have been bought out. And even if land is on offer in the vicinity of the farms, it is often too expensive for farmers due to high land prices. In addition, the process of handing over the land to the next generation is becoming increasingly costly, because succession is taxed on the basis of the increased price of land on lease. Finally, higher land prices are causing the amount of regularly leased acreage to decrease more rapidly. Although the price of leased land also continues to rise, the difference with the free land price is becoming greater, so that the capital gain for the lessor on purchase of the freehold is greater.

Higher land prices stimulate the use of fertilisers, since they form a substitute for land in the case of a considerable number of agricultural crops[1]. As a result, environmental pollution caused by agriculture increases, seriously threatening a number of policy objectives in respect of the environment. Moreover, high agricultural land prices, combined with limited land mobility, hinder land acquisition by the *Dienst Landelijk Gebied* (DLG; 'Countryside Department') and thus the realization of the expansion of the *Ecologische Hoofdstructuur* (EHS; 'Ecological Main Structure').[2] More and more money is required for the purchase of nature reserves and nature development areas and agricultural nature conservation demands increasingly higher payments.

The structure of this chapter is as follows. The next section begins with a description of the real estate market segments, after which we focus on the agricultural real estate market segment. Developments in agriculture and agricultural policy that influence the price of agricultural land will be examined. This is to be followed by an examination on the extent to which 'non-agricultural' developments are responsible for the development of the price of land in the agricultural segment of the real estate market. The following section examines the relative importance of a number of different agricultural and 'non-agricultural' factors affecting the level of the 'agricultural' land price. Finally, this chapter offers a final conclusion and a look at the future.

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[1] Winters (1990:256) "Fertiliser is a substitute for land in many agricultural processes so the strong positive relationship between price support and land prices stimulates fertiliser use. Kawagoe et al. (1986) estimate that a 1 per cent increase in the price of land relative to fertiliser increases the relative use of the latter by 1.4 per cent in the United States and 0.4 per cent in Japan. It is also likely that the tendency towards crop specialisation stimulates pollution. Whereas mixed farming makes relatively balanced demands of the eco-system and is able to counter certain diseases by alternating crops and livestock in particular fields, specialised farms often require additional chemicals to maintain fertility and additional drugs to control disease (Bowers and Cheshire, 1983)."

[2] The *Dienst Landelijk Gebied* ('Countryside Department') is a delegated government department whose tasks include the acquisition of land for the implementation of the *Ecologische Hoofdstructuur* (EHS; 'Ecological Main Structure'). The EHS is an interrelated network of ecosystems of (inter)national importance which are to be permanently maintained, as indicated in the Nature Policy Plan (Ministerie van Landbouw, Natuurbeheer en Visserij, 1990).

5.2   Segmentation of the real estate market via the *Wet Ruimtelijke Ordening*

The government via the 'Town and Country Planning Act' regulates land use in the Netherlands. By means of dos and don'ts, it lays down what use is or is not permitted to the private sector at a given location. The justification for this is derived from the conviction that government intervention in town and country planning is of benefit to society since the free market is found wanting on two counts. In the first place, because the utilization of land by one user may in some cases have negative consequences (negative external effects) for the welfare of the user of the neighbouring land. For example, the welfare of the inhabitants of a residential area may be negatively affected when adjacent plots are used for an industrial estate or rubbish dump. And secondly, because of the public nature of some uses of land, such as dams, roads, nature reserves, and so on.

For various reasons, the result is that the Dutch territory, consisting of 3.4 million hectares of land (and 0.8 million hectares of water), was allocated as follows in 1996: 69 per cent for agriculture, 14 per cent for 'green' activities such as woodlands and nature reserves areas and 16 per cent for 'red' activities such as housing and other buildings, traffic, and recreation, and so on (see Table 5.1.)

Use	Size (x 1,000 ha)	Share of total (%)
Agricultural	2 351	69.4
Woodlands	323	9.5
Nature	138	4.1
Recreation	83	2.4
Housing	224	6.6
Other buildings	96	2.8
Traffic	134	4.0
Other land use	39	1.1
Total (excl. water)	3 387	100

Table 5.1   Land use in the Netherlands (1996). Source: Centraal Bureau voor de Statistiek (1997)

In particular, land use for housing, other buildings, traffic and recreation (the so-called 'red' activities), as well as for woodlands and nature reserves (the 'green' activities) has been expanding over recent decades at the expense of land allotted for agriculture. Table 5.2 illustrates this development for the 'red' activities. In the 1950-1995 period, land use for housing and work and infrastructure increased by 88 per cent and 50 per cent respectively, while the area in use for recreation was 22 times greater in 1995 than in 1950.

The distribution of land use would have been completely different if 'town and country planning' had been left entirely to the free market. Under such circumstances, the 'red' area would have been considerably larger than is now the case. This area has been restricted or kept artificially scarce by means of the 'Town

Year	Housing and work	Recreation	Infrastructure	Total
1950	178.6	3.7	95.1	277.3
1967	220.5	15.4	64.6	300.4
1978	296.1	64.6	126.9	487.6
1989	323.5	78.4	137.4	539.4
1995	336.1	85.0	142.2	563.4

Table 5.2   Development of urban land use 1950-1995 (x 1000 ha). Source: Farjon et al. (1997)

And Country Planning Act'. This results in segmented real estate markets. Five segments are distinguished (Centraal Planbureau, 1999): (i) business premises; (ii) housing; (iii) infrastructure; (iv) agriculture and horticulture; and (v) woodlands and nature areas. Within the separate real estate market segments there are sub-segments, each with its own land price. These differences do not result only from the 'Town and Country Planning Act', but also from other laws and regulations. Within the agricultural segment, for example, not all forms of agriculture and horticulture are permitted at every location. Combined with the immobility of agricultural entrepreneurs, this leads to regional sub-markets with permanent regional differences in agricultural land prices. Another example is the Boswet ('Woodlands Act'), which designates the locations in the 'woodlands and nature areas' segment that must in any case remain forested, thus creating sub-segments with this segment.

   All sub-markets and their components have their own land prices, usually related to the profitability of the permitted land use. Under the pressure of social and economic developments, the 'Town and Country Planning Act', taking the democratic rights of all parties into account, permits continuous modifications of land use. Expansion of real estate market segments at the costs of the agricultural/horticultural segment thus has spin-off effects on the agricultural market segment and affects the 'agricultural' land price. After all, most land is used for agriculture. Thus, segmentation does not mean that the sub-markets cannot affect each other. In consequence of the constant process of reallocating agricultural land, the price of agricultural land is determined not only by its expected profitability in agriculture, but also by its expected value following possible reallocation. The more probable a possible future reallocation of a plot or area becomes, the greater the influence of the new use on the price level. An additional influence on the price of agricultural land in other areas is the resettlement of 'bought-out' agricultural enterprises triggered by the reallocation.

   Figure 5.1 illustrates the effect of the 'Town and Country Planning Act' on prices and acreage in three real estate market segments: business, housing and agriculture/horticulture. D_B, D_H, and D_A are the demand curves for land for business premises, housing and agriculture/horticulture respectively. The bold line shows the cumulative demand curve, D_N. The vertical supply curves S_B, S_H, and S_A indicate the number of hectares on which the 'Town and Country Planning Act' permits business premises, housing and agriculture/horticulture respectively. S_N, finally,

shows the amount of land available in the Netherlands (3.4 million hectares). Note that we show only three segments, so that the horizontal sum of the available land in the sub-markets is not equal to the total area of land in the Netherlands. Each real estate market segment has its own land price, which is the result of the interaction between the segmented demand for land and the artificially limited supply. The highest hectare price is found in the business segment (P_B), followed by housing (P_H) and agriculture/horticulture (P_A). The accompanying acreages are B_R, H_R, and A_R. Now imagine that the 'Town and Country Planning Act' disappears and that the allocation of land is left to free market processes. Real estate market segments will disappear and there will be a single hectare price throughout the Netherlands. This equilibrium price (P_E) is shown in the Figure at the intersection of the cumulative demand curve (D_N) and the national available acreage (S_N). The accompanying acreages for business, housing and agriculture/horticulture respectively are B_E, H_E and A_E. Under free market processes, the 'red' surface area will increase considerably at the expense of the agricultural and horticultural acreage and the price of land will be higher than the price of agricultural land, but quite a bit lower than the prices in the business and housing segments under the 'Town and Country Planning Act'.
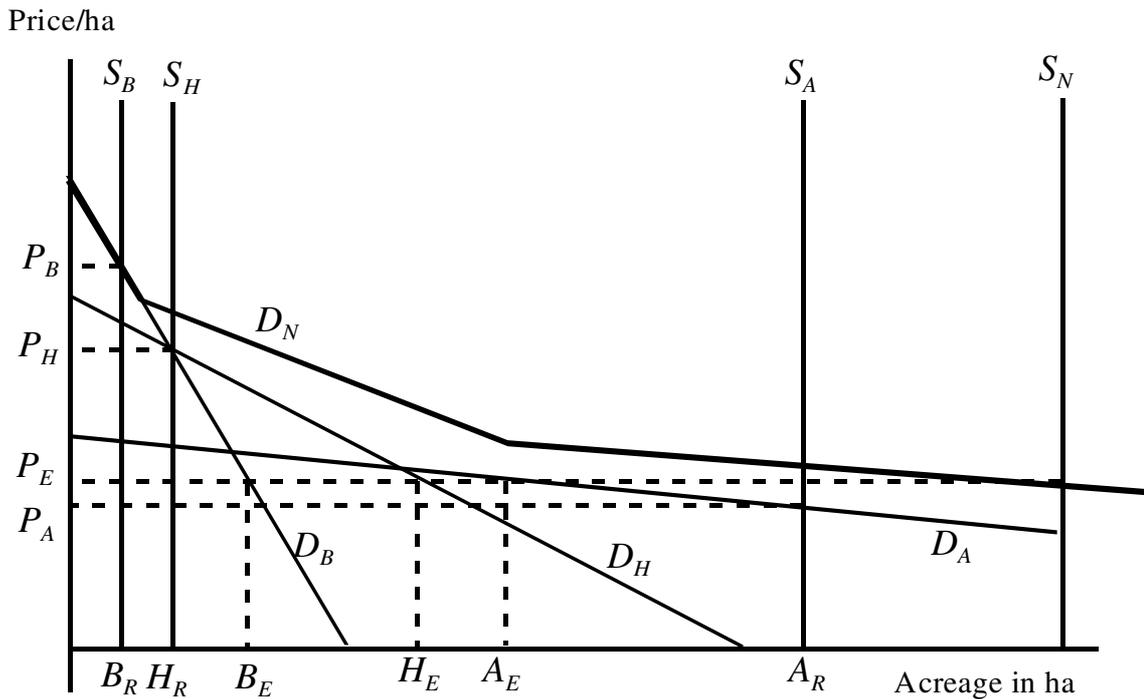
Figure 5.1   The effect of the 'Town and Country Planning Act' on price and acreage in the business, housing, and agriculture/horticulture real estate market segments.

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5.3 Price formation in the agricultural segment of the real estate market

5.3.1 Calculation of the price of agricultural land

With a very strict application of the 'Town and Country Planning Act', the free agricultural land price would primarily be the result of the expected future land yields in agriculture. Under such circumstances, the price of agricultural land is equal to the capitalised future net yield from an extra hectare of land in agriculture (value of marginal product of agricultural land). It is a matter of a simple fraction:

$$(1) \quad \text{Land price} = \text{Net Cash Value land income} = \frac{\text{land income}}{(\text{discount rate - growth rate land income})}$$

The discount rate is influenced by expectations with regard to the amount of the future interest, while the annual land income is influenced by the expected growth of land productivity on the one hand and the expected development of the 'agricultural terms of trade' on the other (the quotient of 'prices received by farmers and prices paid by farmers'). Land productivity in agriculture has been improving constantly for decades (Dijksterhuis, 2000). Changes in the expectations of agricultural entrepreneurs with regard to the constant improvement of land productivity and the agricultural terms of trade have great influence on the price of land. An example may clarify this. Income from land amounting to € 1350 per hectare per year and a discount rate of 5 per cent results in a land price of € 27 000 per hectare (€ 1350 / 0.05). Suppose that the expected growth rate of income from the land, through improved land productivity and/or agricultural terms of trade, is 1 per cent per year. The price of the agricultural land will thereby rise by 25 per cent to € 33 750 per hectare (€ 1350 / [0.05-0.01]).

The agricultural terms of trade are greatly influenced by agricultural support, the EU market and price policy (support to trade: intervention and export support), and, via the agricultural terms of trade, the price of agricultural land as well. Gylfason (1995:11) expresses this as follows:

> "(....) but in the long run, the benefits of farm support accrue primarily to landowners, and then mostly to those who own the largest estates (Winters, 1987; Martin et al., 1989). This is not surprising. Price support raises rents because land is essentially fixed in supply, but it cannot raise the return to farm labour, because the potential entry of workers into agriculture from other sectors is unrestricted, and price support cannot be used to prevent the inevitable exit of labour from agriculture. According to Johnson (1991), a sixth or at most a fifth of all farmers in the industrial countries are responsible for two-thirds to three-fourths of all farm sales and receive support commensurately."

A number of factors within agriculture which are of importance for the development of the price of land, such as milk quotas, manure legislation, compulsory extensive land use and alternative applications will now be examined in detail.

5.3.2 Milk quotas 1984

With regard to the EU market and price policy, it is primarily the milk price supports combined with milk quotas that are of great importance for the price level of agricultural land in the Netherlands. After all, dairy farms make use of two-thirds of the total agricultural acreage in the Netherlands and are thus by far the largest land users. In the first half of the 1980s, the EU decided to employ price supports but to limit the rising production of milk by means of production restrictions. Although the price of land was maintained by the implementation and even expansion of this support, there also arose an indispensable means of production for dairy farmers, which like all other means of production required compensation. In the beginning, the government still attempted to buy up the milk quotas for € 0.30 per kilogram, but soon thereafter (1985) it was calculated that a large group of dairy farmers were able to offer about € 1.15 for a kilogram of levy-free milk (Luijt, 1985). When the government then tried to buy up the milk quota at € 1.15 per kilogram, the quota price had again risen due to the value of the dollar, which by that time had been halved. With the weaker dollar, imported concentrates became very inexpensive, so that the margin on a litre of milk rose even further, ultimately to the present level of nearly € 1.80 per kilogram. Due to the higher quota price, the leeway to pay for the other means of production decreased. Since variable means of production, such as energy, continued to require the same payments as before the superlevy, payment declined in particular for the fixed means of production land and labour. The milk quotas thus had and have a negative effect on the price of land. After all, the cake must now be divided among more means of production.

5.3.3 Manure legislation 1987

Price supports and their influence on the price of agricultural land have also had other consequences. We are concerned here with the damage to the environment and the landscape. Winters (1990:254-5) provides an extensive survey:

> "It is sometimes argued that farm support enhances visual amenity because it encourages rural population stability and the careful and tidy management of farmland. On the other hand, high output prices encourage intensive cultivation and the use of marginal land, while capital grants and tax expenditures encourage building and land improvement. The result is a tendency towards monoculture, extensive building, the closure of footpaths, the destruction of hedgerows and woodlands, the draining of pastures and the use of chemicals. ….. Overall, therefore, it is probable that current farm policies do more harm than good to visual amenity."

Although Winters describes the specific situation in the UK, the essence of his ideas equally applies to the Dutch case. In reaction to the damage to the environment, nature and landscape caused by agriculture, the soil protection legislation (*Wet Bodembescherming*) and the manure legislation (*Meststoffenwet*) came into force in 1987 (Baarda, 1999), followed by the *Natuurbeleidsplan* in 1990 ('Nature Policy Plan'; Ministerie van Landbouw, Natuurbeheer en Visserij, 1990). Broadly speaking, the manure legislation restricts the spreading of manure on

agricultural land and sets requirements for its storage and the manner in which it is spread. On the one hand, it thus leads to higher storage costs, which are covered at the expense of payments for other means of production, such as land. On the other hand, land acquires an extra value because a certain amount of manure can be spread on it. Since this manure does not need to be disposed of in another manner, no costs will be incurred in this respect. The extra value of the land is equal to the costs saved. On balance, the manure legislation resulted in an increase in the price of land. In addition it created a property right for manure disposal, which received economic value in the market.

5.3.4 Compulsory extensive land use: 2.5 livestock units per hectare

Environmental policy can also trigger even more land price effects. A recent report (Goedgeluk et al., 1999) gave evidence that the price of land resulting from environmental policy can rise considerably higher when the environmental requirements are stricter than the restrictions resulting from limitations on milk production. After all, limiting the intensity of land use, the number of animals per hectare, to for instance 2.5 livestock units per hectare will lead to a situation in which dairy farms with intensive land use (more than 2.5 livestock units per hectare) are suddenly facing either an excessive milk quota or too little available land. Table 5.3 shows that this concerns nearly 27 per cent of the dairy farms. Such farms will either have to sell milk quotas or purchase land. As a result, the milk quota price will fall and the price of land will rise. In fact, the quota price then overflows into the land price. At an average litre price of € 1.75 and an average milk quota of 12 000 litres per hectare, the quota value and thus the maximum overflow amounts to € 21000. Given an average agricultural land price exclusive of milk quota of € 29 500 per hectare and of € 50 500 including the milk quota (29 500 + 21 000), this amounts to about 42 per cent of the land price (21 000/50 500).

Livestock units per ha	Dairy farms (number)	Land area (ha)	Milk cows (number)
≺ 2	12 109	404 359	509 378
2 − ≤ 2.5	9 401	304 697	528 335
2.5 − ≤ 4	6 985	177 303	402 624
4 − ≤ 8	835	13 856	51 284
≥ 8	93	324	3 509
Total	29 423	900 539	1 495 130

Table 5.3   Livestock units (only milk cows and calves) per hectare cultivated land (1999). Source: Landbouw-Economisch Instituut/Centraal Bureau voor de Statistiek (1999)

5.3.5 Alternative applications in agriculture

Thus, besides the expected income from land and the expected interest rate, the price level of agricultural land is also influenced by production restrictions in agriculture and environmental policy applicable to agriculture, as well as by the future expectations of agricultural entrepreneurs in this regard. In addition, there is also the effect of alternative land uses, both within and outside the field of agriculture.

Within agriculture, competition for land between agricultural and horticultural sectors affects the price level of agricultural land in a given area. If the land is suitable for other, more intensive forms of cultivation with higher added value per hectare, and if this more intensive cultivation is prominent in the area, then the price of land will partly be influenced by the expected chance of future expansion of these more intensive forms of cultivation, such as glasshouse horticulture, bulb cultivation, arboriculture and intensive dairy farming. Through this competition, the outlook for, in particular, extensive grain farming and extensive stockbreeding becomes in time less favourable.

5.4 Alternative applications outside agriculture

Particularly when the economy is booming, the expected growth of non-agricultural use of agricultural land has great influence on the agricultural land price. We are concerned here with the influence of the other real estate market segments on the agricultural segment. The major claims on agricultural land in connection with a booming economy are made by the expansion of nature reserves and recreation areas and by ongoing urbanization.

5.4.1 Expansion of the Ecological Main Structure

Implementation of the expansion of the Ecological Main Structure (*Ecologische Hoofdstructuur* or EHS) planned in 1990 demands a great deal of agricultural land. The survey in Table 5.4 shows that 190 000 ha of the planned total of 700 000 ha must still be acquired. This acreage is composed of 71 000 ha of managed areas, 69 000 ha of reserve areas and 50 000 ha of nature development areas. In managed areas, management agreements are concluded with the owners of the land, usually farmers. In reserve areas and nature development areas, on the other hand, policy is concentrated on acquiring agricultural land with high natural value that requires management specifically focused on nature. The area concerned amounts to 119 000 ha, which places a considerable claim on the land offered on the free market.

The government's demand for voluntarily supplied land can be extremely high in some areas, varying from 8 per cent to 50 per cent of the total supply. In the provinces of Utrecht and Limburg in particular, little land for expansion remains in the land-based agricultural sectors (Figure 5.2).

It should be clear that a major market party such as the Countryside Department can drive up the price of agricultural land. On the one hand, this is because the government, in attempting to achieve its acquisition objectives via the Countryside Department, is making more demands on the market for agricultural land. On the

other hand, it is because farmers must offer more for neighbouring land than the government in order to achieve their own often essential expansion objectives.

Overall composition EHS	Area in ha
Existing	510 000
• Nature areas	185 000
• Rural estates	25 000
• Woodlands (in EHS)	270 000
• Managed areas	13 000
• Reserve areas	17 000
New	190 000
• Managed areas	71 000
• Reserve areas	69 000
• Nature development areas	50 000
Total EHS (land)	700 000

Table 5.4   Overall composition Ecological Main Structure. Source: Rijksinstituut voor Volksgezondheid en Milieu (1997).
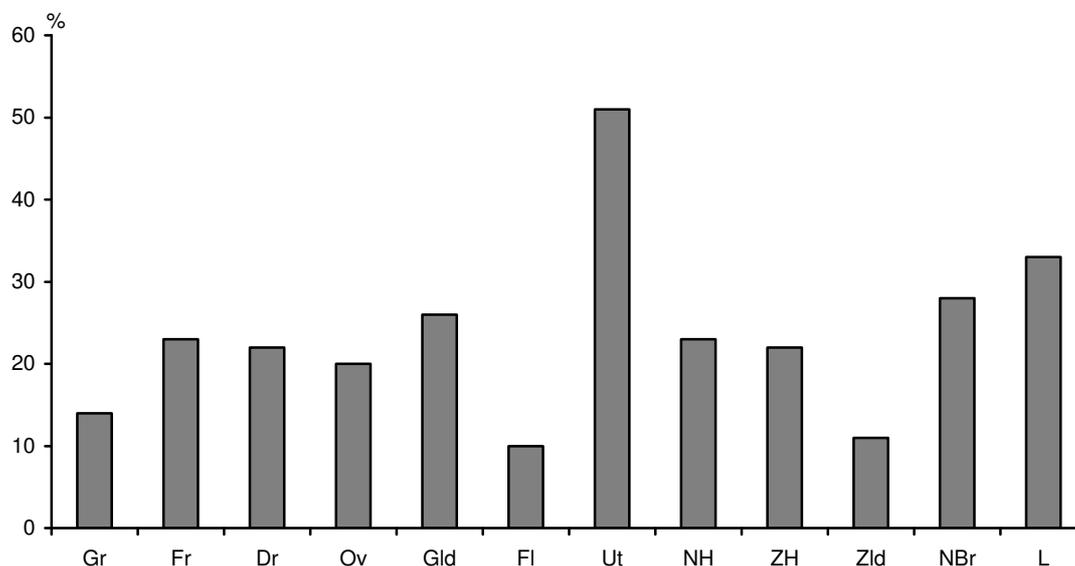
Figure 5.2   Percentage-wise demand for nature development on the total voluntary supply of land in the provinces of Groningen (Gr), Friesland (Fr), Drenthe (Dr), Overijssel (Ov), Gelderland (Gld), Flevoland (Fl), Utrecht (Ut), Noord-Holland (NH), Zuid-Holland (ZH), Zeeland (Zld), Noord-Brabant (NBr), and Limburg (L). Source: Rijksinstituut voor Volksgezondheid en Milieu (1998).

Figure 5.3 shows that an increase of 150,000 ha in the demand for nature areas causes agricultural acreage to decline by the same amount. When the demand for land for agriculture remains the same and the demand for land for nature areas rises, the result is an increase in the total 'green' demand for land. The consequence is a higher price level, with the area under agriculture declining by 150,000 ha and the area devoted to nature expanding by the same amount. The price of this land will also remain higher because more limited agricultural acreage in the future will ultimately mean that only the more profitable crops are retained.
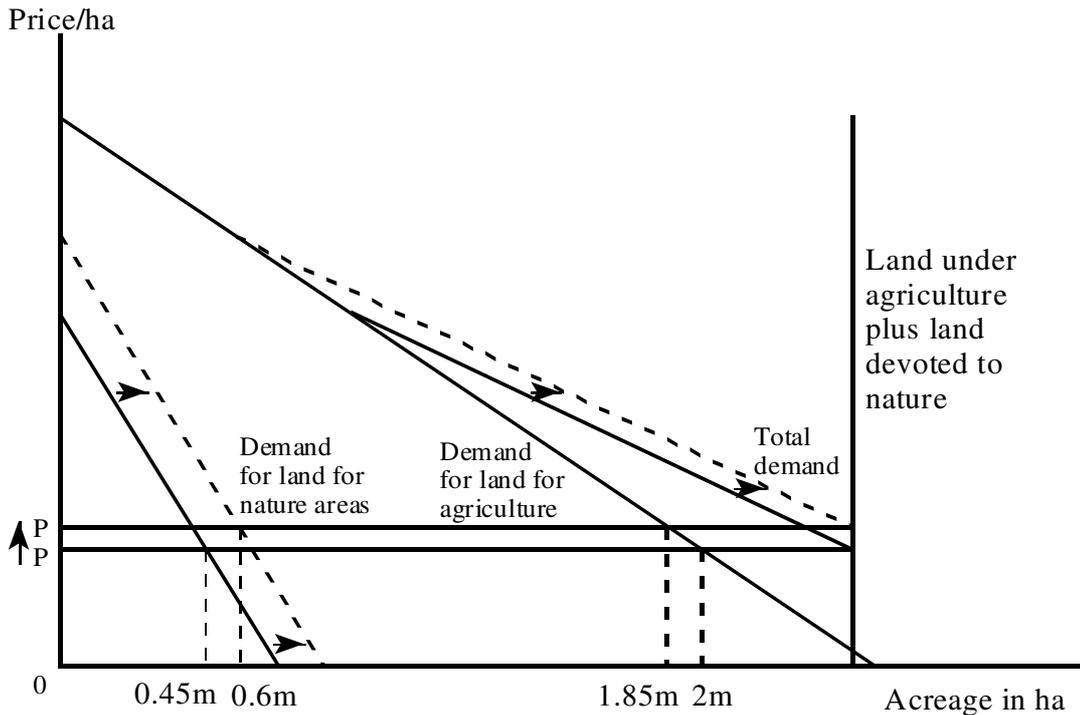
Figure 5.3   Long-term effect on the price of agricultural land of the planned expansion of the EHS by 150 000 ha: from 0.45 m ha in 1995 to 0.6 m ha in 2018.

5.4.2 Ongoing urbanization

The artificial limitation of the 'red' area via the 'Town and Country Planning Act' has created a substantial price difference between 'red' and 'green' zoned land. Table 5.5 illustrates this by comparing hectare prices 'inside and outside VINEX districts'. VINEX stands for *Vierde Nota Ruimtelijke Ordening Extra* ('Fourth Memorandum on Town and Country Planning Extra'). On the map of the Netherlands it points out the new areas for urbanization. 'Outside VINEX districts' means that 'green' activities are concerned. 'Inside VINEX districts' indicates that the area is zoned for 'red' uses. The difference between 'green' and 'red' prices is substantial and increasing year by year. In 1993, for example, the 'red' price was nine times higher than the 'green' price, while the difference in 1997 amounted to a factor of twelve.

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Year	Outside VINEX districts Price/ha	Inside VINEX districts Price/ha
1993	17 200	156 000
1994	17 100	174 000
1995	18 100	207 000
1996	20 000	250 000
1997	21 900	253 000

Table 5.5 Development of prices of agricultural land (in €/ha) outside and inside VINEX districts in the 1993-97 period. Source: Luijt et al. (1999).

The rising demand for residential areas, business premises, infrastructure and nature areas are expressions of an economic upturn. After all, the price level of real estate and the consequent price of building land are supported by the expected growth in income, that is by economic activity (Draper, 1983). The recent boom years and the related price development of real estate are putting a high pressure on the agricultural real estate market segment and the 'Town and Country Planning Act'. This finds expression in the price development of agricultural land, which, as can be seen from Figure 5.4, has been following the general price level of real estate fairly closely over the years.
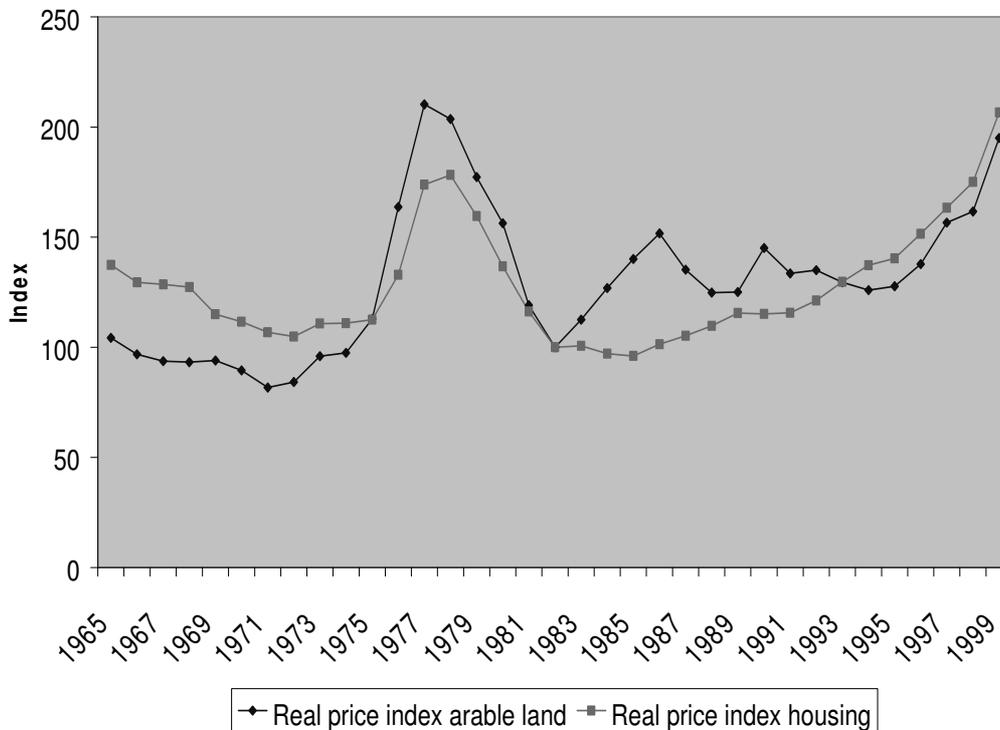
Figure 5.4 Development of the prices of arable land and homes (1982=100) in the 1965–99 period.

According to the Central Bureau of Statistics, the price of agricultural land rose from an average of € 24 000 in 1998 to € 29 500 in 1999. The growth begins increasingly to resemble the explosive growth in land prices of the second half of the seventies. The current rise began in 1995 and there are as yet few signs of stabilization, let alone decline. Corrected for inflation, the high level of the late seventies has now been more or less reached.

Despite the fact that there are a number of significant differences between the present situation and the situation at the end of the seventies, such as the interest rate, inflation, agricultural land price policy, environmental policy, and so on, there is one important similarity: the general increase in real estate prices supported by the booming economy.
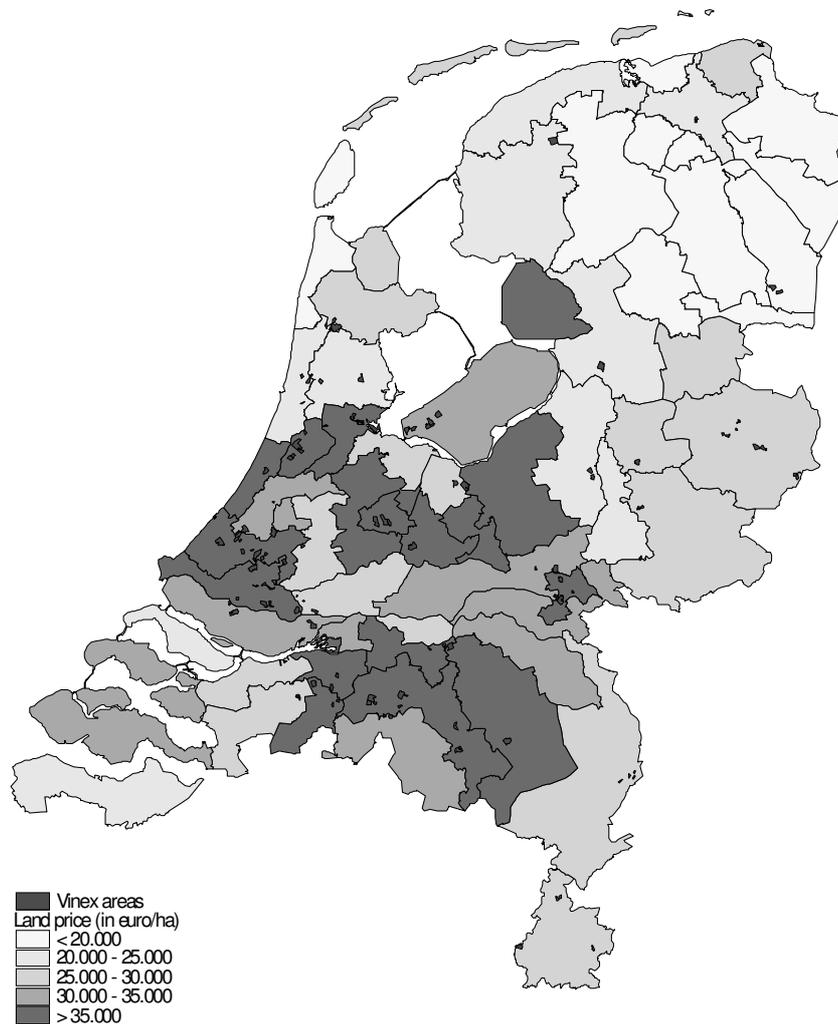
Figure 5.5   VINEX areas and prices of agricultural land zoned for agricultural purposes in 66 agricultural areas in 1998 (€/ha)

Figure 5.4 shows the average price development of agricultural land in the Netherlands. However, the price development differs considerably from region to region, despite the levelling effect of fiscally attractive resettlement within agriculture. While the seventies were primarily characterised by purchases by farms to expand their acreage, now farmers who have been bought out, mainly for 'red' but also for 'green' purposes, are purchasing more and more whole large farms. The fiscally favourable resettlement of agricultural enterprises has not, however, been able to eliminate the regional differences. Figure 5.5 illustrates this and also shows that the prices of agricultural land are highest in areas where urbanization is taking place (VINEX areas). Finally, Figure 5.6 provides an overall survey of the different factors affecting the price of agricultural land.

	Effect on the price of agricultural land
Within agriculture	
Annual income from land	
• Productivity improvements	+
• Deterioration of agricultural terms of trade	-
Policy interventions	
• Production restrictions	-
• Manure legislation	+
• 2.5 livestock units per hectare	+
Competition between agricultural sectors	+
Outside agriculture	
Demand for preservation of nature	+
Demands of ongoing urbanization (incl. resettlement)	+
Low interest	+

Figure 5.6   Survey of factors affecting the price of agricultural land

5.5   Relative importance of factors determining land price

Polman et al. (1999) attempted to estimate the relative importance of the factors determining the price of agricultural land. In the study, a connection was assumed between, on the one hand, the paid market price for land and, on the other, the income from land in agriculture, the share of horticultural land in an area, and the claims on agricultural land under the Vierde Nota Ruimtelijke Ordening Extra (VINEX to 2005) and the Ecologische Hoofd Structuur (EHS to 2018):

(2) $$P_{paid} = a_1 \cdot P_{Shadow} + a_2 \cdot VINEX + a_3 \cdot EHS + a_4 \cdot Horticulture$$

Where : P_{paid} =   the land price paid by a farmer
          P_{shadow} =   shadow price of agricultural land
          VINEX   =   area VINEX/agricultural acreage
          EHS   =   area EHS/agricultural acreage
          Horticulture   =   area horticultural land/agricultural acreage
          a_1, a_2, a_3, a_4 =   parameters

The shadow price of dairy farms indicates what farmers, with respect to the contribution of extra land to the operating result, can pay for this on an annual basis. The shadow price is calculated by means of a balance function. The share of expensive horticultural land in an area reflects the pressure on the price of agricultural land from the horticultural sector. The share of VINEX and EHS claims in an area reflects the non-agricultural pressure on the price of agricultural land for housing, work and nature development. All variables are expected to exert a positive influence on the price of land. The results of the estimate confirm this expectation (Table 5.6).

	P_{shadow}	VINEX	EHS	Horticulture
Mean	933.50	0.011653	0.06868	0.063722
Coefficient	18.13	190 444	217 190	31 349
T-ratio	(11.1)	(2.9)	(9.1)	(2.5)

Table 5.6   Estimated coefficients for the paid land prices on dairy farms in the 1992-95 period (R^2=0.82).

The Figure shows that the price of land can largely be explained by means of the four variables, judging by the high declared variance of 0.82 (R^2=0.82). Moreover, each of the variables provides a reliable contribution to the explanation of the price of land. This is apparent from the t-values of the variables, which are all higher than two. In statistical terms, the variables deviate significantly from zero at a 5 per cent significance level.

The shadow price of land has a positive influence on the paid land price. Based on an infinite time scale, the result is an estimated discount rate of 0.055 (=1/18.13). This is a very plausible result. On average, purchasers demand a return of nearly 5.5 per cent on capital invested in land. To a significant extent, the price of land is determined by the contribution of the maximum bid price for agricultural land. By multiplying the coefficient by the average value (Table 5.6), we find this contribution amounting to some € 7 700. The effect of the VINEX and EHS also seems very plausible. The average VINEX pressure in the Netherlands is 0.011653 (VINEX hectares in an agricultural area divided by the agricultural acreage in that area). And the average EHS pressure is 0.06868 (EHS hectares in an agricultural area divided by the agricultural acreage in that area). We observed a VINEX share

in the land price of € 1 000 and an EHS share of € 6 750. Together, this is more than the estimated bid price for agricultural land (€ 7 700) and thus comparable with the agricultural share. Furthermore, the fact that the EHS share is larger than the VINEX share is plausible. After all, in the case of the EHS the acreage to be transferred is much greater. On the other hand, the purchase prices in the case of VINEX are usually much higher.

In the medium term, the effect of the joint non-agricultural claims on the price of agricultural land is thus roughly as great as the profitability of land on the dairy farm (the shadow price), approximately 47 per cent. The remainder, some 6 per cent, was accounted for by land-intensive horticulture. The total of these contributions amounts to more than € 16 000. The difference with the observed paid land price in the 1992-1995 period should be ascribed to the unexplained portion of the variance.

5.6   Future: a land price spiral?

The use and organization of the limited land available in the Netherlands is one of the most challenging issues for the coming decades. As yet, the issue is far from being resolved. Viewed separately, the environmental, nature, and agricultural policies might be consistent with the goals they are supposed to achieve, but in interaction they are conflicting and preclude the simultaneous achievement of these very same objectives. The agricultural land market was shown to play a pivotal role in this network of interactions. Among the chapter's major conclusions are the following:

High (higher than on the world market) guaranteed prices (EU market and price policy) in combination with technological development lead to expansion of production and increase of scale. Since increase of scale via expansion of acreage is only possible in dribs and drabs, due to the mainly demographically determined rationed supply of agricultural land and the massive non-agricultural claims on it, land use is becoming more and more intensive, although sometimes curbed by production restrictions such as quotas that give rise to costly production rights.

The expansion of production, primarily through intensification, has had effects both on the price of land and on the environment. After all, the whole situation gave rise to high land prices, an increasingly strict environmental policy and a demand for nature policy. Initially, environmental policy took shape through restrictions on manure deposits on the land. On balance, that led to an increase in the price of land. And when environmental policy also starts setting requirements with regard to the intensity of cattle holding (2.5 livestock units per hectare in 2008), land prices will rise even more since the quota price will then overflow into the land price. Finally, nature conservation policy is taking shape via the acquisition of agricultural land in the agricultural segment of the real estate market, until now on a voluntary basis. In consequence, an extra demand for land will be made, with the result that the price of land will rise once again. In addition, a high price may nourish proprietors' beliefs that the price increase is not yet at an end. As a result, landowners dampen the supply of agricultural land and inflate the price again.

When the economy is booming, the demand for agricultural land for urbanization heightens greatly, which in combination with an unsteady 'Town and Country Planning Act', drives up land prices. High prices severely complicate the achievement of environmental and nature policy objectives in at least two ways. First, it raises the cost of acquisition of agricultural land for the Ecological Main Structure. Second, it increases the pace of development of the agricultural structure, resulting in a continuing decline in the number, but an increase in the scale of agricultural enterprises. Economies of scale contribute to the efficiency of the remaining agricultural enterprises, but at the risk of an increased uniformity in terms of outward appearance, causing rural areas to lose their natural identity.

To sum up, the EU market and price policy, with the exception of the milk quotas, caused the price of land to rise, and subsequently the land price rose again due to the environmental and nature policy needed to compensate for the negative effects of that agricultural policy. Finally, the present economic boom is creating a great many 'red' claims on agricultural land, causing the price of agricultural land to rise along with the general increase in real estate prices. For farmers, the resulting extremely high land price is reason to make even more intensive use of land. The interaction between agricultural policy, environmental policy, nature policy and town and country planning policy via the real estate market is plain to see.

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6. The AMS in agricultural trade negotiations: a review

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This article reviews the role of the Aggregate Measure of Support (AMS) in the agricultural trade negotiations of the Uruguay Round. Contrary to expectations at the start of these negotiations, the AMS only occupies a subsidiary position in the final agreement. In order to explain this, first an economic analysis is presented of the Producer Subsidy Equivalent (PSE), the basic AMS concept in the GATT discussions. Secondly, the political AMS debate is described and analysed, using information from unpublished GATT documents. Although the PSE concept is based on simple assumptions, its measurement already meets a number of difficult problems (policy coverage, product coverage, external references prices, currency). Once these are solved, the concept may offer a brief insight into actual governmental support in agriculture. However, the calculations do not provide a sound measure of the trade distortions caused by agricultural policies. Mainly for that reason, the idea of a pure aggregated approach - based on the AMS - proved unsuccessful in the negotiations. Instead, the Contracting Parties accepted the framework of making binding agreements on three separate areas: internal support, market access and export support. While important and very specific commitments were made in the areas of agricultural imports and exports, the AMS has only found application in the internal support area.

Keywords: AMS, agricultural trade negotiations, PSE

6.1 Introduction

In agricultural economics, much attention has been given to Aggregate Measures of Support (AMS) (cf.: Tangermann et al., 1987; Schwartz and Parker, 1988; Hertel, 1989; Josling and Tangermann, 1989; Peters, 1989). Such concepts have been developed to measure the extent, structure and development of agrarian protection in the world. A well-known example of this is offered by the annual reports of the OECD on *Agricultural Markets, Policies and Trade Monitoring and Outlook*, which focus on Producer Subsidy Equivalents (PSE) and Consumer Subsidy Equivalents (CSE) in OECD member countries.

Interest in support measurement was heightened during the Uruguay Round of GATT negotiations on agricultural trade. At the start of these negotiations in 1986, the Contracting Parties expressed their intention to develop an AMS which could bring the wide range of existing agricultural support policies under one roof. The concept should be used not only for monitoring purposes, but also for making binding commitments. Ideally, such commitments could even replace the existing GATT concessions and regulations. In view of this, the AMS was regarded as the central plank on which a new agreement could be based.

This was not realized. In the final GATT agreement, which was signed and ratified in 1994, the AMS only appeared as one of a number of elements, not the key element. Questions about why and how that result was achieved have not been fully addressed in the literature. This article aims to fill the gap by offering a review of conceptual and political issues. It combines work from the authors on economic and political aspects of the AMS (Hamsvoort, 1994; Silvis, 1994). The next section presents an analysis of the PSE, which served as the basis concept of the AMS discussions in the Uruguay Round. Subsequently, Section 3 deals with the debate on the AMS, in chronological order, between the Contracting Parties. Information for this section was retrieved from unpublished GATT documents. The article concludes with a synthesis of the arguments and factors that explain the position of the AMS in the GATT agreement.

6.2   The PSE as an aggregate measure of support

6.2.1 The choice of the PSE

This section describes and analyses the PSE concept as an AMS. First, however, attention must be given to the preliminary question as to why the PSE was actually taken as the basic concept for the GATT discussions on the AMS. This choice was a practical one, and based on availability and measurability.

The PSE concept was developed in the 1970s by the agricultural economist Timothy Josling for the Food and Agriculture Organization of the United Nations (FAO) as a general measure of agrarian support. The concept became well-known in the 1980s when the OECD began using it to implement the Ministerial Trade Mandate of 1982: the ministers required estimates of the extent of government support for a range of products occurring in OECD countries. The American Ministry of Agriculture (USDA) was also working intensively with PSE estimates to provide US trade negotiators with quantitative information on the agriculture and trade policies of other countries (USDA, 1987).

One of the considerations made by the OECD and USDA in choosing the PSE concept was that more government policies could be incorporated in the estimates than would be possible using the traditional measure, the Nominal Rate of Protection (NRP). In principle, the latter only reflects the relation between the domestic market price and the world market price. Another important consideration was that the PSE can be calculated using available data and sources. This would definitely not have been possible with the theoretically more advanced measure, the Effective Rate of Protection (ERP). To calculate the ERP, that intends to reflect the protection of the added value to a sector, support in all sectors has to be taken into account, including the non-agrarian input sectors. Moreover, its calculation requires

estimates of prices and input-output coefficients in the hypothetical situation of free trade (Strak, 1982).

6.2.2 Definition and forms of presentation

According to OECD (Cahill and Legg, 1990:15):

> "The PSE is an indicator of the value of the transfers from domestic consumers and taxpayers to producers resulting from a given set of agricultural policies, at a point in time."

Calculation of the PSEs aims to evaluate the scope of income transfers resulting from government policies. The OECD distinguishes five categories of agricultural policy: market price support, direct payments, input subsidies, general services, and other indirect support measures. In the case of market price support, income transfer occurs because the domestic market price differs from the price at the border (world market price). Since, in OECD countries, the domestic price is usually higher, it creates, in effect, a transfer to producers. The scale of a specific transfer is measured by multiplying the relevant price difference by the domestic volume of production. How this affects the government budget is only an issue in so far as a difference exists between domestic production and consumption. Disregarding inventory fluctuations, this difference corresponds with international trade. The budget benefits from taxes on imports and is burdened by subsidies on exports. Transfers to the producers by means of the other government measures are, however, paid entirely from the budget, accordingly.

The PSE is expressed by the OECD in four different ways:

(1)   as the total value of the transfers to a product or group of products;
(2)   as the value per unit of output;
(3)   as a percentage of the domestic production value (including production-dependent transfers), or, of the consumption value; and
(4)   as a Nominal Assistance Coefficient (NAC).

Expressing the values in percentage form makes it easier to compare the relative support levels over time and between products and countries. The NAC reflects how the implicit domestic price is related to the world market price of a product. The implicit price is calculated here as the sum of the world market price and the PSE per unit. The advantage of NAC values is that they are easy to read: a value of 1 means there is no difference, and a value of 2 means that the calculated domestic price is twice as high as the world market price. The conversion of PSEs into NACs is based on the assumption that all government policies per unit of transfer contribute equally to the particular price differences. Very little can be said against this assumption with respect to market price support and deficiency payments, as long as no special restrictions are attached to the support. However, with respect to other government policies, such as financing of research and training, the assumption is highly debatable. The OECD recognizes this problem, but it does not consider the measurement error to be large, because, as a rule, this type of policy constitutes only a small part of the total support (OECD, 1991).

In calculating the transfers to producers, input subsidies are taken into account, but cost increases of agrarian production methods resulting from government policies are not. However, OECD recognizes one exception to this rule, namely feed. The so-called "feed adjustment" measures the additional costs for livestock farmers resulting from taxes on, and market price supports, of animal feed. With this adjustment, the so-called Gross Total PSEs for livestock products are converted into Net Total PSEs. By adding together the PSEs of all the products to create a PSE for the agrarian sector as a whole, double counting market price support is avoided (OECD, 1991).

6.2.3 Measurement issues

In concrete applications of the PSE concept for various countries and products, a number of problems arise. The following is a short summary of how OECD has dealt with the most important of these. More detailed information can be found in the literature (OECD, 1987, 1990).

Policy coverage. An important difference between the PSE approach originally used by FAO and that adopted by the OECD is that the latter has a much broader policy coverage. The FAO limited itself to product-specific policy measures and paid no attention, for example, to structural policy measures, training and research (Josling and Tangermann, 1989). In contrast, the OECD has consistently tried to include, in the calculations, all agricultural policy measures that affect agricultural production, consumption and trade. However, the availability and usefulness of data are limiting factors for this approach. An important area of concern for OECD was how to achieve the desired consistency in estimation. It is generally known that large discrepancies exist between the availability and quality of data on subsidies, tax facilities and sub-national expenditures. Caution should thus be taken in comparing the PSE estimates of different countries and products (Cahill and Legg, 1990).

Assignment problems inevitably arise in considering policy measures that are not product-specific. The OECD has generally chosen to assign transfers to products based on their part of the domestic production value. Special problems exist with respect to compensations for the withdrawal of the means of agricultural production (e.g. area limits, or quotas), and with respect to unlinked income subsidies. Such policy instruments are becoming increasingly important in OECD countries. The assignment of transfers to products is done case by case "on the basis of the design of each policy programme, but is still subject to debate", according to Cahill and Legg (1990, p. 24).

Product coverage. One of the OECD criteria for selection was that the most important products from its member countries would have to be covered. A second was that the products would not pose any insurmountable calculation problems. On that basis, a standard list was compiled of a limited number of temperate-zone products, including wheat, corn, rice, soybeans, sugar, milk and a few types of meat. Important products excluded are vegetables, fruit, wine and olive oil. To make calculations for a country, products from the list are used unless they constitute a negligible part of the agrarian production value. The OECD estimates that, in the calculations for the period 1986–1989, an average coverage per country of 80% of the total agrarian production value was achieved. Exceptional positions were held by Japan (65%) and Canada (85%) (Cahill and Legg, 1990).

External reference prices. Determination of world market prices has proven to be the most controversial issue faced by the OECD since the levels and trends of PSEs largely depend on them. Considering the pressure created by high PSE estimates, it is not surprising that each country can advocate specific corrections.

Reference prices for the individual countries have been derived, whenever possible, from the market prices at the country's border. For net-exporting countries, the prices are derived on the basis of a 'free-on-board' (f.o.b), and for net-importing countries on the basis of 'cost, insurance, freight' (c.i.f) concept. Thus the reference prices vary by country. An attempt was made to reach an agreement on common reference prices, but this was only successful for milk, a basis for which was found in the milk price of New Zealand. For the other products, it appeared that there was insufficient homogeneity between the countries to determine a common reference price. Differences in the quality and production phase of products on domestic and foreign markets were tackled with the help of technical coefficients and price corrections. Obviously, discussions on this topic are politically charged (Cahill and Legg, 1990).

6.2.4 Some comparative results

To illustrate, a number of PSEs calculated by OECD are given in Table 6.1. The values represent a summation of the PSEs of all selected goods. Total PSEs are given in both American dollars and ECUs. The values listed are only totals: they do not indicate how the support is divided between the products, or what it consists of. The Table provides information on the annual scope of agricultural support; it demonstrates that agricultural support in the OECD in absolute terms is dominated by the large trading countries (the EC, US and Japan), though the degree to which agriculture is supported varies greatly. In the US, the average NAC gap is relatively limited, namely one-quarter. The contrast with the EC, Japan and Norway is obvious. Furthermore, it appears that the measured change in agricultural support depends on the currency used. Thus, a PSE increase in ECUs between the years shown can coincide with a PSE decrease in American dollars.

6.2.5 Interpretation

The interpretation and possible uses of PSE outcomes became the subjects of lively discussion, stimulated, in part, by the OECD summary report of 1987 (Peters, 1989). One of the main questions was whether the PSE is an adequate measure of trade distortion caused by governmental agricultural policies. Analysis of the concept revealed that this is not the case.

The central, but highly unrealistic, assumption behind the calculation of the PSE is that the concept's variables are independent quantities. The external reference prices are considered to be measures of the value (opportunity costs) of the products in an area. No substitution is made of production methods and products. It is further assumed that the specified products are homogenous for producers and consumers.

Country	Units	1992 (e)	1993 (p)
Canada			
Net total PSE	US$ mn	5990	4773
Net total PSE	ECU mn	4628	4074
Net percentage PSE	%	38	32
Average producer NAC		1.52	1.40
EC			
Net total PSE	US$ mn	82,794	79,574
Net total PSE	ECU mn	63,969	67,932
Net percentage PSE	%	47	48
Average producer NAC		1.85	1.93
Norway			
Net total PSE	US$ mn	3086	2664
Net total PSE	ECU mn	2384	2274
Net percentage PSE	%	77	76
Average producer NAC		4.89	4.49
US			
Net total PSE	US$ mn	25,407	28,352
Net total PSE	ECU mn	19,631	24,204
Net percentage PSE	%	21	23
Average producer NAC		1.25	1.29
Japan			
Net total PSE	US$ mn	36,071	34,991
Net total PSE	ECU mn	27,870	29,603
Net percentage PSE	%	71	70
Average producer NAC		3.02	2.93
OECD[a]			
Net total PSE	US$ mn	168,286	163,120
Net total PSE	ECU mn	130,024	139,256
Net percentage PSE	%	41	42
Average producer NAC		1.52	1.52

[a] Excluding Turkey.
e: estimate. p: provisional.

Table 6.1   OECD Producer Subsidy Equivalents of selected countries in 1992 and 1993.

Such assumptions make it possible to use factual data on prices and quantity (domestic and international prices, the means of production utilized, the products produced and consumed). The measurements are thereby given a purely static character; PSEs do not

gauge *dynamic* effects. Thus the outcomes cannot predict trade effects; they simply shed light on an existing situation.

The OECD is now clearly, and rightfully, distancing itself from the view that the PSE could be a suitable indicator of trade distortion. For example: equal PSE and NAC values do not indicate whether they involve a system of production quotas or an unconditional price guarantee; but the effects these different policies have on trade may vary considerably. The role played by the particular country in the world trade of a product is also an important factor. When considering the grain policy of the US, or the dairy policy of the EC, it is unrealistic to apply the small-country assumption that world prices remain unchanged. Consequently, the conclusion can be drawn that the PSE is not a sound measure of trade distortion (Ballenger, 1988; Schwartz and Parker, 1988; Cahill and Legg, 1990). Apart from the measurement issues, this fact severely limits the possible uses of the concept in attaining the objectives of the GATT negotiations.

6.3 The AMS in the Uruguay Round

6.3.1 Introduction

According to the Punta del Este declaration of 1986, the objective of the Uruguay Round was to reach an agreement on the progressive reduction and, wherever possible, the elimination of trade restrictions and distortions arising from agricultural policies. In the specific negotiating proposals made before the end of 1987 by the US, Cairns Group, Canada and the EC, reductions across the board were suggested, which can only be monitored by similarly comprehensive measures (Josling and Tangermann, 1987). For reasons already explained, the PSE concept was favoured as the most suitable AMS and from that moment on, its measurement and use has been discussed intensively in GATT circles at both conceptual and practical levels.

Conceptual issues were discussed by a Technical Working Group (TG) whose only target was to deal with the AMS and related issues. The results of the TG corresponded well with the conclusions arrived at in the previous section. The political issues were discussed by the Negotiating Group on Agriculture (NG5), which has primary responsibility for the sector in the Uruguay Round (Runge & Stanton, 1988). We will now turn to the discussion in this Negotiating Group. The negotiations are described in chronological order, starting with the first note of the NG5 in 1987, followed by the Mid-term Review (1988), the Dunkel paper (1991) and the Blair House Agreement (1992), and ending with the GATT agreement reached in 1993.

6.3.2 AMS issues and the views of contracting parties

Discussion on the AMS/PSE between the Contracting Parties of GATT was launched in September 1987 by a note of the NG5 group (GATT, 1987). This raised a number of issues, which had to be dealt with by the Contracting Parties in order for the AMS to be used in the negotiations. The issues and the views on them expressed by the EC, US, Cairns Group and Scandinavians are summarized in Table 6.2, which is based on several GATT documents (GATT, 1988b-h). Important points are:

(1) *Optional use*. Four different options were described for using the AMS: the "pure" PSE approach, in which the PSE would serve as the more or less central basis for binding commitments (option I); the "target" option, in which the PSE would serve as a basis for an agreed target to be achieved by commitments on policy measures (option II); the PSE as a monitoring device, that should be used to check whether progress in the reduction commitments has been made (option III); and the PSE as a means of strengthening and clarifying current GATT rules and disciplines (option IV).

Almost all contracting parties said they favoured a monitoring role for an AMS. The EC was alone in favouring a "pure" approach in which the AMS would serve as a basis for commitments with respect to support reduction in the long term. The EC hoped, in this way, to avoid making separate agreements on agricultural imports and exports. The specific measure was the SMU (Support Measurement Unit), which differs from the PSE of the OECD in part because only the most trade-distorting measures would be included, and a bonus (credit) would have to be rewarded for meeting production limiting regulations. However, the EC also wanted to isolate the as-yet undetermined support decreases from changing world market prices and exchange rates. That is why SMUs would have to be expressed in national currency, and fixed reference prices would have to be used in making the calculations. This would ensure that changes in the SMU are due only to the modification of support policies (GATT, 1988c).

(2) *Policy coverage*. Which policies should be included? Should all policies, only the trade distorting policies or another group of policies be included? There seemed to be agreement on this issue in that all contracting parties focused on inclusion of the trade-distorting policies. However, only Canada really defined which policies should be regarded as trade distorting.

(3) *Product coverage*. Which products should be included? Should the AMS be calculated for all products, only for products of which information was available or only the products that distort trade most? The parties more or less agreed to start with surplus products because they are the most trade distorting. At a later stage product coverage could be extended.

(4) *Country coverage*. Should the number of countries involved be as large as possible in order to cover a substantial part of production and trade of the product concerned, or should only a selected group of countries be included? The opinions on this issue also seemed to be in agreement. The general consensus was to ultimately make country coverage as wide as possible, but to first take the practical problems into account. This meant that, in the short term, only the countries that distort trade the most should be covered.

(5) *Reference or base period*. Which reference year or period should be chosen as the starting point in the negotiations? Should this be a common reference period, with the risk of not reflecting the most actual support policies, or a reference period that differs per country, but which reflects the most recent situation of the countries concerned? Opinions on this issue varied considerably among the contracting parties. From the overview in Table 6.2, it can be concluded that this was an important political issue. The EC proposed 1984-

Issue	EC	US	Cairns	Nordics
Use	Negotiating binding commitments, using the SMU as AMS.	Only monitoring role for PSE/AMS.	Target-approach, using AMSLOB as AMS.	Monitoring role. AMS not suited for binding commitments.
Policy coverage and decoupling	Market support and direct income payments. Possible exceptions.	All support measures, except bona fide food aids and decoupled safety net payments. Subnational payments if appropriate.	Trade-distorting subsidies and access barriers, including sub-national policies. Direct decoupled income assistance and natural disaster assistance should be excluded.	Measures which only have minor trade effects could be excluded. These should be clearly defined. Most of development assistance programmes could be excluded.
Product coverage	Products in surplus as far as SMU commitments are concerned. Other products at later stage.	All agricultural products, fish and forestry products. Surplus products possible criterion for starting point. Move on to products for which trade restrictions/ problems are greatest.	Widest possible range of agricultural products. Early action: products for which output-based support is greater than 10%.	Product coverage of OECD PSE as starting point.
Country coverage	As wide as possible, including developing countries, even those with negative PSE.	As wide as possible.	Early action (1989-90) by certain developed countries; fuller participation thereafter.	Support a pragmatic approach in developing PSE with greater country coverage.
Reference period	1984/85: policy profile for all countries and commodities.	Need for logical basis and mutual acceptability. Should reflect current levels of support: 1986, or 1988 if process starts in 1989.	Most recent (1988).	Multi-year average immediately preceding the Punta commitment.
External reference price	Lowest external reference price calculated by the OECD (1979-87) to be selected according to country and commodity. Remains fixed.	Should reflect market reality.	OECD methodology: country specific border price for competing products.	Depends on option selected. Under III fluctuating market prices. C.i.f./f.o.b. smoothing.
Monetary fluctuations	Resolved through fixed reference prices.	OECD methodology. Possibility of averaging not rejected.	OECD methodology. Possible moving average.	Moving average/currency basket worth exploring.
Supply control	Credit for effective supply control. Case by case: conservation programmes but not set aside linked to deficiency payments.	Adequately reflected in Total PSE. No blanket credit. Resources would have to be withdrawn from production.	Adequately measured by Total PSE. No special adjustment technically required.	Diversion payments should be excluded from PSE calculations (for some time).

Table 6.2   Synopsis of views on the AMS by selected Contracting Parties.

1985 as the reference year combined with the use of the SMU. This would best take into account the agricultural reforms put into effect since 1983. However, the Cairns Group (including Canada), as a major agricultural exporter, was in favour of using the most recent base period.

(6) *Reference price*. Which reference price should be used, a moving average of several years, a fixed reference price or something else? This raises issues very similar to those related to the reference period. While some contracting parties, like Canada and the US, were in favour of using reference prices that best reflected market reality, the EC was in favour of fixed external reference prices (the lowest of the period 1979-1987) because those prices take better account of CAP reform.

(7) *Monetary fluctuations*. Exchange rate and world price fluctuations are exogenous factors that can influence the AMS of a country even if it has not changed its policies. According to most contracting parties, this could be dealt with by a moving average of the two or three most recent years. Only the EC wished to use a fixed external reference price, for the same reason as that mentioned in the previous paragraph.

(8) *Supply control*. It has been stated that the effect of domestic supply control policies on world trade is underestimated in the AMS. The question is therefore whether credit should be given to countries applying them. The EC (see point 1) and Canada were in favour of correcting the AMS with a credit for supply control. The other contracting parties disagreed with this position, stating that supply control policies were already accurately measured by the AMS.

This overview illustrates that opinions varied, but that the idea of using an AMS was not totally rejected. Only Japan was completely uninterested in using an AMS as a negotiating instrument, a position undoubtedly influenced by the high level of support.

6.3.3 After the Mid-Term Review

After 2 years of discussion on the AMS, a fundamental decision was taken in April 1989. A few months after the failed "Mid-term Review", held in Montreal at the end of 1988, agreement was reached on a framework for further negotiations. This entailed that the parties would negotiate specific binding agreements in each of the following areas: domestic support, market access (import regulation) and export support. The division of the problem into these three areas effectively meant that the parties rejected a completely aggregated approach to negotiating, such as was proposed by the EC. Apparently, the other parties took the view that trade-distorting measures, such as import restraints (e.g. Voluntary Restraint Agreements – "VRAs") and export subsidies were not adequately represented in an AMS.

The role of the AMS was not totally diminished, however, since it remained relevant to domestic support, and discussion continued. Two of the points were the choice of reference period and the question of which government measures should be freed from reduction requirements (the "green" policies) and which policies were regarded as trade-distorting and should be subject to reduction (the "amber" policies).

6.3.4 The Dunkel paper

At the end of 1991, the secretary-general of the GATT presented a compromise proposal for the negotiations in what was named, after him, as the Dunkel paper. Conforming to the agreed framework, this paper outlined specific agreements on internal support, market access and export support. The AMS was assigned a role as a basis for limiting internal support and as an aid in monitoring compliance. The proposed form for the AMS was a total value amount (comparable to the total PSE).

With respect to the policy coverage of the AMS, the Dunkel paper stated that all internal support policies should be included, except those that have no, or negligible, trade-distorting effect. Two general criteria and specific criteria for each policy measure were put forward. Newly introduced policies, for which no specific criteria existed, would be checked against the two general criteria namely that:

- the support in question shall be provided through a publicly-funded government programme not involving transfers from consumers;
- the support in question should not have the effect of providing price support to producers.

The measures for which specific criteria have been established are:

- Government Service Programmes: research, training, and extension and advisory; pest and disease control; inspection; marketing and promotion, excluding expenditure for unspecified purposes that could be used by sellers to reduce their selling price or confer a direct economic benefit to purchasers; infrastructural services.
- Public stockpiling for food security purposes.
- Domestic food aid.
- Decoupled income support.
- Government financial participation in income insurance and income safety net programmes.
- Disaster payments.
- Structural adjustment assistance provided through: producer retirement programmes, resources retirement programmes, investment aids.
- Payments under environmental programmes.
- Payments under regional assistance programmes.

These programmes are all subject to detailed specification, which need not be elaborated here. However the most important condition is that all direct payments should not be related to the type of production, the production level (including payments granted per animal), internal or international prices and production factors. According to the Dunkel paper, only when the programmes meet the two general criteria and their specific criteria, will they be exempted from the proposed AMS reductions.

6.3.5 The Blair House Agreement

The Dunkel paper was resolutely rejected by the EC, but it did, nevertheless, eventually form the basis of the "Blair House" Agreement reached in November 1992 between the US and the EC. This bilateral deal that would later be almost entirely incorporated in the finalized GATT settlement contained special agreements on grain substitutes and oil seeds. It also contained provisions on market access (imposing of tariffs, tariff reductions, and tariff contingents), export support (budget and volume decreases per product) and internal support.

With respect to the latter, the EC and the US agreed upon a general reduction of 20% of the AMS for all products for the period 1994-2000. The EC and the US thus assigned a different role to the AMS from that accorded in the Dunkel Paper, which called for a 20% reduction of the AMS for each product individually. The combined basis of the AMS would give countries more flexibility in reaching their commitments, allowing them to meet the overall target by reducing the AMS of one specific product by more than 20%, while leaving the AMS of other products unchanged.

Another addition of utmost importance to the EC is the exemption of the conditional subsidies (per hectare and per animal) that had just been introduced in the EC's own agricultural policy as part of the MacSharry Reform. Two of the conditions for this exemption are that the support should be as production-neutral as possible (for example by connecting it to historic yields) and that production-limiting measures would be required if a producer wishes to receive the support. The hectare subsidies comply with both conditions, as do the premiums in the animal sector. However, this does not mean that the subsidies and premiums would permanently fall under the "green" category; the provision would last only for the duration of the GATT agreement (6 years).

The two most influential parties of GATT had thus assigned a role to an AMS, but in the form of a slimmed down version of the Total PSE for all products. In addition, this role was aimed not at trade (import and export) in agricultural products, for which separate agreements were made, but only with the reduction of internal support.

Compared to the other provisions, the role of the AMS agreement seems to hold little weight. The Commission of the EC had already noted that producers could comply with the agreement easily and without any disadvantages (Commission of the EC, 1992:6):

> "The maximum AMS allowed after the reductions is 65 million ECU. The effects of the reform of the common agricultural policy and the fact that the direct income support for the producers is not included in the calculations of the AMS legalize the expectation that at the end of the six years the AMS will total 52 billion. The margin of safety is thus considerably large."

6.3.6 The final agreement

The Blair House agreement made it possible for negotiations with the other Contracting Parties to resume, in order to reach a final GATT accord. This was reached in December 1993. Apart from some technical points, the Blair House

agreement was accepted in its entirety. When one compares the position of the AMS in the final agreement with the original views of the contracting parties, one must conclude that a real compromise was reached.

The optional use of the AMS is twofold: it has the function of being a binding commitment, and it has a monitoring role. However, the AMS will only be applied to one of the areas, namely the internal support area, and only with many exemptions. This outcome is, in fact, a logical consequence of the negotiations. Almost all contracting parties agreed that only trade-distorting policy measures should be taken into account. All parties had opinions about the policies which should be included in, or excluded from, the AMS, but there was a large "grey" area of policies that were left out. The final policy coverage closely resembles the policy coverage used in the Aggregate Monetary Level of Output-Based Support (AMLOBS) as proposed by the Cairns Group. This is a PSE derivative which only covers policies that directly affect production.

The issue of possible credits for countries applying supply control policies has been widely discussed by the contracting parties. The final GATT agreement does not devote many words to this problem. The only context in which it receives attention is in the conditions required to exempt direct payments under production-limiting programmes from internal support reduction.

The remaining points relate to fluctuating external reference prices and exchange rates, and the choice of the base year. With respect to the world price and exchange rate fluctuations, most contracting parties were in favour of taking a (changing) average of the most recently available reference prices and exchange rates in order to best reflect the market reality and the current support situation. However, the EC proposed the use of a fixed external reference price, which would solve the problem of fluctuating external reference prices and the problem of fluctuating exchange rates. In the agreement, a compromise was made to use a fixed external reference price based on the 3-year average of 1986-1988, with the period also being the average of these years.

6.4   Synthesis

In the foregoing section it was shown how an AMS became one of the elements in the final agreement of the Uruguay Round. Thus the intention expressed by the contracting parties at the start of the negotiations to develop, and use, an aggregate measure of support was realized. However, the final role of the AMS does not correspond with the idea that the concept should become the key element of the agreement. The material presented in this review shows that the final outcome has conceptual, as well as political, reasons.

If one considers measurement problems and costs, the choice of the PSE, as the basic concept of the AMS discussions, was a practical choice. However, conceptual analysis shows that the PSE and its derivatives are not a sound measure of trade restrictions and distortions caused by agricultural policies. Limiting or reducing PSEs does not guarantee that the trade-distorting effects of national import and export policies will decline. Added to this is the practical problem that the development of PSEs, due to exogenous factors, such as exchange rate fluctuations, can only be minimally controlled by the countries themselves.

Already, in April 1989, the pure aggregated approach to the negotiations was rejected, when the contracting parties accepted the framework of making binding agreements on three separate areas: internal support, market access and export support. From then on, the AMS only played a role in the internal support area. The negotiations in the areas of market access and export support would result in very specific commitments. In our view, this enabled the negotiations in the internal support area to stick with the aggregated approach.

The internal support area (and with it the role of the AMS) did not evolve as a very critical element in the negotiations. Compared to the broad policy coverage of the PSE, many government measures were taken out of the AMS and freed from reduction requirements (the "green" policies versus the "amber" policies). Agreement was reached upon a general reduction of the AMS for all products together, creating great flexibility in reaching the commitment, but at the same time undermining its effectiveness. Further, the deficiency payments in the US farm policies and the conditional payments that had been introduced in the EC as part of the MacSharry Reform, were excluded from the reduction requirements. Thus, a role was assigned to the AMS, but only in the form of a slimmed-down version of the Total PSE for all products, and not covering the more crucial areas of agricultural imports and exports.

The question remains as to why it was still regarded as important to write an AMS provision into the agreement rather than to abandon it completely. Was it because the contracting parties did not wish to abandon the starting position? Alternatively, was it because there will eventually be a new negotiation in which an AMS might play a more important role? Time will tell!!

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7. Conclusions and directions for future research

We have presented a variety of allocation problems in the earlier chapters. The topics covered in this volume are a small contribution to the existing literature on resource allocation theories, which have covered a great deal of ground since Adam Smith's seminal piece. Besides providing a summary and presenting the main conclusions in the next section, this final chapter suggests some directions for future research against the background of the theoretical developments since Paul Samuelson's pure theory of public expenditure in the early '50s.

7.1 Summary and main conclusions

7.1.1 The allocation of the planet's capital stocks

'Sustainability' has risen high on the political agenda in recent years, yet no agreement has been reached as to what sustainability exactly means. The definition of sustainability given in the Brundtland report - probably the most widely quoted definition - expresses two key concerns also present in many other definitions: recognition of the long-run impact of resource and environmental constraints on patterns of development and consumption and concern for this impact on the well-being of future generations. While most people will readily agree with these concerns and the content implicitly referred to, a precise description of the goals to be achieved reveals the vast contradictions that linger below the surface of the concept. We argued that these contradictions have emerged because of two issues that obscure the sustainability debate. The first concerns the still ongoing debate between economists and ecologists holding different visions about the limits of economic growth and the carrying capacity of the Earth. The second issue relates to the observed discrepancy between theoretical sustainability and practical sustainability. Both issues trouble the sustainability debate because people think they are addressing the same issue, when in fact they are not. In chapter 2, we addressed both of these issues and analyzed their implications for the sustainability debate.

A number of conclusions can be drawn. First, the analysis supports the notion of strong sustainability. This suggests that the controversy between economists and ecologists can be largely considered as unproductive because their notions of sustainability are not sufficiently underpinned by theory. Assuming that we are correct, the logical question can be raised: why then is the debate not yet at an end? Costanza (1995) argues that the ongoing debate can be attributed to the general lack of interest among the majority of economists in problems of the environment, and a parallel lack of interest among the majority of ecologists in economic issues, combined with a lack of dialogue between the two groups.

The analysis also shows that the theoretical concept of strong sustainability is hard to put into practice because the setting of correct sustainability constraints is hampered by substantial uncertainties and lack of knowledge, and because it

appears unlikely that human society will be prepared to pay the bill for reverting to a path of sustainable development. It is important that these discrepancies between theory and practice are clearly recognised in order to avoid misunderstandings between scientists and policy makers trying to implement policies for sustainability. In response to these problems, advocates of strong sustainability now generally acknowledge that only some parts of the Natural Capital stock are critical, i.e. those in which replacement is impossible or unlikely. Practical application of strong sustainability then requires that these critical components of Natural Capital be identified and protected. Pearce and Atkinson (1995) suggest three criteria for identifying 'critical' Natural Capital, i.e. irreversibility, uncertainty, and loss aversion, but acknowledge the practical difficulties in identifying that part of the Natural Capital stock that provides critical functions. Although this may be considered a first step towards operationalisation of strong sustainability it is not sufficient to solve all of the observed problems.

We argue that some of the 'misunderstandings' could be avoided and the consensus-building process on the notion of sustainability could be boosted by reframing the debate by the distinction of three concepts, originally developed by Musters et al. (1994): the sustainable Environmental Utilisation Space (EUS), the measured EUS, and the chosen EUS. The 'sustainable EUS' refers to a theoretical EUS defined by sustainability constraints set in an environment of perfect information, i.e. strong sustainability with full information. However, because the real world is one of uncertainty and lack of information, the 'sustainable EUS' can never be defined, not even by scientific research. Instead, the EUS as currently defined by scientific research, although often said to indicate the 'sustainable EUS', in fact is the 'measured EUS'. That is, it indicates the possibilities of the environment, known at a given moment and measured by means of a well-defined method (Musters et al., 1994). Finally, the 'chosen EUS' concerns that part of the 'measured EUS' that will actually be used, which is ultimately determined by the extent to which human society is prepared to pay the price of transition from the current to the new state, and basically reflects the desired social goals. One way of viewing the chosen EUS is as a social contract with Earth, unilaterally agreed upon by society. The Earth will eventually signal its approval or disapproval through natural processes.

By reframing the debate as described above, it is hoped that some of the resources currently bound in the unproductive debate between economists and ecologists could be freed up and re-employed to bridge the gap between the 'sustainable EUS' and the 'measured EUS', and between the 'measured EUS' and the 'chosen EUS'. While the former may be accomplished by more and better research, the latter requires improved communication of scientific evidence to politicians and the general public. Narrowing the gap between the 'sustainable EUS' and the 'chosen EUS' should be a challenge to all of us, while closing it should be the ultimate goal.

7.1.2 The allocation of environmental goods and services in the countryside

Since the launch of the Agri-Environmental Regulation in 1992, environmental contracting has become a key instrument in rural environmental policy across the European Union (EU). The increased importance of agri-environmental policy has, to date, not been reflected in innovative policy design (Latacz-Lohmann and Schilizzi, 2005b). Innovative policies based on auctions have been proposed to improve policy performance by increasing the cost-effectiveness of public spending for the provision of countryside benefits. Auctions have the potential to reveal, at least partly, bidders' compliance costs, thereby reducing the information asymmetry on on-site costs and local impacts between landholders and the conservation agency (Van der Hamsvoort and Latacz-Lohmann, 1996). Despite this potential, the diffusion of auctions into the practice of agri-environmental management has been slow. Most practice-based environmental conservation and enhancement programmes in farming, especially those in the EU, currently operate on the basis of fixed payments for compliance with a predetermined set of management prescriptions.

In chapters 3 and 4 we analyzed the potential benefits and possible costs of auctions as a quasi-market mechanism for public goods from agriculture. We presented a brief essay on the characteristics of the 'market' for countryside benefits and on auction theory and its applicability to conservation contracting. We presented a formal model of optimal bidding behaviour, applied it to a hypothetical conservation programme and simulated programme performance for different auction designs under various assumptions relative to a fixed-rate posted-price mechanism. Finally, we analyzed possible limitations and drawbacks of green auctions.

A number of conclusions can be drawn. The analysis suggests that green auctions can be a powerful means for conservation agencies to increase the effectiveness of public spending for the provision of countryside benefits. The outstanding feature of auctions is their inherent potential to reveal information about the landholders' compliance costs, therefore reducing the informational imbalances between the conservation agency and the landholder. Moreover, the conservation agency is able to control the allocation of funds by setting up rules under which the tenders offered by the landholders are selected. This mechanism, however, requires information on site-specific environmental impacts of farming which may not be consistently available. The high efficiency gains, which can be achieved by directly targeting the programme objectives in the bid selection process, may in fact call for increased investment in agro-environmental data collection.

Auctions, as compared to fixed-rate payment schemes, yield the highest benefits when the conservation agency has little information about landholders' compliance costs, the number of potential participants is large, the contracts offered are homogeneous, farms are heterogeneous in their compliance costs, and the production of the environmental good or service in question is separable between farms. The fewer of these conditions apply, the higher the relative preferability of fixed-rate payments or individually negotiated payments.

The major contribution of the papers in chapters 3 and 4 is that they make auction theory applicable to conservation contracting. Some of the benchmark assumptions have been relaxed to portray the auction environment as accurately as possible. Nevertheless, some simplifying assumptions remain, both with respect to the model and auction theory. For example, the farm-level model considers only one input and one output. A more elaborate model with multiple inputs and outputs, which allows for substitution, may produce a more moderate effect on programme performance. Another simplification is the assumption of independent private values, which requires that farmers know precisely their opportunity costs of programme participation. In practice, however, there is often an element of uncertainty among farmers as to the consequences of adopting conservation practices, resulting in affiliated values instead of independent private values. Also, farmers in the EU have proved to be reluctant to participate in conservation programmes because they fear that the government will not allow them to remove the management changes after the contracts have expired. All this may have unforeseeable implications for bidding behaviour, which, consequently, could affect the results presented here.

Bearing this in mind, how relevant is auction theory to assisting practical auction design in real policy contexts? Because of its shortcomings, the theory cannot provide us with a cut-and-dried solution in most real world settings. In our opinion, it can, however, and should play an important role in considering auction design and bidding behaviour so as to avoid drawbacks that might otherwise occur. In this respect, the analysis in chapters 3 and 4 suggests that had auction theory been consulted in devising the US Conservation Reserve Program (CRP) bidding process, it might have been able to predict some of the problems of that bidding process (e.g., declining bidding competition after multiple signups; problems resulting from pursuing an enrollment target) in advance. In addition, the use of auctions in conservation contracting fits in well with the general trend towards a 'value for money approach' that policy has adopted in the provision of public services. Bidding is perceived to be fair, which is politically important, making a transfer publicly legitimate. By holding an auction, the public agency avoids being confronted with questions about the level of pre-determined payments or the choice of negotiation partners (Rothkopf and Harstad, 1994).

The benefits of auctions come at the cost of likely higher transaction costs on the side of the farmers, although this argument lacks empirical proof so far. The fact that most conservation schemes in the EU operate a fixed-rate payment mechanism may be an indication that auctions, in fact, involve high transaction costs. Also, strategic bidding behaviour in multiple-signup auctions is a potential source of operational difficulties and reduced efficiency of the auction market. Both experimental studies and agent-based simulation studies that have appeared since the publication of the auction work in this volume, have confirmed the experience with the US Conservation Reserve Program: when bidders have the opportunity to learn from preceding bidding rounds, they will use that information to update their bids and reap a higher share of the 'surplus' – at the detriment of auction performance. Proposals to combat bidder learning have been made in the literature, but none of these have been tested empirically (Latacz-Lohmann and Schilizzi, 2005). Finally, conservation agencies are inexperienced in holding auctions, implying a high risk of 'implementation failures', and the majority of farmers still

appear to prefer an 'equal payment for equal output approach' with which they are so familiar from the agricultural commodity markets.

7.1.3 The allocation of land in the Netherlands

One of the most significant problems confronting the Netherlands at the start of the 21st century is the use and organization of the limited land available. The high level of economic growth in recent years and the increasing prosperity have resulted in a greatly heightened demand for land for home construction, infrastructure, business premises, and nature and landscape. On the other hand, the amount of land is limited and most of it (69 per cent) is reserved for agriculture. The growth in demand and the limited availability of land is being translated into developments in the real estate market.

In the Netherlands, however, the real estate market is not a free market. The government regulates the use of space by means of the *Wet op de Ruimtelijke Ordening* (WRO; 'Town and Country Planning Act') and thus restricts the allocation options for the available space. Moreover, the development potential of various agricultural and non-agricultural sectors is influenced to a greater or lesser extent by sector-specific policy, such as agricultural policy, nature and landscape policy, and environmental policy. All these developments affect the supply of and demand for land in the Netherlands, which has important consequences for the developmental possibilities of different economic sectors.

In chapter 5 we analyzed the allocation of space in the Netherlands, in particular the effect of the 'Town and Country Planning Act', government policies in respect of agriculture, nature, landscape, and the environment and developments in agricultural and non-agricultural sectors on the allocation and price of agricultural land. Viewed separately, the environmental, nature, and agricultural policies might be consistent with the goals they are supposed to achieve, but in interaction they are conflicting and preclude the simultaneous achievement of these very same objectives. The agricultural land market was shown to play a pivotal role in this network of interactions. Among the chapter's major conclusions are the following:

High (higher than on the world market) guaranteed prices (EU market and price policy) in combination with technological development lead to expansion of production and increase of scale. Since increase of scale via expansion of acreage is only possible in dribs and drabs, due to the mainly demographically determined rationed supply of agricultural land and the massive non-agricultural claims on it, land use is becoming more and more intensive, although sometimes curbed by production restrictions such as quotas that give rise to costly production rights.

The expansion of production, primarily through intensification, has had effects both on the price of land and on the environment. After all, the whole situation gave rise to high land prices, an increasingly strict environmental policy and a demand for nature policy. Initially, environmental policy took shape through restrictions on manure deposits on the land. On balance, that led to an increase in the price of land. And when environmental policy also starts setting requirements with regard to the intensity of cattle holding (for example a standard of 2,5 gve per hectare), land prices will rise even more since the quota price will then overflow into the land price. Finally, nature conservation policy is taking shape via the acquisition of agricultural land in the agricultural segment of the real estate market, until now on

a voluntary basis. In consequence, an extra demand for land will be made, with the result that the price of land will rise once again. In addition, a high price may nourish proprietors' beliefs that the price increase is not yet at an end. As a result, landowners dampen the supply of agricultural land and inflate the price again.

When the economy is booming, the demand for agricultural land for urbanization heightens greatly, which in combination with an unsteady 'Town and Country Planning Act', drives up land prices. High prices severely complicate the achievement of environmental and nature policy objectives in at least two ways. First, it raises the cost of acquisition of agricultural land for the Ecological Main Structure. Second, it increases the pace of development of the agricultural structure, resulting in a continuing decline in the number, but an increase in the scale of agricultural enterprises. Economies of scale contribute to the efficiency of the remaining agricultural enterprises, but at the risk of an increased uniformity in terms of outward appearance, causing rural areas to lose their natural identity.

To sum up, the EU market and price policy, with the exception of the milk quotas, caused the price of land to rise, and subsequently the land price rose again due to the environmental and nature policy needed to compensate for the negative effects of that agricultural policy. Finally, the economic boom of the late '90s created a great many 'red' claims on agricultural land, causing the price of agricultural land to rise along with the general increase in real estate prices. For farmers, the resulting extremely high land price is reason to make even more intensive use of land. The interaction between agricultural policy, environmental policy, nature policy and town and country planning policy via the real estate market is plain to see.

7.1.4 The allocation of trade distortions

During the GATT (now WTO) negotiations on agricultural trade, which started in 1986, the Contracting Parties expressed their intention to develop an Aggregate Measure of Support (AMS) which could bring the wide range of existing agricultural support policies under one roof. The concept should be used not only for monitoring purposes, but also for making binding commitments. Ideally, such commitments could even replace the existing GATT concessions and regulations. In view of this, the AMS was regarded as the central plank on which a new agreement could be based.

This was not realized. In the final GATT agreement, the AMS only appeared as one of a number of elements, not the key element. Questions about why and how that result was achieved have not been fully addressed in the literature. Chapter 6 aims to fill the gap by offering a review of conceptual and political issues. It presents an analysis of the PSE, which served as the basic concept of the AMS discussions in the Uruguay Round, deals with the debate on the AMS between the Contracting Parties and provides a synthesis of the arguments and factors that explain the position of the AMS in the GATT agreement. Among the chapter's major results are the following.

The intention expressed by the Contracting Parties at the start of the negotiations to develop, and use, an aggregate measure of support was realized. However, the final role of the AMS does not correspond with the idea that the concept should become the

key element of the agreement. Chapter 6 shows that the final outcome has conceptual, as well as political, reasons.

If one considers measurement problems and costs, the choice of the PSE, as the basic concept of the AMS discussions, was a practical choice. However, conceptual analysis shows that the PSE and its derivatives are not a sound measure of trade restrictions and distortions caused by agricultural policies. Limiting or reducing PSEs does not guarantee that the trade-distorting effects of national import and export policies will decline. Added to this is the practical problem that the development of PSEs, due to exogenous factors, such as exchange rate fluctuations, can only be minimally controlled by the countries themselves.

Already, in April 1989, the pure aggregated approach to the negotiations was rejected, when the Contracting Parties accepted the framework of making binding agreements on three separate areas: internal support, market access and export support. From then on, the AMS only played a role in the internal support area. The negotiations in the areas of market access and export support would result in very specific commitments. In our view, this enabled the negotiations in the internal support area to stick with the aggregated approach.

The internal support area (and with it the role of the AMS) did not evolve as a very critical element in the negotiations. Compared to the broad policy coverage of the PSE, many government measures were taken out of the AMS and freed from reduction requirements (the "green" policies versus the "amber" policies). Agreement was reached upon a general reduction of the AMS for all products together, creating great flexibility in reaching the commitment, but at the same time undermining its effectiveness. Further, the deficiency payments in the US farm policies and the conditional payments that had been introduced in the EU as part of the MacSharry Reform, were excluded from the reduction requirements. Thus, a role was assigned to the AMS, but only in the form of a slimmed-down version of the Total PSE for all products, and not covering the more crucial areas of agricultural imports and exports.

The question remains as to why it was still regarded as important to write an AMS provision into the agreement rather than to abandon it completely. Was it because the Contracting Parties did not wish to abandon the starting position? Alternatively, was it because there will eventually be a new negotiation in which an AMS might play a more important role? Although a fully-fledged answer to these questions is difficult, the AMS discussion in the Uruguay Round has made at least one thing clear. Despite the intentions expressed by the Contracting Parties at the start of the negotiations, they never had the true intention to develop an AMS which could measure real trade distortions. Instead, each Contracting Party in the negotiations had an interest in developing an AMS, which would minimise the 'calculated' trade distortions caused by the Contracting Party itself and maximise those caused by the other Contracting Parties. The slimmed-down AMS in the final agreement, of which many government measures were taken out and freed from reduction requirements, supports this view. Reducing international trade distortions is a collective action problem that requires the joint effort of Contracting Parties with the true motivation to liberalise trade. Unfortunately, the AMS discussion in the Uruguay Round revealed that the opposite seems to be true: instead of co-operating towards a common goal, each Contracting Party tried to ride free on the efforts of others, eventually at the detriment of all. Over a decade has passed since

the final GATT agreement was signed and ratified, but the discrepancy between Contracting Parties' intention and actual behaviour seems to remain. The Doha-development agenda of 2001 has the aim to improve access to international markets by further trade liberalisations indeed, yet Contracting Parties' option to exempt special or sensitive products from reduction commitments, among other things, questions whether the Doha Round will effectively increase market access. The WTO turned and turns out to be an uncooperative club in which each Contracting Party aims to minimise its own costs of reducing trade distortions and to charge the full burden to the other Parties.

7.2   Literature review and directions for future research

In chapter 1 each of the allocation models in this volume was defined in terms of clubs, sharing arrangements, membership, and (outputs of) club goods; terms which are familiar in the literature on allocation theory, especially theories of the allocation of public goods. This section suggests some directions for future research against the background of the theoretical developments in public good allocation. The section begins with a brief history of these developments since Paul Samuelson's pure theory of public expenditure in the early '50s, followed by some directions for future research.

7.2.1   A brief history of allocation theory

Although the origins of 'allocation theory' can be traced to Adam Smith's "The Wealth of Nations" (1776), the majority of economic articles examining allocation theory have appeared since Paul Samuelson (1954, 1955, 1958) wrote his seminal piece 'The Pure Theory of Public Expenditure'. He set out in three brief papers a unifying theory of optimal resource allocation and optimal clubs. He mathematically and graphically extended neo-classical economic theory, in which all goods and services are private in consumption, to include collective consumption goods and services, defined the optimality conditions and explored alternative clubs to attain the optimum. His theory culminated a century of writing on public expenditure, by such authors as Pantaleoni (1967)[1883], Sax (1967)[1883], Mazzola (1967)[1890], Wicksell (1967)[1896] and Lindahl (1967[1919]; 1967[1928]) and on the problem of optimal taxation by all the great neoclassical writers, and was formulated in definitive mathematical terms.

The extreme simplicity of the model provoked considerable criticism. Early critics, such as Margolis (1955), pointed out the difficulty of finding situations that would precisely fit the model. Neo-classical economic theory as well as the model formalised by Samuelson applies only to a polar or extreme case. These models may successfully predict strategies and outcomes in fixed situations approximating the initial conditions of the models, but they cannot predict outcomes outside that range[1]. Within the two decades after Samuelson, serious attempts were made to

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[1] Samuelson (1972[1969]:504) himself seems to acknowledge this, stating that "(…) this is much the most constructive and comfortable point, nihilism or doubt about the solution for the general case of any public good might be out of order in connection with many particular forms of public goods. It is here that many of my critics will turn out to have a valid point (…)".

build on and extend the basic model for application to a broader range of circumstances, notable contributions being those of Tiebout (1956), Olson (1974[1965]), Buchanan (1965) and Hardin (1968). Tiebout's "A Pure Theory of Local Expenditure" extended Samuelson's model to include local or territorial public goods. Olson's "The Logic of Collective Action" was concerned with the effects of group size and group composition on the provision of pure and impure public goods and contained the rudiments of the theory of clubs, which was co-founded and more formally developed by Buchanan. In his seminal piece "An Economic Theory of Clubs", Buchanan generalised Samuelson's theory to encompass impure public goods to bridge the gap between pure private and pure public goods. Finally, Hardin's discussion on "The Tragedy of the Commons" is worth noting, because he popularised the problems raised by the exploitation of open access and common property resources. Problems that later appeared to have a structure that is very similar to that of the public good problem (Cornes and Sandler, 1996). Since the time of those pioneers, a vast literature has emerged containing numerous extensions and modifications of the basic theories[2], including the allocation models presented in this volume (see section 1.2). The result is a spectrum of discrete models that differ in representation, scope and mathematical detail, ranging from the neo-classical economic theory of pure private goods at one end to Samuelson's neoclassical theory of pure public goods at the other. But Margolis' criticism of half a century ago remains: each model applies only to a polar or extreme case. No general theory has been developed, formulated in definitive mathematical terms, which covers the whole spectrum of possible situations and from which all other theories can be derived.

7.2.2 Some directions for future research

A general resource allocation model or, synonymously, a general theory of clubs requires extending traditional club theories in a number of fashions. As an exhaustive list of future extensions would be impossible, we focus on what we think are the most crucial extensions, including the endogenisation of sharing arrangements and excludability.

Sharing arrangements

In those models in the spectrum that are supported by a mathematical structure, sharing arrangements of clubs invariably are exogenous to the theory or receive little or no attention at all. Minasian (1964:80) first pointed out this flaw, which was later confirmed and reinforced by Buchanan (1967), in a critical comment on Samuelson's pure theory of public expenditure: "A pure theory of public expenditure purporting to identify on economic grounds the goods that are best

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[2] The advances in public good theory and club theory have been surveyed by Cornes and Sandler (1986 and 1996). Also see Scotchmer (1994) for a survey of the theory of clubs and Sandler (1992) for a survey of the theory of collective action including a survey of the literature spawned by *The Logic of Collective Action*. The reader should also consult the excellent work of common pool resource problems by Ostrom (1990), the innovative study on territorial collective goods by Foldvary (1994) and the recent work on urban goods and services by Webster and Wai-Chung Lai (2003). These studies also contain useful lists of references.

provided by collective action should have the power to govern choice among alternative institutional arrangements on the basis of their relative merits. The present theory of public goods is incapable of generating the relevant economic information." Samuelson (1972[1964]) acknowledged Minasian's conclusion in his comment on the Minasian paper and elsewhere (1958, 1972[1967], 1972[1969]). In a note on the indeterminacy of the governmental role in public good theory, he put it most aptly: "The pure theory of public expenditure (…) cannot properly be interpreted to imply that private goods should be produced by private enterprise and public goods should be produced by government directly. (…) Where the consumption externalities intrinsic to a non-private good occur, all that I would insist on is that laissez faire cannot be counted on to lead to an optimum. There is a prima facie case, so to speak, for social concern and scrutiny of the outcome; but that does not necessarily imply outright state ownership or in every case public regulation. The exact form in which the social concern ought to manifest itself depends on a host of considerations that have to be added to the model (Samuelson, 1972[1967]:47)." Since the Minasian-Samuelson debate, many economists have studied the effects of institutional design and its resulting game theory structure on optimal resource allocation, but none of them includes institutional design as a choice variable. Often, researchers analyze the performance of a discrete club relative to a set of normative optimality conditions or settle for a comparison between a few clubs. The model of optimal bidding behaviour in chapters 3 and 4, and the many examples presented by Cornes and Sandler (1996) give evidence of this approach. The bidding model in this volume simulates club performance for different auction types and other payment schemes relative to a flat-rate offer system. In terms of Pareto-efficiency, we therefore compare club efficiency for a few discrete payment schemes relative to a reference scheme, one scheme turning out to be Pareto-inferior or Pareto-superior to another scheme, but none of them necessarily is the 'optimal' scheme.

In the future more work along these lines can be expected, judging from the suggested research directions in this area by such authors as Sandler (1992), Sandler and Tschirhart (1997) and Cornes and Sandler (1996). "An analysis of institutions is needed, and this requires the discrete comparison of alternative forms, each with its own set of net benefits for the agents and total benefits (Sandler, 1992:199)." This is at odds with the work of, for example, Olson (1974[1965]), Ostrom (1990), Foldvary (1994) and Webster and Wai-Chung Lai (2003) as well as with everyday experience, which reveals that clubs will form where institutional, technological and demand conditions foster them. Given these conditions, people craft their own clubs, including government, to allocate resources in the best interest of society, and as these conditions are constantly changing, so are clubs. One of the missing links here is a comprehensive theory of club provision. Such a theory requires a different approach, one in which the club itself is endogenous to the theory, a theory that will include as a variable to be determined the organizational form of the club. In terms of the analysis in chapters 3 and 4, such a theory would allow us to define the optimal sharing arrangement for the producer clubs - rather than settling for a comparison between a few arrangements – which might well differ from those included in the simulation.

Excludability

Traditional allocation models also presume that all club goods are excludable or non-excludable by nature. A club good is said to be excludable if the club can prevent non-members from enjoying the benefits of the good and implies the existence of some literal or figurative club gate through which members must enter and exit to get access to the good (Foldvary, 1994). Passing through the gate implies acceptance of the sharing arrangement of the club, including exclusion rules, and "implicitly sets a time limit to the membership; when it expires, one must again pass through the gate (Foldvary, 1994:)" [3]. By contrast, a club good is said to be non-excludable if non-members cannot be denied access to the benefits of the club good even not if they refuse to pass through the club gate and, hence, partake in the sharing arrangement. That is to say, members then must pass through the club gate to get access to the sharing arrangement, but not to get access to the club good. A common playground in a residential area serves as an example. Suppose that the playground is co-owned and shared by the residents according to a mutually agreed contractual arrangement that specifies utilisation, maintenance and financing rules. Suppose further that home ownership within the area's boundaries serves as the club gate, but that there is no barrier, supervisor or other exclusion mechanism to prevent non-residents from using the playground. The purchase of a house or residential apartment implies the acceptance of all rules that forbid, permit or require some action with respect to the playground, but give no exclusive right to the benefits of the playground, which are also accessible to non-residents. Non-residents then get a free ride on the efforts of residents; they get access to the benefits of the playground without partaking into the sharing arrangement.

However, few if any club goods are excludable or non-excludable by nature, but by economy; that is, the motivation for erecting and maintaining an exclusion mechanism is determined by efficiency considerations. A private road could physically be closed off to through traffic, passers-by paying the owner a toll to use the road. But if toll revenues do not outweigh the sum of congestion and exclusion costs, exclusion is inefficient and the road turns out to be economically non-excludable, passers-by gaining an external benefit. Even a natural event, such as a solar or lunar eclipse, is not non-excludable a priori. A partial eclipse can be observed from each and every place on the planet and no living individual can be kept from enjoying the event from his or her own window, but only a few geographic places on earth give natural access to a total eclipse. If the owners of those places erect a club gate and charge visitors a rent for using the grounds during the eclipse, no one can observe the total eclipse free of charge except for the landlords themselves.

A general allocation theory requires a different approach, in which excludability itself is endogenous to the theory and the classification of club goods into excludable and non-excludable sets emerges as an output of the analysis. Such a theory may well come up with different conclusions about the Pareto-efficiency of

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[3] A club gate may be a literal or figurative fence (Foldvary, 1994). Literal fences include turnstiles and tollbooths. Figurative fences include the use of space, such as the act of entering into or living in a sovereign community's territory, the purchase of a good or service, or the purchase of property rights.

specific solutions to allocation problems than the traditional theories in which excludability is exogenous to the analysis. The allocation of natural resources in chapter 2 may serve as an example. Traditional economic analyses of natural resource allocation often take the organizational forms of clubs, membership, technology and the excludability or non-excludability of the natural resource as given. However, technological improvements may change cost-benefit considerations such that a previously non-excludable natural resource becomes excludable. The history of Yellowstone Park illustrates this. At the time of Yellowstone's creation in 1872, the park was non-excludable and the amenity rents associated with the Yellowstone region dissipated through open access ensuing a 'tragedy of the commons'. However, this changed with the arrival of railroads. The Pacific Railroad recognised the potential amenity rents from Yellowstone and captured them by vertically integrating its monopoly on transportation to the region with the supply of tourist facilities in the park. This gave the Railroad de facto ownership of the park and turned the park into an excludable resource that lasted until automobiles were allowed to enter in 1915. Thereafter the Railroad's monopoly was eliminated - turning the park into an open access resource again - and rent dissipation occurred through congestion (Anderson and Hill, 1996).

7.2.3 To close

Still other areas in which more club research is needed and which should receive attention if a general allocation theory could be developed include joint products and mixed goods, producer clubs and clubs, whose membership consists of both consumers and producers, the effect of information asymmetries, self-interest orientation and cognitive competences of club members on allocative efficiency, and the effect of space and distance on allocation decisions. In a recent personal communication James Buchanan (10 March 2005) commends any efforts "to extend the whole notion of allocative efficiency to include the endogenous formation, operation, and maintenance of institutional forms, notably the formation of clubs, inclusively defined." He interprets such efforts "as moving to fill in the rather awesome gap between the arid reaches of general equilibrium theory and the down to earth practical treatment of institutions, a gap that remains unexplored territory and opens up analytically interesting opportunities." Van der Hamsvoort (2005) has made a first attempt to develop a general theory of optimal resource allocation, in which clubs, sharing arrangements, excludability, joint products, self-interest orientation and the spatial dimension are endogenised. Currently, Van der Hamsvoort and Cornes work together to elaborate on this still seminal piece. More work along this line of research appears warranted, since no general theory of clubs exists.

A general allocation theory may serve as an intellectual tool or model to understand why some club solutions seem to work in some settings and not others, especially when the allocation of collective goods and services is concerned. Many questions that we seek to answer centre on the governance of collective good provision. Can and will individuals organize themselves and coordinate their actions to provide collective goods and services without the need of governments? Must governments always intervene to accomplish provision? What preconditions are conducive to successful provision?

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SAMENVATTING EN ONDERZOEKSAANBEVELINGEN

In de vorige hoofdstukken hebben we een verscheidenheid aan allocatieproblemen gepresenteerd. De onderwerpen die in dit boek worden besproken, vormen een bescheiden bijdrage aan de bestaande literatuur over allocatietheorieën, een terrein dat zich sinds het oorspronkelijk werk van Adam Smith aanzienlijk heeft ontwikkeld. Behalve een samenvatting en de belangrijkste conclusies worden in dit laatste hoofdstuk, met in het achterhoofd de theoretische ontwikkelingen sinds Paul Samuelsons 'pure theory of public expenditure' in de vroege jaren 50, ook een aantal suggesties voor toekomstig onderzoek gedaan.

Samenvatting en belangrijkste conclusies

De allocatie van de kapitaalvoorraden op aarde

Ondanks het feit dat 'duurzaamheid' de afgelopen jaren hoog op de politieke agenda staat, is er vooralsnog geen overeenstemming over wat duurzaamheid precies inhoudt. De definitie van duurzaamheid in het Brundtland rapport – waarschijnlijk de meest geciteerde definitie – geeft uitdrukking aan twee zorgen, waaraan ook veel andere definities uiting geven: erkenning van de langetermijnimpact van beperkingen op natuurlijke hulpbronnen en milieubeperkingen op ontwikkelings- en consumptiepatronen, en zorg voor deze impact op de welvaart van toekomstige generaties. Hoewel de meeste mensen het zonder aarzelingen eens zijn met deze zorgen en de inhoudelijke thema's waar ze impliciet naar verwijzen, onhult een precieze omschrijving van de te realiseren doelen de enorme tegenstrijdigheden achter het concept. We stellen dat deze tegenstrijdigheden ontstaan zijn vanwege twee vraagstukken, die het duurzaamheidsdebat vertroebelen. Het eerste betreft het nog immer aanhoudende debat tussen economen en ecologen met verschillende visies op de grenzen van de economische groei en het draagvermogen van de aarde. Het tweede vraagstuk heeft betrekking op de waargenomen tegenstelling tussen theoretische duurzaamheid en praktische duurzaamheid. Beide vraagstukken verstoren het duurzaamheidsdebat omdat mensen denken dat ze hetzelfde probleem aanpakken, terwijl ze dat feitelijk niet doen. In hoofdstuk 2 stelden we beide vraagstukken aan de orde en analyseerden we de gevolgen voor het duurzaamheidsdebat.

Een aantal conclusies kan worden getrokken. Ten eerste, de analyse ondersteunt het concept van sterke duurzaamheid. Dit suggereert dat de controverse tussen economen en ecologen grotendeels beschouwd kan worden als improductief omdat hun duurzaamheidsconcepten niet voldoende worden onderbouwd door de theorie. Aangenomen dat we het bij het rechte eind hebben, kan de logische vraag worden gesteld: waarom is het debat dan nog niet ten einde? Costanza (1995) stelt dat het aanhoudende debat te wijten is aan een overwegend gebrek aan interesse bij een meerderheid van de economen in omgevingsvraagstukken, en een vergelijkbaar

gebrek aan interesse bij een meerderheid van de ecologen in economische vraagstukken, gecombineerd met een gebrek aan dialoog tussen beide groepen.

De analyse laat ook zien dat het theoretische concept van sterke duurzaamheid moeilijk in praktijk te brengen is, omdat het vertalen van dit concept naar gebruiksrestricties bemoeilijkt wordt door substantiele onzekerheden en gebrek aan kennis, en vanwege het feit dat onwaarschijnlijk lijkt dat de maatschappij bereid zal zijn om de rekening van een terugkeer naar een duurzame ontwikkeling te betalen. Het is belangrijk dat deze tegenstellingen tussen theorie en praktijk duidelijk worden herkend om misverstanden tussen wetenschappers en beleidsmakers, die proberen beleid te voeren op duurzaamheid, te voorkomen. In antwoord op deze problemen, wordt door voorstanders van sterke duurzaamheid algemeen erkend dat slecht enkele delen van de Natuurlijke Kapitaalvoorraad essentieel zijn, dat wil zeggen dat deel van de voorraad dat onmogelijk of onwaarschijnlijk te vervangen is. Praktische toepassing van sterke duurzaamheid verlangt vervolgens dat deze essentiële elementen van het Natuurlijk Kapitaal geïdentificeerd en beschermd worden. Pearce en Atkinson (1995) voeren drie criteria aan om 'essentieel' Natuurlijk Kapitaal te identificeren, namelijk onomkeerbaarheid, onzekerheid, en aversie tegen verlies, maar erkennen de praktische complicaties bij het identificeren van dat deel van de Natuurlijke Kapitaalvoorraad dat essentiële functies vervult. Hoewel dit beschouwd kan worden als een eerste stap in de richting van het operationaliseren van sterke duurzaamheid is het niet voldoende om alle waargenomen problemen op te lossen.

We stellen dat een aantal van de 'misverstanden' vermeden zou kunnen worden en het proces gericht op het verkrijgen van consensus over het begrip duurzaamheid bevorderd zou kunnen worden door het debat opnieuw vorm te geven via het onderscheiden van drie concepten, oorspronkelijk ontwikkeld door Musters et al. (1994): de duurzame Milieugebruiksruimte (MGR), de gemeten MGR, en de gekozen MGR. De 'duurzame MGR' verwijst naar een theoretische MGR gekenmerkt door gebruiksbeperkingen die zijn vastgesteld in een omgeving met onbeperkte informatie, oftewel sterke duurzaamheid met volledige informatie. Echter, aangezien de werkelijkheid er een is van onzekerheid en gebrek aan informatie, kan de 'duurzame MGR' nooit worden gepreciseerd, zelfs niet door wetenschappelijk onderzoek. Integendeel, de MGR zoals momenteel afgebakend door wetenschappelijk onderzoek, waarvan vaak wordt beweerd dat het de 'duurzame MGR' aangeeft, is in feite de 'gemeten MGR'. Dat wil zeggen, het geeft de mogelijkheden van de natuurlijke omgeving aan, gegeven de kennis op dat moment en gemeten via een duidelijk omlijnde methode (Musters et al., 1994). Tot slot, de 'gekozen MGR' betreft dat deel van de 'gemeten MGR' dat daadwerkelijk wordt gebruikt. De 'gekozen MGR' wordt uiteindelijk bepaald door de mate waarin de maatschappij bereid is om de prijs van de overgang van de huidige naar de nieuwe situatie te betalen en reflecteert feitelijk de gewenste maatschappelijke doelen. Één manier om tegen de 'gekozen MGR' aan te kijken is als een maatschappelijk contract met de aarde, eenzijdig overeengekomen door de mensheid. De aarde zal uiteindelijk haar goed- of afkeuring via natuurlijke ontwikkelingen laten blijken.

We hebben de hoop dat door het debat, zoals hierboven omschreven, te hervormen, sommige hulpbronnen, die nu worden aangewend voor het improductieve debat tussen economen en ecologen, kunnen worden vrijgemaakt en

opnieuw kunnen worden aangewend om het gat tussen de 'duurzame MGR' en de 'gemeten MGR', en tussen de 'gemeten MGR' en de 'gekozen MGR' te overbruggen. Terwijl het eerste gat wellicht via meer en beter onderzoek kan worden gerealiseerd, vereist het tweede gat een verbetering in het overbrengen van wetenschappelijke resultaten en bewijsvoeringen op politici en het grote publiek. Het verkleinen van het gat tussen de 'duurzame MGR' en de 'gekozen MGR' zou een uitdaging moeten zijn voor ons allemaal, terwijl het dichten ervan het ultieme doel zou moeten zijn.

De allocatie van omgevingsgoederen en -diensten in het landelijk gebied

Sinds de lancering van de 'Agri-Environmental Regulation' in 1992 is het afsluiten van omgevingscontracten een belangrijk instrument in het rurale omgevingsbeleid geworden door de hele Europese Unie (EU). De toename in het belang van 'agri-environmental policy' heeft tot op heden niet geleid tot innovatieve beleidsontwikkelingen (Latacz-Lohmann and Schilizzi, 2005b). Met het oog op het verhogen van de kosten-effectiviteit van de inzet van publieke middelen in het landelijk gebied, zijn voorstellen gedaan voor innovatief beleid gebaseerd op veilingen. Veilingen hebben de potentie om, tenminste ten dele, de nalevingskosten van bieders te onthullen, waardoor de informatieasymmetrie tussen grondeigenaars en de 'conservation agency' over lokale effecten en kosten wordt gereduceerd (Van der Hamsvoort and Latacz-Lohman, 1996). Ondanks deze potentie, doen veilingen in de praktijk slechts langzaam hun intrede in agri-environmental management. De meeste programma's in de landbouw die gericht zijn op behoud en verbetering van de omgevingskwaliteit, vooral die in de EU, werken momenteel op basis van vaste prijzen voor naleving van een vooraf bepaalde combinatie van voorschriften in de bedrijfsvoering.

In de hoofdstukken 3 en 4 analyseerden we de potentiële baten en kosten van veilingen in hun hoedanigheid als een quasimarktmechanisme voor publieke goederen vanuit de landbouw. We gaven een korte uiteenzetting over de kenmerken van de 'market' voor publieke goederen in het landelijk gebied en over veilingtheorie en haar toepasbaarheid op het afsluiten van omgevingscontracten. We introduceerden een formeel model van optimaal biedgedrag, pasten het toe op een hypothetisch programma tot behoud van de natuurlijke omgeving en simuleerden de resultaten van het programma voor verschillende veilingontwerpen met wijzigende vooronderstellingen. Deze resultaten werden vervolgens vergeleken met een programma met vaste prijzen, dat als referentie diende.

De analyse leidt tot een aantal conclusies. Het laat zien dat groene veilingen een krachtig middel voor 'conservation agencies' kunnen zijn om de kosteneffectiviteit van de inzet van publieke middelen voor de voorziening van publieke goederen in het landelijk gebied te verhogen. Een bijzonder kenmerk van veilingen is hun intrinsieke potentie om informatie over de nalevingskosten van grondeigenaren boven water te krijgen, waardoor de informatievoorsprong van de grondeigenaar ten opzicht van de 'conservation agency' wordt gereduceerd. Bovendien heeft de 'conservation agency', door het opstellen van selectiecriteria voor de door grondeigenaren geboden bedragen, meer grip op de inzet van financiële middelen. Dit mechanisme vereist echter locatiespecifieke informatie over de effecten die de landbouw heeft op de natuurlijke omgeving, die niet altijd en onafgebroken

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beschikbaar zijn. De hoge efficiencywinst die kan worden bereikt door het bod-selectie proces zodanig in te richten dat geboden bedragen worden geselecteerd op basis van hun relatieve bijdrage aan de programmadoelen, kan wellicht nopen tot een verhoogde investering in het verzamelen van 'agro-environmental' data.

Vergeleken met vaste-prijs systemen, is het rendement van veilingen het hoogst wanneer de 'conservation agency' weinig informatie heeft over de nalevingskosten van grondeigenaren, het aantal potentiële deelnemers groot is, de geboden contracten homogeen zijn, landbouwbedrijven heterogeen zijn in hun nalevingskosten, en de productie van het omgevingsgoed of de omgevingsdienst in kwestie deelbaar is tussen landbouwbedrijven. Naarmate minder van deze voorwaarden van toepassing zijn, worden vaste of individueel uitonderhandelde prijzen relatief gezien interessanter.

De belangrijkste bijdrage van de papers in de hoofdstukken 3 en 4 is that ze veilingtheorie toepasbaar maken op het afsluiten van omgevingscontracten. Sommige standaard-aannames zijn losgelaten om de veilingomgeving zo nauwgezet mogelijk te beschrijven. Desondanks bevat het model een aantal vereenvoudigende aannames, zowel met betrekking tot het model zelf als met betrekking tot de veilingtheorie. Zo neemt het landbouwbedrijfsmodel slechts één input en één output in beschouwing. Een geavanceerder model met meerdere inputs en outputs, waarbij substitutie mogelijk is, laat wellicht een gematigder effect op de programmaresultaten zien. Een andere vereenvoudiging is de aanname van 'independent private values', die veronderstelt dat boeren volledige informatie hebben over hun opportunitykosten van deelname aan het programma. In de praktijk is echter vaak sprake van enige onzekerheid onder boeren over de gevolgen van deelname aan omgevingsprogramma's, resulterend in 'affiliated values' in plaats van 'independent private values'. Daarnaast hebben boeren in de EU laten zien aarzelend te staan tegenover deelname aan programma's gericht op behoud van de natuurlijke omgeving omdat ze vrezen dat de overheid na afloop van de contracten hen niet zal toestaan de gedane aanpassingen in de bedrijfsvoering weer ongedaan te maken. Dit alles kan wellicht onvoorziene gevolgen hebben voor het biedgedrag en dientengevolge voor de resultaten die uit onze analyse volgen.

Met dit in ons achterhoofd kunnen we ons de vraag stellen in hoeverre veilingtheorie behulpzaam kan zijn bij het ontwerpen van veilingen in de alledaagse beleidsrealiteit. Haar tekortkomingen verhinderen de theorie om ons een pasklare oplossing te bieden voor de meeste praktijksituaties. Naar onze mening echter, kan en zou het een belangrijke rol moeten spelen bij het denken over veiling ontwerp en biedgedrag om de nadelen, die anders zouden kunnen ontstaan, te vermijden. De analyse in de hoofdstukken 3 en 4 wijst er in dit verband op dat zou de veilingtheorie geraadpleegd zijn geweest bij het ontwerpen van het biedproces in de US Conservation Reserve Program (CRP), het wellicht mogelijk zou zijn geweest om sommige problemen in dat biedproces (bijvoorbeeld minder concurrentie tussen bieders na meerdere inschrijfrondes; problemen voortvloeiend uit het hanteren van een participatiedoelstelling) vooraf te voorspellen. Bovendien past het gebruik van veilingen bij het afsluiten van omgevingscontracten prima bij de algemene trend in de richting van een 'value for money' benadering, die het beleid steeds meer toepast bij de voorziening van publieke diensten. Bieden wordt gezien als eerlijk, wat politiek belangrijk is en een transactie publiekelijk legitimeert. Door een veiling te houden, vermijdt de overheid vragen over vooraf

vastgestelde prijsniveaus of over de keuze van de onderhandelingspartners (Rothkopf en Harstad, 1994).

De voordelen van veilingen gaan gepaard met waarschijnlijk hogere transactiekosten voor boeren, hoewel deze redenering vooralsnog empirisch bewijs ontbeert. Het feit dat de meeste omgevingsprogramma's in de EU opereren op basis van vaste-prijsmechanismen is wellicht een indicatie dat veilingen feitelijk hoge transactiekosten met zich meebrengen. Daarnaast is strategisch biedgedrag bij veilingen met meerdere inschrijfronden een potentiële oorzaak voor een aantal operationele problemen en reduceert het de efficiëntie van de veilingmarkt. Zowel experimentele studies als 'agent-base' simulatiestudies, die zijn verschenen sinds de publicatie van de veilingpapers in de boek, hebben de ervaring met de US Conservation Reserve Program bevestigd: zodra bieders de gelegenheid hebben om te leren uit voorafgaande biedronden, zullen ze die informatie gebruiken om hun eigen bod aan te passen en een groter deel van het 'surplus' op te stijken – ten koste van het veilingrendement. In de literatuur zijn verschillende voorstellen gedaan om het leereffect van bieders tegen te gaan, maar geen van deze is empirisch getest (Latacz-Lohmann and Schilizzi, 2005). Tot slot, 'conservation agencies' zijn onervaren in het houden van veilingen, met als gevolg een hoog risico op 'uitvoeringsfouten', en de meerderheid van de boeren lijkt nog steeds de voorkeur te geven aan een 'equal payment for equal output' benadering, waar ze in de landbouw zo vertrouwd mee zijn.

Grondallocatie in Nederland

Een van de belangrijkste problemen waar Nederland in het begin van de 21^e eeuw voor staat is het gebruik en de inrichting van de beperkt beschikbare ruimte. De enorme economische groei van de afgelopen jaren en de toenemende welvaart hebben geleid tot een sterk toenemende vraag naar ruimte voor woningbouw, infrastructuur, bedrijfslocaties, landbouw en natuur en landschap. De voorraad grond daarentegen is beperkt en heeft voor het overgrote deel (69%) een agrarische bestemming. De stijging in de vraag naar en de beperkte beschikbaarheid van grond vertaalt zich naar ontwikkelingen op de grondmarkt.

De grondmarkt in Nederland is echter geen vrije markt. De overheid reguleert het ruimtegebruik middels de *Wet op de Ruimtelijke Ordening* (WRO) en beperkt daarmee de allocatiemogelijkheden van de beschikbare ruimte. Bovendien worden de ontwikkelingspotenties van verschillende agrarische en niet-agrarische sectoren in meer of mindere mate beïnvloed door sector-specifiek beleid, zoals het landbouwbeleid, natuur- en landschapsbeleid, en milieubeleid. Al deze ontwikkelingen beïnvloeden de vraag naar en het aanbod van grond in Nederland en hebben belangrijke gevolgen voor de ontwikkelingsmogelijkheden van verschillende sectoren.

In hoofdstuk 5 analyseerden we de allocatie van ruimte in Nederland, met name het effect van de Wet op de Ruimtelijke Ordening, het overheidsbeleid ten aanzien van landbouw, natuur en landschap, en milieu, en de ontwikkelingen in agrarische en niet-agrarische sectoren op de agrarische grondprijs. Afzonderlijk bezien, strookt het milieu-, natuur- en landbouwbeleid wellicht met de doelen die men hiermee verondersteld te bereiken, maar in interactie met elkaar zijn ze conflicterend en beletten ze het tegelijkertijd realiseren van deze zelfde doelen. De

analyse heeft laten zien dat de agrarische grondmarkt een centrale rol speelt in dit netwerk van interacties. Enkele van de belangrijkste conclusies uit het hoofdstuk zijn de volgende:

Hoge (hoger dan op de wereldmarkt) gegarandeerde prijzen (EU markt- en prijsbeleid) leiden in combinatie met technologische ontwikkeling tot uitbreiding van de productie en schaalvergroting in de landbouw. Aangezien schaalvergroting maar mondjesmaat via areaaluitbreiding mogelijk is, vanwege het demografisch bepaalde gerantsoeneerde aanbod van en de omvangrijke niet-agrarische claims op landbouwgrond, wordt grond steeds intensiever benut. Soms evenwel afgeremd door productiebeperkingen (quota), waardoor kostbare productierechten ontstaan.

De uitbreiding van de productie via vooral intensivering had zowel effecten voor de grondprijs als voor het milieu. Het geheel was immers aanleiding tot hoge grondprijzen, een steeds strenger milieubeleid alsmede een roep om natuurbeleid. Het milieubeleid kreeg in de eerste plaats vorm door een beperking van de mestafzet op de grond. Dat leidde per saldo tot een stijging van de grondprijs. En wanneer het milieubeleid ook nog eisen gaat stellen aan de intensiteit van de veebezetting (bijvoorbeeld een norm van 2,5 gve per hectare), dan zullen de grondprijzen nog verder stijgen doordat de quotumprijs gaat overlopen in de grondprijs. Ten slotte krijgt het natuurbeleid vorm via de verwerving van landbouwgronden in het agrarisch segment van de grondmarkt. Tot nu toe nog op vrijwillige basis. Daardoor ontstaat er een extra vraag naar grond, met als gevolg dat de grondprijs nogmaals verder stijgt. Bovendien kan een hoge prijs grondeigenaars voeden in hun overtuiging dat de prijzen nog verder zullen stijgen, met als gevolg dat het aanbod van agrarische grond wordt getemperd en de prijs nog verder stijgt.

Ten tijde van een hoogconjunctuur stijgt de vraag naar agrarische grond voor verstedelijking enorm, wat in combinatie met een veranderlijke Wet op de Ruimtelijke Ordening de grondprijzen verder opdrijft. Hoge prijzen bemoeilijken het realiseren van milieu- en natuurdoelen in het beleid ernstig op ten minste twee manieren. Ten eerste, verhogen ze de kosten van grondverwerving voor de Ecologische Hoofdstructuur. Ten tweede, versnellen ze de ontwikkelingen in de agrarische structuur, resulterend in een voortdurende daling in het aantal landbouwbedrijven, maar ook in een schaalvergroting van de bedrijven. Schaalvoordelen dragen bij aan de efficiëntie van de overblijvende landbouwbedrijven, maar met gevaar voor nivellering in de uiterlijke verschijningsvorm van bedrijven, waardoor het landelijk gebied haar natuurlijke identiteit dreigt te verliezen.

Samenvattend deed het EU markt- en prijsbeleid, met uitzondering van de melkquotering, de grondprijs stijgen en later steeg die grondprijs nog eens vanwege het milieu- en het natuurbeleid dat nodig is om de negatieve gevolgen van dat landbouwbeleid te compenseren. Ten slotte zorgde de hoogconjunctuur eind jaren 90 voor veel rode claims op landbouwgrond, waardoor de agrarische grondprijs met de algehele stijging van de prijzen van onroerend goed mee omhoog werd getrokken. De resulterende extreem hoge grondprijs is voor de landbouw aanleiding tot een nog intensiever grondgebruik. Ziedaar de interactie tussen landbouwbeleid, milieubeleid, natuurbeleid en ruimtelijk beleid via de grondmarkt.

De allocatie van handelsverstoringen

Tijdens de GATT (nu WTO) onderhandelingen over agrarische handel, die startten in 1986, spraken de 'Contracting Parties' het voornemen uit om een 'Aggregate Measure of Support' (AMS) te ontwikkelen die de diverse bestaande vormen van landbouwondersteuning onder één dak zou kunnen brengen. Het concept zou niet alleen voor monitoringsdoeleinden gebruikt moeten worden, maar ook om bindende afspraken te maken. Idealiter zouden dergelijke afspraken zelfs de bestaande concessies en verordeningen binnen de GATT moeten vervangen. Met het oog hierop werd de AMS gezien als de voornaamste grondslag waarop het nieuwe akkoord zou kunnen worden gebaseerd.

Dit werd niet gerealiseerd. In het uiteindelijke GATT akkoord verscheen de AMS slechts als *een* onderdeel, niet als *het* onderdeel. Vragen over waarom en hoe dat resultaat werd bereikt, worden in de literatuur niet volledig behandeld. Hoofdstuk 6 probeert deze leemte op te vullen door een overzicht te geven van de conceptuele en politieke discussie over dit concept. Het geeft een analyse van de PSE, die de basis vormde voor de AMS discussies in de Uruguay Ronde, behandelt het debat over de AMS tussen de 'Contracting Parties' en geeft een synthese van de argumenten die de plaats van de AMS in het uiteindelijke GATT akkoord verklaren. Enkele van de belangrijkste resultaten uit het hoofdstuk zijn de volgende.

Het voornemen van de 'Contracting Parties' bij de start van de onderhandelingen om een 'Aggregate Measure of Support' te ontwikkelen en te gebruiken, werd gerealiseerd. De uiteindelijke rol van de AMS is echter niet in overeenstemming met de gedachte dat het concept een bepalend onderdeel van het akkoord zou moeten worden. Hoofdstuk 6 laat zien dat het uiteindelijke resultaat zowel conceptuele als politieke redenen heeft.

Als we kijken naar de meetproblemen en de kosten, dan was de keuze voor de PSE als basisconcept voor de AMS-discussies een praktische keuze. De conceptuele analyse laat echter zien dat de PSE en haar afgeleiden geen goede maatstaf zijn voor het meten van handelsrestricties en –verstoringen veroorzaakt door het agrarische beleid. Het beperken of reduceren van PSE's garandeert niet dat de handelsverstorende effecten van nationaal im- en exportbeleid zullen dalen. Bovendien kunnen landen zelf, vanwege exogene factoren zoals fluctuaties in wisselkoersen, de ontwikkeling van PSE's slechts minimaal onder controle houden.

Al in april 1989 werd de volledig geaggregeerde benadering in de onderhandelingen van de hand gewezen, toen de 'Contracting Parties' het plan accepteerden om bindende afspraken te maken op drie verschillende terreinen: binnenlandse ondersteuning, markttoegang en exportondersteuning. Vanaf dat moment speelde de AMS slechts een rol in de onderhandelingen over binnenlandse ondersteuning. De onderhandelingen over markttoegang en exportondersteuning zouden resulteren in erg specifieke afspraken. Naar onze mening heeft de onderhandelingen over binnenlandse ondersteuning in staat gesteld om vast te houden aan de aggregeerde benadering.

De binnenlandse ondersteuning (en daarmee de AMS) ontwikkelde zich niet tot een beslissend element in de onderhandelingen. Vergeleken met het brede beleidsbereik van de PSE, werden veel overheidsmaatregelen uit de AMS gehaald en vrijgesteld van reductie (de 'groene' versus de 'oranje' beleidsmaatregelen). Er

werd een akkoord bereikt over een algemene reductie van de AMS voor alle producten samen, wat grote flexibiliteit gaf bij het bereiken van het akkoord, maar tegelijkertijd haar effectiviteit ondermijnde. Verder werden de garantiesubsidies in het landbouwbeleid van de USA en de voorwaardelijke subsidies, die in de EU waren geïntroduceerd als onderdeel van de MacSharry Reform, uitgesloten van de reductieeisen. Zo werd dus een rol toegekend aan de AMS, maar slechts in de vorm van een uitgeklede versie van de 'Total PSE' voor alle producten, en exclusief de terreinen van agrarische importen en exporten, die van doorslaggevender betekenis waren.

De vraag blijft waarom het nochtans als belangrijk werd gezien om het akkoord te voorzien van een bepaling over de AMS in plaats van er volledig van af te zien. Was dit omdat de 'Contracting Parties' hun eerdere voornemen niet wilden opgeven? Of was het omdat er tezijnertijd een nieuwe onderhandelingsronde zou komen, waarin een AMS een prominentere rol zou kunnen spelen? Hoewel een volleerd antwoord op deze vragen moeilijk is, heeft de AMS-discussie in de Uruguay Ronde ten minste één ding duidelijk gemaakt. Ondanks de voornemens van de 'Contracting Parties' bij aanvang van de onderhandelingen, hebben ze nooit echt de intentie gehad om een AMS te ontwikkelen, die de werkelijke handelsverstoringen zou kunnen meten. Elke 'Contracting Party' in de onderhandelingen had er belang bij om een AMS te ontwikkelen, die de 'berekende' handelsverstoringen veroorzaakt door de 'Contracting Party' zelf zou minimaliseren en de handelsverstoringen veroorzaakt door de andere 'Contracting Parties' zou maximaliseren. The uitgeklede versie van de AMS in het uiteindelijke akkoord, waar veel overheidsmaatregelen uit waren gehaald en vrijgesteld van reductie, ondersteunt deze visie. Het reduceren van internationale handelsverstoringen is een 'collective action problem' dat de gezamenlijke inspanning vereist van de 'Contracting Parties' met de juiste motivatie om de handel te liberaliseren. Helaas heeft de AMS discussie in de Uruguay Ronde getoond dat het tegenovergestelde opgeld lijkt te doen: in plaats van samen te werken in de richting van een gemeenschappelijk doel, probeert elke 'Contracting Party' gratis mee te liften op de inspanningen van anderen, uiteindelijk ten nadele van iedereen. Meer dan een decennium is nu voorbij sinds het uiteindelijke GATT akkoord werd getekend en geratificeerd, maar de discrepantie tussen voornemen en gedrag van de 'Contracting Parties' lijkt te blijven bestaan. De Doha ontwikkelingsagenda van 2001 richt zich weliswaar op het verbeteren van de toegang tot internationale markten door verdere handelsliberalisaties door te voeren, maar onder andere het feit dat 'Contracting Parties' de mogelijkheid hebben om speciale of 'gevoelige' producten te vrijwaren van reductieafspraken, doet twijfels rijzen over de mate waarin de Doha Ronde feitelijk zal leiden tot een vergrote markttoegang. De WTO bleek en blijkt een oncoöperatieve club waarin elke 'Contracting Party' probeert de eigen kosten, die voortvloeien uit het terugbrengen van handelsverstoringen, te minimaliseren en de volledige kosten ten laste van de andere 'Parties' te brengen.

Literatuuroverzicht en onderzoeksaanbevelingen

In hoofdstuk 1 werd elk allocatiemodel in dit boek beschreven in termen van clubs, 'sharing arrangements', ledental en (outputs van) clubgoederen; bekende begrippen in de literatuur over allocatietheorieën, met name theorieën over de allocatie van publieke goederen. Deze paragraaf doet een aantal onderzoeksaanbevelingen tegen de achtergrond van de theoretische ontwikkelingen in de allocatie van publieke goederen. De paragraaf begint met een kort historisch overzicht van deze ontwikkelingen sinds de publicatie van Paul Samuelsons 'pure theory of public expenditure' in de vroege jaren 50, gevolgd door een aantal onderzoeksaanbevelingen.

Een kort historisch overzicht van allocatietheorieën

Hoewel de oorsprong van 'allocatietheorieën' teruggaat naar Adam Smith's "The Wealth of Nations" (1776), is de meerderheid van de economische artikelen over allocatietheorieën pas verschenen na Paul Samuelsons oorspronkelijke werk 'The Pure Theory of Public Expenditure' (Samuelson, 1954, 1955, 1958). In drie korte papers zette hij een algemene theorie uiteen over de optimale allocatie van hulpbronnen en optimale clubs. Hij breidde de neoklassieke economische theorie, waarin alle goederen en diensten privaat in consumptie zijn, wiskundig en grafisch uit met collectieve goederen en diensten, definieerde de optimaliteitsvoorwaarden en verkende alternatieve clubs om dit optimum te bereiken. Zijn theorie culmineerde in een eeuw van schrijven over 'public expenditure' door auteurs als Pantaleoni (1967)[1883], Sax (1967)[1883], Mazzola (1967)[1890], Wicksell (1967)[1896] en Lindahl (1967[1919]; 1967[1928]) en over het probleem van 'optimal taxation' door alle grote neoklassieke schrijvers, en werd geformuleerd in duidelijke wiskundige vergelijkingen.

De buitengewone eenvoud van het model ontlokte behoorlijk wat kritiek. Vroege critici, zoals Margolis (1955), wezen op de moeilijkheid om situaties te vinden die precies in het model pasten. Zowel de neoklassieke economische theorie als Samuelsons model zijn alleen toepasbaar op polaire of extreme gevallen. Deze modellen zijn wellicht succesvol in het voorspellen van strategieën en uitkomsten in vastomlijnde situaties zoals beschreven door de aannames in de modellen, maar ze kunnen geen voorspellingen doen in situaties die buiten dat bereik vallen[1]. In de twee decennia volgend op Samuelsons artikel werden serieuze pogingen ondernomen om voort te bouwen op het basismodel en het uit te breiden voor toepassing op een ruimer aantal situaties. Bijzondere bijdragen werden geleverd door Tiebout (1956), Olson (1974[1965]), Buchanan (1965) en Hardin (1968). Tiebouts "A Pure Theory of Local Expenditure" breidde Samuelsons model uit met lokale of territoriale publieke goederen. Olsons "The Logic of Collective Action" gaat over de effecten van groepsgrootte en de samenstelling van een groep op de

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[1] Samuelson (1972[1969]:504) zelf lijkt dit te erkennen wanneer hij zeg dat "(…) this is much the most constructive and comfortable point, nihilism or doubt about the solution for the general case of any public good might be out of order in connection with many particular forms of public goods. It is here that many of my critics will turn out to have a valid point (…)".

voorziening van 'pure' en 'impure' publieke goederen en bevat de beginselen van de clubtheorie. Tegelijkertijd met Olson en in eerste aanleg onwetend van elkaar, ontwikkelde Buchanan een formelere en wiskundig onderbouwde versie van de clubtheorie. In zijn oorspronkelijke werk "An Economic Theory of Clubs" veralgemeniseerde Buchanan Samuelsons model tot een model dat ook 'impure' publieke goederen omvatte met als doel om de leemte tussen 'pure' private goederen en 'pure' publieke goederen te vullen. Tot slot is Hardins verhandeling over "The Tragedy of the Commons" de moeite van het vermelden waard, omdat hij het probleem van de exploitatie van 'open access' en 'common property resources' populariseerde. Problemen, die later een structuur bleken te hebben die erg veel leek op die van het publieke goederenprobleem (Cornes and Sandler, 1996). In navolging van deze pioniers is uitgebreide literatuur verschenen met talrijke uitbreidingen op en aanpassingen van de basis theorieën[2], inclusief de allocatiemodellen die in dit boek zijn gepresenteerd (zie paragraaf 1.2). Het resultaat van dit alles is een spectrum van afzonderlijke modellen die verschillen in wijze van presenteren, bereik en wiskundig detail, variërend van de neoklassieke economische theorie van 'pure' private goederen aan het ene uiteinde tot Samuelsons neoklassieke theorie van 'pure' publieke goederen aan het andere uiteinde. Maar Margolis' kritiek van een halve eeuw geleden is nog steeds van toepassing: elk model is van toepassing op alleen een polaire of extreme situatie. Nog altijd ontbreekt het aan een eenduidig en wiskundig geformuleerde algemene theorie die het hele spectrum van mogelijke situaties kan omvatten en waarvan alle andere theorieën kunnen worden afgeleid.

Enige onderzoeksaanbevelingen

Om te komen tot een algemeen model voor de allocatie van hulpbronnen of, synoniem, een algemene clubtheorie moet het traditionele clubmodel op een aantal aspecten worden aangepast. Aangezien het onmogelijk is om een volledige lijst van mogelijke aanpassingen te geven, richten we onze aandacht op de in onze ogen meeste cruciale uitbreidingen, namelijk de endogenisering van 'sharing arrangements' en uitsluitbaarheid.

<u>'Sharing arrangements'</u>

In die modellen in het spectrum die worden ondersteund door een wiskundige structuur worden 'sharing arrangements' van clubs steevast óf als exogene beschouwd óf er wordt weinig of geen aandacht aan besteed. Minasian (1964:80) wees als eerste op deze tekortkoming, die later bevestigd en versterkt werd door Buchanan (1967) in een kritisch commentaar op Samuelsons 'pure theory of public

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[2] Cornes en Sandler (1986 en 1996) geven een overzicht van de ontwikkelingen in de theorie over publieke goederen en clubgoederen. Zie ook Scotchmer (1994) voor een overzicht van de clubgoederentheorie en Sandler (1992) voor een overzicht van de 'theory of collective action' inclusief een overzicht van de literatuur voortgebracht door *The Logic of Collective Action*. We adviseren de lezer ook Ostroms (1990) uitstekende werk over 'common pool resource problems' te raadplegen, Foldvary's (1994) vernieuwende studie over territoriale collective goederen en het recente werk van Webster en Wai-Chung Lai (2003) over stedelijke goederen en diensten. Deze studies bevatten tevens nuttige literatuurreferenties.

expenditure': "A pure theory of public expenditure purporting to identify on economic grounds the goods that are best provided by collective action should have the power to govern choice among alternative institutional arrangements on the basis of their relative merits. The present theory of public goods is incapable of generating the relevant economic information." Samuelson (1972[1964]) erkende Minasians conclusie in zijn reactie op de Minasian paper, maar ook elders (1958, 1972[1967], 1972[1969]). In een notitie over de onduidelijkheid over de rol van de overheid in de publiekegoederentheorie, stelde hij dat: "The pure theory of public expenditure (…) cannot properly be interpreted to imply that private goods should be produced by private enterprise and public goods should be produced by government directly. (…) Where the consumption externalities intrinsic to a non-private good occur, all that I would insist on is that laissez faire cannot be counted on to lead to an optimum. There is a prima facie case, so to speak, for social concern and scrutiny of the outcome; but that does not necessarily imply outright state ownership or in every case public regulation. The exact form in which the social concern ought to manifest itself depends on a host of considerations that have to be added to the model (Samuelson, 1972[1967]:47)." Sinds het Minasian-Samuelson debat hebben vele economen de effecten van instituties - en de spel-theoretische structuur die daaruit voorvloeit – op de optimale allocatie van hulpbronnen onderzocht, maar geen van hen neemt instituties op als een keuzevariable. Veelal analyseren en vergelijken onderzoekers de resultaten van een afzonderlijke club met een normatieve set van optimaliteitsvoorwaarden of nemen ze genoegen met een vergelijking tussen enkele afzonderlijke clubs. Het veilingmodel in de hoofdstukken 3 en 4 en de vele voorbeelden in Cornes en Sandler (1996) vertonen tekenen van deze benadering. Het veilingmodel in dit boek simuleert de resultaten van clubs voor verschillende typen veilingen en andere beloningssystemen ten opzichte van een systeem met uniforme prijzen. In termen van Pareto-efficiëntie vergelijken we daarmee de efficiëntie van clubs voor een aantal afzonderlijke beloningssystemen ten opzichte van een referentiesysteem, maar geen van deze systemen is noodzakelijkerwijs het 'optimale' systeem.

   Afgaande op de onderzoeksaanbevelingen op dit terrein van auteurs als Sandler (1992), Sandler en Tschirhart (1997) en Cornes en Sandler (1996), kunnen we in de toekomst meer werk volgens deze lijn verwachten. "An analysis of institutions is needed, and this requires the discrete comparison of alternative forms, each with its own set of net benefits for the agents and total benefits (Sandler, 1992:199)." Dit strookt evenmin met het werk van bijvoorbeeld Olson (1974[1965]), Ostrom (1990), Foldvary (1994) en Webster en Wai-Chung Lai (2003) als met onze alledaagse ervaringen, die laten zien dat clubs zich zullen ontwikkelen naar gelang de institutionele en technologische omstandigheden en naar gelang de behoeftes. Gegeven deze omstandigheden en behoeftes, vormen mensen hun eigen clubs - inclusief overheidsclubs – om hulpbronnen zo optimaal mogelijk te alloceren, en aangezien de omstandigheden en behoeftes zich voortdurend wijzigen, veranderen clubs ook. Één van de ontbrekende schakels hier is een allesomvattende theorie over de voorziening van goederen en diensten door clubs. Een dergelijke theorie vereist een andere benadering, een waarin de club zelf endogeen is in de theorie, een theorie die de organisatievorm van de club opneemt als een keuzevariable. In de bewoordingen van hoofdstuk 3 en 4 zou een dergelijke theorie ons in staat stellen om de optimale 'sharing arrangement' te bepalen – in plaats van genoegen te

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nemen met een vergelijking tussen enkele afzonderlijke 'arrangements' – die wel eens af zou kunnen wijken van de 'sharing arrangements' die opgenomen zijn in de simulatie.

Uitsluitbaarheid

Traditionele allocatiemodellen veronderstellen ook dat alle clubgoederen van nature uitsluitbaar of niet-uitsluitbaar zijn. Een clubgoed wordt uitsluitbaar genoemd als de club niet-leden ervan kan weerhouden om te genieten van de baten van een goed. Dit houdt in dat er letterlijk of figuurlijk een clubtoegangspoort is, waar mensen door in- en uitgaan om toegang te krijgen tot het goed (Foldvary, 1994). Het passeren van de poort impliceert instemming met de 'sharing arrangement' van de club, inclusief de regels voor uitsluiting, en "implicitly sets a time limit to the membership; when it expires, one must again pass through the gate (Foldvary, 1994:)" [3].

Een clubgoed wordt daarentegen niet-uitsluitbaar genoemd indien niet-leden de toegang tot de baten van het clubgoed niet kan worden ontzegd, zelfs niet als ze weigeren om door de clubtoegangspoort heen te gaan en derhalve deel te nemen in de 'sharing arrangement'. Dit betekent dat leden door de clubtoegangspoort heen moeten om toegang te krijgen tot de 'sharing arrangement', maar niet om toegang te krijgen tot het clubgoed. Een gemeenschappelijke speeltuin in een woonwijk moge als voorbeeld dienen. Veronderstel dat de speeltuin gemeenschappelijk eigendom is van en wordt gedeeld door bewoners in de wijk volgens een onderling overeengekomen 'contractual arrangement' dat precies aangeeft hoe gebruik, onderhoud en financiering geregeld zijn. We veronderstellen verder dat de aankoop van een huis in de wijk fungeert als de clubtoegangspoort, maar dat er geen hek, controleur of ander uitsluitmechanisme is om bezoekers aan de wijk ervan te weerhouden de speeltuin te gebruiken. De aankoop van een huis of appartement impliceert instemming met alle regels die voorzien in het verbieden, toestaan of verlangen van bepaalde activiteiten of handelingen met betrekking tot de speeltuin, maar verleent geen exclusief recht tot de baten van de speeltuin, die ook toegankelijk zijn voor niet-bewoners. Niet-bewoners kunnen daarmee gratis meeliften op de inspanningen van bewoners; ze krijgen toegang tot de baten van de speeltuin zonder deel te nemen in de 'sharing arrangement'.

Weinig of geen clubgoederen zijn echter van nature uitsluitbaar of niet-uitsluitbaar, maar zijn economisch uitsluitbaar of niet-uitsluitbaar. Dat wil zeggen, de motivatie om een uitsluitmechanisme in te stellen en in stand te houden wordt bepaald door efficiëntieoverwegingen. Een privéweg kan fysiek worden afgesloten voor doorgaand verkeer, waarbij passanten tol betalen aan de eigenaar voor het gebruik van de weg. Maar indien de tolopbrengsten niet opwegen tegen de som van de kosten veroorzaakt door congestie en de uitsluitkosten, is uitsluiting inefficiënt en blijkt de weg economisch niet-uitsluitbaar te zijn. Passanten ontvangen dan een externe baat. Zelfs een natuurverschijnsel, zoals een zons- of maansverduistering, is

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[3]   Een clubtoegangspoort kan een letterlijke of figuurlijke afscheiding zijn (Foldvary, 1994). Letterlijke afscheidingen zijn bijvoorbeeld tourniquets en tolhuisjes. Figuurlijke afscheidingen omvatten onder andere het gebruik van ruimte, zoals het deel gaan uitmaken van of gaan wonen op het grondgebied van een soevereine gemeenschap, de aankoop van een goed of dienst, of the aanschaf van eigendomsrechten.

niet per definitie niet-uitsluitbaar. Een gedeeltelijke verduistering kan vanaf elke plaats op de aarde waargenomen worden en geen enkel levend individu kan ervan worden weerhouden om vanuit zijn of haar eigen raam van het verschijnsel te genieten, maar slechts vanaf enkele plaatsen op deze aardbol is een totale verduistering te zien. Indien de eigenaars van deze locaties een clubtoegangspoort instellen en bezoekers een prijs in rekening brengen voor het gebruik van het terrein gedurende de verduistering, kan niemand de totale verduistering gratis waarnemen behalve de eigenaars zelf.

Een algemene allocatietheorie vereist een andere benadering, waarin uitsluitbaarheid zelf endogeen is in de theorie en de indeling van clubgoederen in uitsluitbare en niet-uitsluitbare groepen een output in plaats van een input van de analyse is. Een dergelijke theorie zou best eens met andere conclusies ten aanzien de Pareto-efficiëntie van specifieke oplossingen voor allocatieproblemen op de proppen kunnen komen dan de traditionele theorieën waarin uitsluitbaarheid als exogene wordt beschouwd. De allocatie van natuurlijke hulpbronnen in hoofdstuk 2 moge daarbij als voorbeeld dienen. Traditionele economische analyses van de allocatie van natuurlijke hulpbronnen nemen veelal de organisatievorm van clubs, ledental, technologie, en de uitsluitbaarheid of niet-uitsluitbaarheid van de natuurlijke hulpbron als gegeven aan. Technologische verbeteringen kunnen echter een zodanig effect hebben op kosten en baten dat een goed dat eerder economisch niet-uitsluitbaar was, nu uitsluitbaar wordt. De geschiedenis van Yellow Stone Park illustreert dit. Ten tijde van de oprichting van Yellowstone in 1872, was het park niet-uitsluitbaar en de opbrengsten die voortvloeiden uit de aantrekkelijkheid van de Yellowstone regio verdwenen door de vrije toegankelijkheid van het gebied, uiteindelijk leidend tot een 'tragedy of the commons'. Dit veranderde echter door de komst van spoorwegen. De Pacific Railroad zag de potentiële opbrengsten van de aantrekkelijkheid van Yellowstone en eigende zich deze opbrengsten toe door haar monopolie op het transport naar de Yellowstone regio verticaal te integreren met de voorziening van toeristenfaciliteiten in het park. Dit verschafte de Railroad het de-facto-eigendom van het park en veranderde het park van een niet-uitsluitbare in een uitsluitbare hulpbron. Deze situatie duurde voort totdat in 1915 auto's tot het park werden toegelaten. Sindsdien is de Railroad haar monopolie kwijt – en is het park weer een 'open access' gebied geworden – en verdwijnen opbrengsten door congestie (Anderson en Hill, 1996).

Tot slot

Naast 'sharing arrangements' en 'uitsluitbaarheid' zijn er nog andere terreinen, waarvoor meer onderzoek nodig is en die aandacht zouden moeten krijgen als een algemene allocatietheorie zou kunnen worden ontwikkeld. Deze terreinen of aspecten betreffen onder andere 'joint products' of 'mixed' goederen, producentenclubs en clubs, waarvan de leden bestaan uit zowel consumenten als producenten, het effect van informatie asymmetrie, de cognitieve vaardigheden van clubleden en de mate waarin ze gericht zijn op eigenbelang, en het effect van ruimte en afstand op allocatiebeslissingen. In een persoonlijke boodschap beveelt Buchanan (10 maart 2005) elke poging aan "to extend the whole notion of allocative efficiency to include the endogenous formation, operation, and maintenance of institutional forms, notably the formation of clubs, inclusively

defined." Hij vat dergelijke pogingen op "as moving to fill in the rather awesome gap between the arid reaches of general equilibrium theory and the down to earth practical treatment of institutions, a gap that remains unexplored territory and opens up analytically interesting opportunities." Van der Hamsvoort (2005) heeft een eerste poging gedaan om te komen tot een algemene theorie voor de optimale allocatie van hulpbronnen, waarin clubs, 'sharing arrangements', uitsluitbaarheid, 'joint products', gerichtheid op eigenbelang en de ruimtelijke dimensie endogeen zijn. Momenteel is Van der Hamsvoort samen met Cornes bezig om dit nog rudimentaire artikel verder te ontwikkelen. Meer werk langs deze onderzoekslijnen lijkt gerechtvaardigd, aangezien een algemene clubtheorie nog immer niet bestaat.

Een algemen allocatietheorie kan dienen als intellectueel gereedschap of model om te begrijpen waarom sommige club oplossingen lijken te werken in sommige situaties maar niet in andere, vooral waneer het gaat om collectieve goederen en diensten. Veel van de vragen die we proberen te beantwoorden, concentreren zich op de 'governance' van de voorziening van collectieve goederen. Kunnen en willen individuen zichzelf organiseren en hun acties coördineren om collectieve goederen te voorzien zonder inmenging van de overheid? Moeten overheden altijd interveniëren om voorziening tot stand te brengen? Welke basisvoorwaarden moeten aanwezig zijn voor een succesvolle voorziening?

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