Under What Conditions are Decentralized Solutions to Collective Action Problems Likely?

by

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I. Human Coordination

In order to understand the problem of collective - in contrast to individual - action one needs to be familiar with the most important institution coordinating human activities, i.e. the market mechanism. Every introductory economics text starts with an emphasis on scarcity and goes on to explain the need to find some way of deciding how particular resources are to be allocated and distributed.[1]

To find an acceptable answer to these questions is the first collective action or collective decision making problem that humans have to face. In a Robinson Crusoe world these questions are answered without the involvement of any inter-personal coordination. Robinson Crusoe is "only" concerned with the task of weighing the utility of different activities for himself i.e. "making sure" that marginal utilities are the same in every use. As soon as the analysis concerns at least two individuals, the additional concern is with the interaction of preferences and their coordination. In a scarce world not all preferences can be satisfied and even the ones that can are not satisfied at the same cost; this is the heart of any collective action problem. Indeed with only a few individuals the collective action problem is still a fairly simple one. Answers to the basic economic questions can be provided by a general meeting of all individuals, for example, in a tribe assembly. Problems can be discussed there and a specific division of labor based on personal contact and informal institutions will result. If one of the hunters of the tribe needs a new bow, he will simply contact the bow-maker and tell him about his need for a new bow in order to fulfill his role in the community. Free riding and shirking are avoided by personal contact. Allocative and distributional questions are solved through face-to-face communication. Norms are enforced by strong social pressure. In this form of economic organization the distinction between private and collective goods is almost meaningless.

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[1] The basic economic questions due to scarcity are:

a) material: what and how much?

b) organizational: what from whom?

c) technical: how?

d) in space: where?

e) in time: when?

In addition to these allocative questions there is the distributional question (for whom).

Different from face-to-face societies is the coordination mechanism in great-number societies. In monetized economies with specialization, mechanization and industrialization, individual valuations are effectuated on markets and indicated by prices. Of course there is a multitude of different types of mechanism that can be envisioned and some have actually been employed. The most obvious distinction is the one between a planned economy and a market economy. Instead of elaborating further on the coordination mechanism of a planned economy – which is somewhat similar to the coordination in a face-to-face society - and the one of a market economy, a discussion of criteria that can be used to evaluate specific social coordination mechanisms is provided. Three criteria are distinguished:

1. collection of knowledge
2. dissipation of knowledge
3. utilization of knowledge

Given the constitutive lack of knowledge of each individual about the preferences of every other individual, let alone the doubtful interest one individual i might have in some other individual $j \neq i$ unknown to him, the smooth collection, dissipation and utilization of knowledge about preferences, technology and the amount of resources are key problems that coordination mechanisms need to solve.

The general task of a coordination mechanism is to "consider" individual preferences, technology and the set of available resources and generate a general vector of relative valuations $\vec{v}$.

In order to understand the construction of a general valuation vector, imagine an exchange economy in a world without time and space i.e. in a world with no transaction cost, infinitely fast adaptation etc. In such a heuristic world, the transactions taking place would result in an instantaneous equilibrium which produces a system of ratios of exchange. This is the general, relative valuation vector $\vec{v}$.

Specifically $\vec{v}$ fulfills the following condition

$$MRS^{i}_{xy} = MRS^{j}_{xy} \quad \forall \quad i \neq j, \in P, \text{ and } x \neq y, \; x, y \in G$$

This guarantees that the marginal rates of substitution between all possible pairings of goods in the total set of goods G are each equal for all individuals in the population set P. In addition to exchange efficiency, the coordination mechanism needs to be efficient in terms of its production as well. Production and exchange efficiency is guaranteed if in addition the marginal rate of substitution for a pair of goods in G is equal to the marginal rate of transformation i.e. the rate at which production can be shifted from one good to the other at the production possibility frontier of the economy.

$$MRS_{xy} = MRT_{xy} \qquad \forall \quad x, y \in G$$

It is important to note that so far only a complete and Pareto optimal vector of ratios of exchange for all goods in the economy has been established.[2] Given preferences, technology and a fixed set of resources this vector is termed $\vec{v}$. This vector fulfills a purely heuristic role. It will be used as a measuring rod for the desirability of coordination mechanisms. Since this paper does not deal with the specific mathematical construction of this heuristic, readers interested in a formal proof of how one arrives at such a vector of relative valuations given technology, preferences and a fixed amount of resources are referred to graduate level microeconomics texts. It should be noted that this line of argument is one of the key concepts in economics since Walras.

Taking the choice of a market based coordination mechanism as given, the effects of particular institutional mechanisms are analyzed. Generally speaking a market economy represents a high powered coordination mechanism to solve the allocative questions mentioned above, because it provides incentives to collect and utilize knowledge and a unique measuring rod, namely relative prices in order to dissipate knowledge.[3] From that perspective, relative prices are the most important ingredient in a market based coordination mechanism.[4]

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[2] In an economy with G goods without medium of exchange, $G(G-1)/2$ transactions would need to be observed in order to construct a vector $\vec{v}$. Since it will be necessary to compare $\vec{v}$ with $\vec{p}$, the vector of relative prices that emerges under a given institution, $\vec{v}$ has G elements where an G+1 good is assumed to be the numeraire.

[3] The capacity of spontaneous orders to utilize dispersed knowledge and the role of competition as a discovery procedure are emphasized by Hayek (1945). Hayek (1978:125) is aware of the necessity of rules that constrain competitive efforts to strategies that serve consumer interests.

[4] Indeed, even in a planned economy, decisions are based on relative prices. However, the “relative prices” in a

However, the adaptation of a specific market institution I_m entails a specific vector of relative prices $\vec{p}_m$ even if preferences, technology and the set of resources is held constant. If there is a complete set of markets so that every good is traded in a market at publicly known prices and if firms and households act perfectly competitively, the first fundamental welfare theorem indicates that the outcome is Pareto optimal.[5] If the economic constitution I^* fulfills these conditions, $\vec{v}$ corresponds to the vector of relative prices $\vec{p}_{I^*}$. As a result, profit maximization is guaranteed to be in perfect correspondence to utility maximization.

In a world without perfect economic constitution, the essential question is to what degree the outcomes of a particular market institution and its respective selection mechanism have desirable properties. Following Vanberg (1994:184f), the desirability of a specific market institution is conditional on the desirability of the set of relative prices generated by this mechanism and to what extent this set approximates the vector of relative valuations $\vec{v}$.

Of particular interest is the normative content of spontaneous market order and individual entrepreneurial market success. If the merit of entrepreneurial success in a market economy is only seen in the fact that profits have been made, the notion is without normative content. Since market success is measured in profits, this statement only amounts to saying that what is honored by the market has the virtue of being profitable. This is obviously indisputable but at the same time such statements are of little interest. By contrast, it would be a meaningful but also disputable claim, to say that a particular market institution selects in favor of entrepreneurs who are successful in the sense that they improve general welfare, where the preferences of individuals are the only relevant measuring rod for economic welfare.

As long as market selection is discussed in general terms, without specifying the constraints that condition market behavior to say that successful entrepreneurs will be selected by the market, does not reveal much about what being successful means, other than high profits, nor does it reveal whether success is desirable in any sense other than that it creates profits. Without being able to say something substantive about what it is that is expected to be successful, it is impossible to discuss whether that which creates profits is desirable.

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planned economy do not emerge endogenously; they are determined by the social planner.

[5] In the following, the specific problems market institutions might face that do not relate to the problem of relative prices approximating relative valuations given technology and given a set of resources, will be neglected.

By contrast, to the extent that the terms under which market competition takes place are known, it is possible to distinguish conceptually between success and high profits. It is possible to conjecture what, given a specific market constitution, is likely to be successful and therefore create profits. And it is possible to meaningfully discuss whether what is predicted to be successful, is also – in terms of the standard introduced above – desirable. Judgements about particular coordination mechanisms are therefore conditional claims. In this paper they are made to be conditional on the satisfaction of preferences (of relative valuations). To use a radical example, a market order in which it is legal to burn down the factory of a competitor, creates a different set of relative prices than a market order in which competition is constrained to areas in which it is deemed socially productive (Eucken 1951).

Returning to the classification of goods normally used to indicate coordination problems in a market setting, it is possible to say that, for private goods, a mechanism has been found (actually it would be more precise to speak of a mechanism that "creates" characteristics associated with strictly private goods and is able to coordinate on these goods) that answers the basic economic questions and provides incentives to continuously improve upon the answers found. For this domain, the original collective action problem is solved by an institutional structure that is characterized by anonymous coordination through relative prices. Under this system, neither an omniscient social planner is needed to reason about and calculate how many and what type of goods are produced, out of what type of parts and ingredients will be needed, where and when, and for whom, nor is it necessary to individually engage into worldwide polling methods (in analogy to the face-to-face society) in order to coordinate production and consumption activities. Given specific assumptions, all relevant relative valuations emerge endogenously.

Depending on the economic constitution, aligning individual self interest with general interest through a set of relative prices is more or less possible. Once the heuristic construction of an ideal economic constitution I^* is abandoned, the institutional preconditions turn out to be very complex. Without going further into the problem of collective goods[6], it is important to point to the limits a specific economic constitution might exhibit. The emphasis on "specific economic constitution" is made in order to demonstrate that an infinite number of economic

[6] All strictly non-private goods are called collective goods. Following Bonus (1978), collective goods are public to various degrees (Öffentlichkeitsgrad). Using excludability and rivalry as criteria, CPR's, public goods, club goods etc. can be distinguished.

constitutions can be envisioned. This implies that some among these can deal with certain aspects better than others. It is meant to emphasize that specific problems cannot properly be dealt with within a specific economic constitution as long as the specific market structure - which to a relevant extent determines market outcomes - is not changed. This distinction will become highly important. The selection in favor of higher profits and the incentives provided by this selection mechanism will generally imply a specific market constitution within which certain activities lead to profits. If this particular activity is carried out in an alternative constitutional setting, the formerly profitable activity might result in heavy losses. This also pertains to the distinction between the excludable vs. non-excludable and the rival vs. non-rival characteristics of goods. These categories will be used generally and therefore not solely with respect to a specific institution, physical reality or human perceptions and valuations. For example, in a market economy where a specific tradable permit scheme for CO_2 emissions exists, CO_2 emissions are rival since permits are scarce and represent costs. In an alternative market economy where no tradable permit or other mechanism exists, CO_2 emissions continue to be non-rival.

What is honored under or within a specific market constitution does not therefore necessarily reflect preferences. Given the unrealistic nature of I^*, perfect identity of $\vec{p}$ and $\vec{v}$ will never be encountered. However, there are different degrees of approximation of relative valuations by relative prices and therefore between utility maximization and profit maximization within market constitutions. In this context, two separate issues have to be considered. First, profit maximization might not correspond to utility maximization, no matter whether this activity takes place on the individual or aggregate level. The second pertains to the possibility that these activities create different effects depending on the level of analysis, for example individual profit or utility maximization (assuming perfect congruence on the individual level) might result in negative aggregate effects (emergent properties). The free rider problem falls in this second category. Holding preferences, technology and the set of available resources constant, these discrepancies are solely due to the institutional structure of market processes. Depending on the institution, preferences will become more or less effective in relative prices and therefore relative prices will approximate relative valuations to a greater or lesser extent.

The distinction between the level of rules and the level of game moves is crucial in understanding the proposed distinction between pure and constitutional collective action problems, a definition which is far from strict, since it fully hinges on the particular

institutional structure in the light of which the collective action problem is analyzed. Under the institutional set A, a specific collective action problem y might be termed constitutional, under an institutional set B it might be termed pure and under an institutional set C it might not even be a collective action problem but a problem of individual action.

Recapitulating, in a tribal setting, there is no limit to the expression of valuations because coordination takes place through general meetings of the tribe. As soon as face-to-face coordination becomes unfeasible and inefficient, widely impersonal coordination mechanisms are used to coordinate individual economic activities (North 1990). In a market economy, however, relative valuations are not directly processed but approximated by a vector of relative prices $\vec{p}$ which might not correspond to relative valuations. In this case, it is very likely that due to a specific institution I_m, only a subset $\vec{v}_m$ of all possible valuations is covered. Depending on the market institution I_m, $\vec{v}$ is approximated by $\vec{p} = \vec{v}_m$ which is a subset of $\vec{v}$. The goods for which relative valuations are contained in the complimentary set to $\vec{v}_m$ (the set $\vec{v} - \vec{v}_m$) are collective goods. For these goods markets and therefore prices do not emerge spontaneously.

II. The Notion of Scarcity

In the social sciences scarcity as a meaningful concept can only imply that relevant groups or individuals perceive a particular time and place bound shortage or abundance.[7] In that sense scarcity is not an objective category. Coal, for example, is of course a scarce resource in the sense that it is a) not available abundantly (physical limits – if for one moment the possibility for regeneration is neglected), b) that the coal available at a certain extraction cost is not abundant and c) that by walking through the streets of east Berlin in 1989, where coal was used as a primary heating element, one might have considered coal not scarce enough. The first type of scarcity is an immediately binding constraint on economic activity – as soon as coal reserves have been exhausted, there will be no more coal. The two other categories are more intricate. The notion of extraction cost is a human construction just as much as the displeasure of coal emissions released into the air of east Berlin. Nevertheless there is a distinction. The idea that coal might be termed not "available" beyond a certain extraction cost is insofar incorrect as coal is still available but its extraction is not warranted. This is a concept that emanates from relative prices for various extraction technologies and also for coal substitutes which, in turn, are generated by individual interactions within a particular coordination mechanism. This coordination mechanism also provides specific incentives to generate substitutes and improve extraction technology. As indicated above, the market mechanism works relatively well as long as the amount of non-excludable and/or non-rival goods involved is low. For example, as long as coal is a strictly private good (meaning no externalities attached to any use of coal) and as long as there are no other collective goods that influence relative prices relevant to coal supply and demand, it represents an excludable and rival good.[8] Prices for coal will form on coal markets reflecting physical resource constraints surrounding the location and total amount of coal, technological constraints (of extraction and available substitutes) and individual purchasing power (individual preferences), but also on relative valuations of other purely private goods. The resulting scarcity is indicated by the relative price of coal. Taking technology and physical restraints as given, the question of relative valuations remains. Even if, additionally, preferences are taken as given, it needs to be

[7] Scarcity is a bi-directional problem in the sense that the problem might arise due to the abundance of a particular resource or product at a particular time and place, or in its classic version due to rareness or deficiency.

[8] This is difficult to envision, since it is a system of simultaneous equations which generates the price vector in standard general equilibrium models. As soon as one variable changes, the whole vector is affected.

demonstrated that no preferences exist that are not reflected in relative prices. If individual preferences are taken as the sole orientation, a problem can only arise if goods exist in this economy that are not strictly private.

To sum up, three different determinants of scarcity can be identified. The first is a physical scarcity, here the quantity available in the region, world or universe, and its regeneration rate (if renewable) is considered. The second is a social mechanism (market) based scarcity that depends on the extent to which particular preferences and valuations are reflected by a specific coordination mechanism (interaction of individuals) and the incentives provided by that institution. This scarcity is induced by the choice of the institutional structure used to transform individual valuations into relative prices. The third is scarcity as represented in relative valuations irrespective of the institutional structure (of course this is a heuristic argument). It contains additional preference elements not included in the other categories.

The distinction between pure and constitutional collective action hinges on scarcity as reflected in markets vs. scarcity reflected in preferences that cannot be voiced within markets. As soon as the goods involved do not possess strictly private properties, "it can be shown that various aspects of 'market failure' occur and different types of institutions other than those of an open, competitive market may be needed." (McGinnis/Ostrom 1996:466) Once the assumption of the existence of only strictly private goods is dropped, alternatives to market institutions may be required. As a consequence, relative prices even for the remaining strictly private goods are necessarily biased if not incorrect. This is a very important point since the necessity of "different types of institutions" is in so far nontrivial that market coordination cannot be partially abandoned. It may be possible that market coordination is circumvented for certain aspects and for a certain time but, generally, all alternative institutions introduced to remedy "market failure" (Bator 1958) will, by necessity, operate under the shadow of market incentives and therefore will need to be powerful enough to override the market incentives created by a set of relative prices that is inappropriate to achieve human wants.[9]

Generally speaking, market scarcity as indicated by relative prices reflects overall valuations if excludable and rival goods are analyzed, that is, the assumption of a complete set of

[9] The concept of internal and external institutions developed by Lachmann (1963) represents a useful distinction between a market institution as an external institution and, for example, local CPR institutions as internal institutions operating in the shadow of the external market institution.

markets is fulfilled. If this is not the case and, for example, a rival but non-excludable good (CPR) is analyzed, the original issue, namely to coordinate individual preferences in a world of scarcity, is raised again.

In the following, a collective good problem is characterized as a pure collective action problem, if all relevant individual valuations are reflected in the relative prices pertaining to the situation. Pure collective action problems arise within and remain consistent with the market system. They are consistent with the market system and can rely on economic incentives as a powerful motivational tool and on the price mechanism to indicate relative valuations. Pure collective action problems are about achieving cooperation in the design of internal institutions that increase economic efficiency and can be implemented effectively. Pure collective action operates in the shadow of market incentives. However, as Hardin (1982:70) indicates, "goods amounting to money in the pockets of those who benefit from them do not normally come to mind when one thinks of Samuelson's public goods, or even, more generally, of politics."

A collective good problem is called a constitutional collective action problem if the market does not reflect relative scarcity and treats the good as non-rival. In this case profit maximization is a misleading proxy for utility maximization. This introduces the necessity to discuss and agree on a specific normative goal.[10] Here the general problem of coordinating valuations with respect to scarce resources – previously termed the original economic problem – is again raised since relative prices as proxy for relative valuations are not available. This case is termed constitutional because it runs counter to economic incentives as generated by the market system and requires changes on the constitutional level to implement scarcity which is otherwise not recognized.[11]

[10] If the normative goal can be derived from relative prices (as in pure collective action problems) it does not pose a major problem. Disagreement normally focuses on the distribution of profits (Libecap 1995:168).

[11] Just as "collective" in "pure collective action" implies that a solution can be found collectively, the "constitutional" in "constitutional collective action" implies that a solution can be found on the constitutional level.

III. A Model of Collective Action

Following Olson (1965:22ff.) and Sandler (1992:23ff.) for the basic setup of a standard collective action problem, the potential existence of constitutional collective action problems is demonstrated.

The model concerns the production of a collective good whose provision level is Q.[12] Just as in Olson (1965), several qualifications of the model will be omitted for tractability[13].

The Nash equilibrium in a collective action setting requires that firm[14] i chooses its contribution q^i to the collective good to maximize profits. F_i represents the fraction of group revenue R_g for the ith individual i.e. $F_i = R_i / R_g$. The objective function for the Nash problem can be written as

$$\max_{q^i}[F_i R_g - C_i(q^i)] \qquad [1]$$

where individual cost C_i is assumed to be an increasing linear function in q^i. In addition, total provision is the sum of individual *i*'s provision and the aggregate provision of the other individuals $\tilde{Q}$, so that $Q = q^i + \tilde{Q}$.

For Nash behavior, $\tilde{Q}$ is held constant when maximizing. The cost function for the individual and that for the group are assumed to be identical with constant marginal cost, so that $dC/dQ = dC_i/dq^i = k$ for all Q and q^i, where k is constant. The first order condition for the Nash problem is

$$F_i dR_g / dQ - dC_i / dq^i = 0, \qquad [2]$$

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[12] Alternatively the model can be applied specifically to a CPR. In that case, Q represents the total number of assets allocated to appropriation from a CPR, C the costs of these assets and R_g the group revenue generated from the CPR. The specific functional form of R would differ from the functional form of R in the public good case.

[13] For a more refined treatment of collective action problems see Sandler (1992) or Cornes/Sandler (1996). It should be noted that the argument also applies to the more elaborate models presented there.

[14] For simplicity, reference is made to firms but of course the argument remains valid, after some additional assumptions, for individuals as well.

in which the concave revenue function R_g indicates that the marginal revenue for the group declines as provision increases.[15] In [2] the firm's marginal revenue equals the marginal cost of provision. When equation [2] holds for each i, a Nash equilibrium is achieved. The simultaneous satisfaction of the system of first order conditions in equation [2] determines an optimizing vector of q^i's. Summing over these q^i's the Nash quantity Q^N that satisfies equation [1] for each i is obtained. To establish the suboptimality of this quantity Q^N, it needs to be shown that group profits can be increased.

This group optimum corresponds to

$$\max_Q(R_g - C) \qquad [3]$$

Where collective action is chosen to maximize the group's profits. The optimum must fulfill the following first order conditions.

$$dR_g/dQ - dC/dQ = 0, \qquad [4]$$

so that the group's or the merger's marginal revenue from provision equals its marginal cost of provision. Denoting Q^M as the $\arg\max(R_g - C)$, or the provision level that satisfies [4]. If the Nash quantity, Q^N, that satisfies equation [2] is used to evaluate the left hand side of equation [4], [5] results.

$$\frac{dR_g(Q^N)}{dQ} - \frac{dC(Q^N)}{dQ} > 0 \qquad [5]$$

[15] R_g is assumed to be a continuous function, strictly concave in Q. In this context it is unnecessary to specify the type of summation technology assumed. Even though this implies that some aspects of collective goods will not be made explicit, it renders the model more general and more tractable. See Walker/Gardner/Ostrom (1990:205) for a plastic example of summation technology in a CPR context and Davis/Holt (1993:324) for an overview and also public good aggregation mechanisms.

since the marginal revenue evaluated at Q^N equals $F_i dR_g(Q^N)/dQ$ by equation [2], where $0 < F_i < 1$.[16] By equation [5] and strict concavity of the objective function, [6] results

$$Q^N < Q^M \qquad [6]$$

so that the merger quantity implies an improvement over the Nash quantity. Group profits can be increased by moving from Q^N to Q^M.

Since the only relevant measuring rod are utilities and not profits and cost which depend on the particular market constraints, optimal quantities in a Paretian sense can only be obtained by maximizing utility for the group.

$$\max_Q (U_g - D) \qquad [7]$$

Where collective action is chosen to maximize the group's net utility. The optimum must fulfill the following first order conditions.

$$dU_g/dQ - dD/dQ = 0, \qquad [8]$$

so that the group's marginal utility from provision equals its marginal disutility of provision. Denoting Q^* as the $\arg\max(U_g - D)$, or the provision level that satisfies [8]. If the merger quantity, Q^M, that satisfies equation [4] is used to evaluate equation [8], the result is ambiguous.

$$\frac{dU_g(Q^M)}{dQ} - \frac{dD(Q^M)}{dQ} \neq 0 \qquad [9a]$$

$$\frac{dU_g(Q^M)}{dQ} - \frac{dD(Q^M)}{dQ} = 0 \qquad [9b]$$

[16] If $F_i = 1$, q_i were equal to Q, no pure collective action problem would exist. [5] holds because Q^N results from an aggregation of q_i's that maximize individual revenues where only part of the revenues created are considered by every firm (the revenues directly collected by each respective firm).

If [9a] is true, which empirically is the most likely case, it entails the following result

$$Q^M \neq Q* \qquad [10]$$

so that the merger quantity implies either too little or too much provision depending on the case, hence, suboptimality. The group is made better off with provision at $Q*$ rather than Q^M or Q^N.

Equation [9b] holds iff the following is guaranteed

$$dU_g / dQ - dD/dQ = dR_g / dQ - dC/dQ \qquad [11]$$

i.e. equations [4] and [8] hold for the same $Q*$. This is in turn guaranteed iff a scalar s exists such that

$$s\vec{p} = \vec{v} \qquad [12]$$

i.e. the vector of relative valuations $\vec{v}$ used to maximize utility in [7] can be represented as a scalar multiplication of the vector of relative prices $\vec{p}$ used to maximize profits in [4].

IV. Typology of Action Situations

The previous discussion centered on the original collective action problem, namely the problem that in great-number societies problems need to be resolved and actions need to be coordinated in a different fashion than in face-to-face settings. A basic model was presented demonstrating the consequences of a discrepancy between profit and utility maximization. In this section, a typology of action situations is presented. Profit as a key coordination variable in market settings is analyzed with respect to its consequences for successful collective action.

Collective action is warranted if the utility of collective action is greater than the sum of the utilities of individual actions.[17]

$$U_{\sum_{i=1}^{n} i}(CA) \geq \sum_{i=1}^{n} U_i(IA) \qquad [1a]$$

or in alternative notation

$$NU_C \geq \sum NU_I \,, \qquad [1b]$$

where NU_C represents the net utility of collective action and $\sum NU_I$ represents the sum of the net utilities of individual action. If these conditions are not met, individual action is superior to collective action. Of course this does not imply that collective action will necessarily take place every time this condition is fulfilled. Two issues are addressed. The first one is well-known and concerns the incentives that individuals face. In most cases, incentives exist for the individuals involved to free ride on the collective action of others. This aspect of the fragility of collective action and the variables affecting this fragility will not be addressed in this paper. The second issue raised pertains to situations in which these problems are either already solved, or negligible. The focus is on the incentives faced by the group as a whole irrespective of the problems of group formation due to individual incentives.

[17] Following Hardin (1982:41), the minimum group size necessary for collective action is $N = k$. It is the group size for which [1] holds with equality.

Inequality [2] guarantees that collective action (CA) is Pareto optimal and superior to individual action (IA) for a group of N individuals. Collective action is taken, as long as some individuals $i \in N$ are made better off and no individual $i \in N$ is made worse off.

$$U_i(CA) \geq U_i(IA) \qquad \forall i \in N \qquad [2]$$

Pareto optimality is a strong condition. By allowing the potential compensation (Kaldor/Hicks) of losers, the scope of the analysis could be broadened. As long as optimality is defined on $\vec{v}$, i.e. on utility space, the concept used is of secondary importance.

In addition, the following condition needs to be satisfied in order to rule out negative sum collective action in-between groups. Again, [2] holds for all individuals i choosing collective action.

$$U_{\sum_{i=1}^{n} i} + U_{\sum_{i=n+1}^{m} i} + \sum_{i=m+1}^{p} U_i \geq \sum_{i=1}^{n} U_i + U_{\sum_{i=n+1}^{j} i} + \sum_{i=j+1}^{p} U_i \qquad [3]$$

where m and j are the last individuals for which [1] and [2] hold. They represent the best response repartition of the fraction $P-N$ of the population depending on whether N individuals decide to act collectively (left side of [3]) or individually (right side of [3]).

The inequality condition [1] represents the "demand" side. The next categories exemplify what types of demand will be satisfied to what extent under market conditions or alternatively under what conditions demand can be satisfied in a market setting (either by collective action or market coordinated individual action). Depending on the types of demand, action scenarios are developed within which individuals and/or groups are confronted with different market incentives to supply. This section treats the economic constitution as a constant and asks for conditions that need to be met in order for supply to develop endogenously.

Individual Action

Individual market transactions take place if $PR_I \geq PC_I$ or if $PP_I \geq 0$, where PR_I represent the pecuniary revenue out of individual market action, PC_I represents the pecuniary cost of individual market action and PP_I represents the pecuniary profits of individual market actions. When these conditions are fulfilled, the respective market actions will be taken **irrespective** of utility calculations. The strive for pecuniary profits is an essential part of the unavoidable logic of market coordination. If the condition $\max PP_I = \max ANU$ (invisible hand property) is met, the maximization of individual pecuniary profits will simultaneously maximize aggregate net utility ANU. Only if that is the case will optimality be reached, which implies that $NU_C \leq \sum NU_I$. In the case of strictly private goods, a correspondence between individual profit maximizing behavior and aggregate utility maximization exists.

Pure Collective Action

In the case of pure collective action, a correspondence between collective profit maximizing behavior and aggregate utility maximization exists.

Market incentives for collective action exist only if $PP_C \geq \sum PP_I$, with $PP_C \geq 0$, where PP_C represents the pecuniary profits of collective action and $\sum PP_I$ represents the sum of pecuniary profits of individual market actions. Even though there is a correspondence between collective profit maximization and aggregate utility maximization, the problems involved here result from individual incentives to defect despite the overall optimality of collective action. Individual defection can occur because it might guarantee even higher profits to the individual than the prospective share of the (on aggregate higher) group profits. For the problem of moving from individual action to collective action, see for example Olson (1965) and Hardin (1982).

Constitutional Collective Action

In the case of constitutional collective action, there is no complete correspondence between individual and/or collective profit maximization and aggregate utility maximization.

Adverse market incentives exist if $PP_C \leq \sum PP_I$ and $NU_C \geq \sum NU_I$ hold both. This implies that aggregate utility can be improved upon through collective action even though this action will not be honored by pecuniary profits. “Profits” in this case are realized directly in utility increases and are not of pecuniary kind. In this case not only the free rider problem (pure collective action problem) exists in the sense of adverse individual incentives but the group as a whole faces adverse market incentives. This is due to the particular external institution used to coordinate economic behavior.

An interesting aspect to be noted is the case where $PP_C \geq \sum PP_I$ but $NU_C \leq \sum NU_I$. For this case, the problem with market incentives has been recognized theoretically a long time ago. It has been dealt with in practice by modifying the economic constitution to include anti trust and anti collusion policies. An interesting aspect is that the perverse incentives associated with the constitutional collective action case, which represents the opposite case, have not been identified explicitly so far.

The section concludes that depending on the type of collective action problem, zero contribution is not unlikely and a “tragedy of the commons” (Hardin 1968) might well result if the economic constitution remains unmodified.

V. The Logic of Markets

Market competition implies constant pressure for cost reductions and profit increases. This pressure makes up the efficiency and effectiveness of markets. Without proper constitutional constraints, this pressure would lead to unproductive competition (Eucken) in the form of cost externalization and collusion. It is not far fetched to claim that unrestrained competition has an inherent tendency to obviate competition. If these tendencies are not counteracted, competition loses its desirable properties.

Recognizing both, that market actors are responsive to the incentives they face and that market selection has the potential to weed out those who are relatively less successful in their response, implies limits to the possibilities of individual and collective action.

The Limits of Market Based Action

Competitive markets provide strong incentives for cost reductions and profit increases. Even in environments where it is uncertain what strategy will effectively increase profits ex post, market selection guarantees that only those firms will survive that ex post seem to have acted as if they had maximized profits (Alchian 1950:214).[18]

It is therefore very unlikely to find economic behavior that counteracts the incentives provided by markets. In a market economy, production decisions are based on relative prices. The entrepreneur does not need to know as much as the bow maker in the face-to-face setting. Entrepreneurs do not have to think through with what person the bow will have its highest value for society. Without knowing who will be the better hunter, providing the community

[18] For present purposes and throughout the whole paper it is sufficient to know that firms behave "as if" they are maximizing profits. To use Alchian's (1950:219) words: "Success is discovered by the economic system through a blanketing shotgun process, not by the individual through a converging search." One aspect not addressed by Alchian is the fact that the analogy to biological or natural selection is only partial since, in the domain of Darwinian evolution, the selection mechanism cannot be chosen (even genetic engineering does not directly influence selection). This is fundamentally different in the case of cultural evolution and of course in the economic domain where success in terms of market selection depends on the market institution and therefore is far from being an unalterable fact.

with more food, the product reaches the one person who values it most because he can use it more efficiently. In the words of Adam Smith (1776/1981), entrepreneurs are "...led by an invisible hand ... and thus without intending it, without knowing it, advance the interest of the society, and afford the means to the multiplication of the species."[19] Those who are not capable of reducing cost and have relatively lower profits are not selected and are driven out of the market. Costs, or better relatively higher costs without product changes, is something that markets are very efficient to punish.

Anonymous profit maximization in markets functions perfectly in the sense that a Pareto optimal allocation is achieved as long as all goods are strictly private. If that is not the case, i.e. if there is no congruence between profit and utility maximization on either individual or aggregate level or both, a collective action problem emerges. In most circumstances where this is the case, entrepreneurs will not even have the information that their activities – although highly profitable – reduce aggregate utility.

They continue to receive signals that profits are to be gained (costs can be reduced) or that profits can be increased (costs be avoided) **irrespective** of the fact that these signals might run counter to relative valuations. Even if entrepreneurs were aware of the negative consequences of their actions and adapted accordingly, they would not be selected by the market and their place would be taken by less concerned or ignorant entrepreneurs.

In the economic literature this has been termed "market failure" (Bator 1958) even though this is highly misleading, since the problem does not arise because markets fail, but because they work so efficiently.[20] The market mechanism links incentives to relative prices but the link between relative prices and relative valuations cannot be guaranteed endogenously; it is an institutional question – respective failure. If this link is missing or if it is incomplete, the problem is not market based (i.e. pertaining to behavior within market institutions), but results from an improper mapping of relative valuations $\vec{v}$ into relative prices $\vec{p}$. This constitutional problem can be solved by changing the rules within which market activity takes place.

[19] This quote is found in part IV, 1, §10.

[20] The term can only be saved by interpreting "market failure" to mean that markets fail to be in existence, which again would indicate a failure on the constitutional level.

Assuming that no market incentives work towards the realization of a specific outcome, and knowing that trying to incorporate values not reflected in relative prices leads to higher costs, market actors - be they individuals or groups - are systematically incapable of realizing the desired outcome.

The Degree of Embeddedness and the Shadow of Market Selection

The constraints of market based action in solving collective action problems have been elaborated. These limits or constraints on individual and collective action within a specific economic constitution, however, only apply to cases where the degree of embeddedness of the particular action arena is high. The degree of embeddedness is a measure indicating to what extent the action arena is under the shadow of the incentives provided by the external market institution. If the degree of embeddedness is high, there is no incentive to develop alternative internal institutions to solve collective action problems. Even if internal institutions form, they will not be able to persist unless they are in accordance with the economic constitution. Even with weaker selection in a context of moderate embeddedness, adverse incentives remain, that reduce the chances for successful collective action if they run counter to the collective efforts.

The incentives provided to entrepreneurs will remain active unless deliberately circumvented. The chances of successfully circumventing market incentives are, however, systematically restricted. This is different in a face-to-face setting, where coordination does not take place via prices or the price mechanism. If market coordination plays only a limited role, institutions and mechanisms designed to solve local collective action problems will not fail due to the economic constitution.

This is the reason why sheltered face-to-face communities just as centrally planned economies are left out of the typology presented. They represent special cases, namely coordination outside the realm of markets.[21] The far more relevant case empirically is the local community or firms involved in collective action problems embedded in a monetized economy with division of labor. In these cases, it is theoretically clear that market incentives working towards collective action increase the likelihood of successful collective action, whereas when

[21] While analyzing local collective action problems, it is important to realize to what extent "self-contained worlds" are analyzed.

market incentives run counter to collective action, successful organization becomes unlikely. This is true irrespective of individual free riding aspects potentially present in both cases.

That individuals or even groups of individuals cannot solve certain problems in the shadow of markets, calls in the necessity of actions at another level. This does not imply that governments or groups of governments should directly provide the respective good through an hierarchical organization. On the contrary, it only implies that changes in the rules become necessary which will enable economic agents to deal with the problems themselves.

VI. Some Intuition on Pure and Constitutional Collective Action

Most of the conditions identified for successful collective action are based on and concerned with conditions under which individuals can organize themselves in an effective manner. Empirical research in the field and in the laboratory has identified a number of factors that critically affect outcomes in collective action situations.[22] These factors belong to three categories: physical, behavioral and (internal) institutional variables. The distinction presented here focuses on the enhancing and inhibiting role of the market incentives provided by the structure of the economic constitution.

The following two examples of collective action problems are presented to demonstrate the applicability of the distinction developed in this paper. The first example, pertaining to pure collective action, is taken from the field. It is presented in a very condensed form in order to focus on the specificities of particular importance here. The second example for a constitutional collective action problem does not relate to a specific field setting. The reason for this lies in the fact that the descriptions of collective action problems known to the author do not include all the variables that would be relevant in order to identify whether a specific collective action problem falls into this category or not.[23] Both examples imply a high degree of embeddedness.

Pure Collective Action in Groundwater Basins

As indicated in the definition of a pure collective action problem, the problem turns on the particular incentives individuals face with respect to defection or participation. As defined previously, collective action is warranted since collective profits are greater than the sum of profits through individual actions, but nevertheless an individual's payoff is maximized by being the only one who is free riding. The problem is to get the individuals to cooperate or to keep them from reducing overall profits by discontinuing the collective effort.

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[22] See, for example, Ostrom/Gardner/Walker (1994), Ostrom (1999), Ostrom (2000) and the literature cited there.

[23] This is a problem that can only be remedied empirically. Intuitively constitutional collective action is probably encountered more frequently in larger scale cases.

Following Ostrom (1990:105f), a brief sketch of the situation and the stakes in the groundwater basin CPR located in the south coastal plain of California is given.

> "In a semiarid region such as Los Angeles, groundwater basins are extremely valuable when used in conjunction with surface supply systems. First, they are sources of inexpensive and high-quality water, as compared with the cost of importing water from long distances. In 1985, the Metropolitan Water District charged $240 per acre-foot (the volume of water that would cover one acre of land with one foot of water) as the wholesale price for imported water from northern California and from the Colorado River. The cost of pumping groundwater in the Los Angeles area averaged around $134 per acre-foot – a saving of more than $100 per acre-foot. If the 282,458 acre-feet of groundwater that were pumped in 1985 from the three basins ... had been replaced with surface water, it would have cost the industrial users, the urban households, and the irrigators at least $28 million more per year.
>
> The value of the basins as sources of water supply is overshadowed, however, by their even greater value as natural storage vessels that can retain water for use during periods of peak demand. … In the area of the West Basin, with an annual demand for water of 327,435 acre-feet, storage reservoirs that could hold 52,400 acre-feet would be required if the basin were not available for this purpose. The replacement costs for this single basin would be about $3.01 billion. The loss of all groundwater basins underlying the Los Angeles metropolitan area would be an economic disaster of major proportions."

As this passage demonstrates, clear market incentives exist on the collective level. The natural scarcity of water in the Los Angeles area render underground water basins a valuable resource, simply because alternative means of transporting and storing water for times of high demand are more expensive. Abstracting from many of the aspects of this situation and the fact that not all water basins have succeeded in organizing and managing the extraction of water efficiently, this case clearly represents a pure collective action problem. Market incentives in the form of relative prices push towards an efficient collective use of the groundwater basins. This situation arises because of the value of water, the costs involved in pumping water, the cost involved in building water storage facilities above ground and the cost of transporting water over long distances. All in all, relative prices for water, transportation, storage and pumping technology render ground water basins an important resource.[24] Therefore the conditions for a pure type of collective action problem are satisfied. Once collective action is achieved, costs are reduced or profits increased.[25]

[24] This may not be as evident as it sounds. In a world where pumping technology is relatively more costly than transportation, underground water basins might be of no interest at all. It would be relatively less costly to transport water from further regions and build water storage facilities above ground. In another possible world, the cost of pumping underground water could be roughly identical to the cost of transporting water from other

A further aspect of the California water basin case is that overextraction was the logical outcome of the manner in which groundwater rights were defined in the region prior to the institutional changes that remedied some of the problems. Again, this is an indication for the pure type of collective action. Internal institutions (Lachmann 1963), i.e. local water rights in California, have been modified in order to increase economic efficiency. These internal institutional changes, however, remained under the shadow of the external market institution which provided the relevant information on the valuation of water and technology through the set of relative prices. Because the external institution was able to deal with the water problem (water being potentially an excludable, and of course rival, good), purely economic incentives existed to use water efficiently i.e. change institutions through collective action locally. However, due to the nature of the problem, only a "public enterprise" could effectively maximize profits.

Constitutional Collective Action in Fisheries

Looking at the standard Gordon-Clark harvesting model for fisheries it is possible to specify under which conditions constitutional collective action problems might arise. Purely individual action leads to the total rent dissipation outcome, which may or may not result in species extinction,[26] but which is economically inefficient. As a result, collective action of the pure type is likely since profits can be increased through some sort of common management or change of internal institutions - as in the groundwater basin case outlined above. Assuming further that this pure collective action problem has been solved and market "efficiency" (profit max.) has been achieved, there remains the possibility that this is not Pareto optimal as

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regions and building facilities for water storage. In that case, the pumping race would take place without considerable economic effects. As soon as the underground water basins are rendered useless (for example due to salt water intrusion), people would switch to water imports without a change in the price of water.

[25] "If benefits and costs are not in money and are not readily exchangeable for money, we may say that the collective good and its costs are not fungible." (Hardin 1982:70). Hardin comes relatively close to the difference presented here. The emphasis here is, however, not limited to the pecuniary nature of benefits and costs, but concerns the dynamic market incentives which either push towards collective action or detract from it.

[26] Moran and Pearce (1997:85) write in this context "As long as the costs of harvesting are positive, some of the resource is left intact, though with low sustainable yields. Nonetheless, population dynamics are ill understood and hence the risk of extinction is higher, the lower are the stocks. It is quite possible, therefore, for open access to create the conditions in which harvest levels give rise to stock levels that are below minimum viable sizes."

indicated by the fact that there may be alternative allocations which would improve the subjective utility of all individuals.[27] In the public entrepreneur profit maximizing context (merger-case) it is, for example, still possible for the resource to be depleted completely even if total depletion is Pareto inferior to preservation.[28] This is the case if the growth rate of the species is smaller than the discount rate. Since the growth rate of the resource is effectively the rate of return on the resource and the discount rate is equal to the opportunity cost of capital, it is clear that if the rate of return of the resource is less than what the owner can obtain by investing elsewhere, the resource will be run down to zero with immediate effect.[29] As Ostrom (1990:207) indicates:

> "Simply following short-term profit maximization in response to the market price for a resource unit may, in a CPR environment, be exactly the strategy that will destroy the CPR, leaving everyone worse off. Non-monetized relationships may be of importance."

The problem, however, consists in how to give emphasis to these non-monetized values. Without market coordination this problem would not arise since the distinction between

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[27] There might be a host of allocations which would improve one individual's utility enough to theoretically compensate the reduction of subjective utility of others. This would, however, require cardinal inter-personal utility comparisons.

[28] Of course it might still be the case that extinction is Pareto optimal. On the other hand it might also be the case that even if the resource is not depleted harvesting levels are too high from a Paretian point of view. Depletion is used here, because there is some intuitive appeal of characterizing depletion as Pareto inferior to conservation. Of course, this is an empirical question which ultimately hinges on individual valuations. From the perspective of this paper it would be ill-advised to try to estimate or derive preferences using costs and profits as defined above. To the contrary these measures will not be a good approximation since it is exactly the missing correspondence between relative prices and relative valuations that initially lead to the problem.

[29] This logic has clearly been recognized by Moran and Pearce (1997:86) who write: "Under such conditions of 'optimal extinction' it will pay to 'mine' the resource to extinction." Maier-Rigaud (1992:39) speaks in this context of an "economically optimal ecological catastrophe". It should be noted that this logic does not depend on the **assumption** of a specific rate used to discount the future. The fundamental economic logic behind the comparison of opportunity cost C^O (mining the resource to extinction and earning interest on the capital) and the rate of return on the resource (maximum sustainable yield multiplied with the price per unit), both as measured by the market, remains valid with or without discounting future returns and future opportunity costs. This is necessarily so as long as both sides of the inequality $\delta(MSY \times p) < \delta(C^O)$ are discounted with the same discount factor δ.

monetary and non-monetary value would not exist. In the case described by Ostrom, the mapping of $\vec{v}$ into $\vec{p}$ is distorted or otherwise no one would be left worse off.

Assuming that some entrepreneurs decide not to fish at the profit maximizing rate because fishing at this rate would lead to the complete destruction of the CPR. If the entrepreneurs sell their fish on a competitive market, this decision implies self-exploitation if not bankruptcy. Not fishing at the profit maximizing rate implies higher fishing costs which result in lower profits or even monetary losses. In a market setting where relative valuations are not well approximated by relative prices, preferences for the conservation of a fish species may enter the coordination mechanism only as costs, even if conservation is generally preferred to extinction. This might be the case because the market constitution considers only the good "fish". Without constitutional change, the market is systematically unable to recognize that what it "interprets" as additional costs in the production of fish is not due to inefficient technology and fishing techniques but is in reality the provision costs of a good which did not enter the price vector but whose existence is valued more than the cost incurred in producing it – by definition of the constitutional case.

The identification and systematization of such cases might turn out to be of high interest for the research on collective action. How is it possible to implement preferences neglected by the market process? What are the constitutional settings necessary for successful collective action? This paper has taken a first step in formulating an answer to these questions.

Bibliography

Alchian, Armen	**1950** Uncertainty, Evolution, and Economic Theory, Journal of Political Economy, Vol. 58, pp. 211-221
Bator, F. M.	**1958** The anatomy of market failure, Quarterly Journal of Economics, LXXII, pp. 351-79
Bonus, Holger	**1978** Ordnungspolitische Aspekte öffentlicher Güter, in: Neuere Entwicklungen in den Wirtschaftswissenschaften, Schriften des Vereins für Socialpolitik, N.F. Bd. 98, pp. 51-73, Duncker & Humblot
Clark, Colin W.	**1973** The Economics of Overexploitation, Science, Vol. 181, pp. 630-634
Clark, Colin W.	**1973** Profit Maximisation and the Extinction of Animal Species, Journal of Political Economy Vol. 81(4), pp. 950-961
Cornes, Richard/ Sandler, Todd	**1996** The Theory of Externalities, Public Goods and Club Goods, 2nd edition, Cambridge University Press
Davis, Douglas/ Holt, Charles	**1993** Experimental Economics, Princeton University Press, Princeton New Jersey
Eucken, Walter	**1951** The Foundations of Economics. Chicago: University of Chicago Press
Gordon, Scott H.	**1954** The Economic Theory of a Common-Property Resource: The Fishery, Journal of Political Economy, Vol. 62 (2), pp. 124-142
Hardin, Garrett	**1968** The Tragedy of the Commons, Science, Vol. 162(1), pp. 243-248
Hardin, Russell	**1982** Collective Action, Resources for the Future, Johns Hopkins University Press, Baltimore and London
Hayek, Friedrich A.	**1945** The Use of Knowledge in Society, American Economic Review, Vol. 35, pp. 519-530
Hayek, Friedrich A.	**1978** New Studies in Philosophy, Politics, Economics and the History of Ideas. Chicago: The University of Chicago Press
Heritier, Adrienne	**2000** The Provision of Common Goods Across Multiple Arenas, Political Science Research Perspectives Max Planck Project Group: "Common Goods: Law, Politics and Economics" mimeo
Keohane, Robert/ McGinnis, Michael/ Ostrom, Elinor	**1992** Proceedings of a Conference on Linking Local and Global Commons, Harvard University, April 23-25
Lachmann, Ludwig M.	**1963** Wirtschaftsordnung und Wirtschaftliche Institutionen, ORDO Jahrbuch für die Ordnung von Wissenschaft und Gesellschaft, Vol.14, pp. 63-77
Libecap, Gary D.	**1995** The Conditions for Successful Collective Action, in: Local Commons and Global Interdependence – Heterogeneity and Cooperation in Two Domains, ed. by Robert Keohane and Elinor Ostrom, Sage Publications
Maier-Rigaud, Frank P.	**1999** Externality or Public Good? Choosing the Adequate Framework to Cope with Environmental Problems, Working paper 1/1999
Maier-Rigaud, Gerhard	**1992** Die Herausbildung der Umweltökonomie: Zwischen axiomatischem Modell und normativer Theorie, pp. 27-44, ed. by F. Beckenbach, Die ökologische Herausforderung für die ökonomsiche Theorie. Metropolis Verlag, Marburg
McGinnis, Michael/ Ostrom, Elinor	**1996** Design Principles for Local and Global Commons, ed. By Oran R.Young, in: The International Political Economy and International Institutions, Vol. II Cheltenham, UK, Edward Elgar, pp. 465-493

Moran, Dominic/ Pearce, David	**1997** The Economics of Biodiversity, in: Henk Folmer and Tom Tietenberg ed. The International Yearbook of Environmental and Resource Economics 1997/1998: A Survey of Current Issues, Cheltenham: Edward Elgar
North, Douglas	**1990** Institutions, Institutional Change and Economic Performance, Cambridge University Press
Olson, Mancur	**1965** The Logic of Collective Action Harvard University Press
Ostrom, Elinor	**1990** Governing the Commons – The Evolution of Institutions for Collective Action, Cambridge University Press
Ostrom, Elinor	**1999** Coping with Tragedies of the Commons, Workshop in Political Theory and Policy Analysis, Working paper W98-24
Ostrom, Elinor	**2000** Collective Action and the Evolution of Social Norms, forthcoming in the Journal of Economic Perspectives
Ostrom, Elinor/ Gardner, Roy/ Walker, James	**1994** Rules, Games, and Common-Pool Resources, Ann Arbor, Michigan, The University of Michigan Press
Sandler, Todd	**1992** Collective Action. Theory and Applications, University of Michigan Press, Ann Arbor
Smith, Adam	**1776**/**1981** An Inquiry into the Nature and Causes of the Wealth of Nations, 2 Volumes, ed. by R.H. Campbell and A.S. Skinner, Textual ed. W. B. Todd. The Glasgow Edition of the Works and Correspondence of Adam Smith, Liberty Fund, Indianapolis
Vanberg, Viktor	**1994** Cultural Evolution, Collective Learning, and Constitutional Design, in: Economic Thought and Political Theory, ed. by David Reisman, pp. 171-204, Kluwer Academic Publishers, Boston/Dordrecht/London
Walker, James/ Gardner, Roy/ Ostrom, Elinor	**1990** Rent Dissipation in a Limited-Access Common-Pool Resource: Experimental Evidence, Journal of Environmental Economics and Management, Vol. 19, pp. 203-211