Working Paper

Virtuous and Adverse Selection Within Economic Organizations

Massimo Egidi

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IIASA International Institute for Applied Systems Analysis □ A-2361 Laxenburg □ Austria
Telephone: +43 2236 807 □ Fax: +43 2236 71313 □ E-Mail: info@iiasa.ac.at

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This Working Paper is an outcome of the collaboration between the TED Project at IIASA and the Experimental Economics Laboratory (EEL), University of Trento, Italy.

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EEL: A Brief Presentation

The Laboratory of Experimental Economics was created in 1991 within the Department of Economics of the University of Trento. Its initial purpose was to conduct experiments in analysis of organisational behaviour – which is still its principal area of interest although others have recently been added, most notably study of the formation of choice behaviour in demand for consumer goods and decision making in the fiscal and distributive area.

The orgiginal idea was to develop models of 'organisational learning' which describe the growth of organisational and informational structures in firms and institutions, and to conduct analysis and empirical verification utilizing recent techniques developed in the field of Experimental Economics. This purely experimental work is now flanked by analysis in the theoretical area of the organisation and the firm. Particular emphasis has been placed on the development of models of information structures in firms and on the representation and simulation of the multiactor decision processes that unfold within them, at the managerial and planning level and also from the point of view of consensus formation. The work of the Laboratory has fully borne out the decision to conduct research from three different disciplinary points of view: (a) that of the cognitive sciences, in order to deepen understanding of learning processes by means of laboratory experiments and in order to model the knowledge transfer mechanisms that characterize organisational learning; (b) that of the theory of decision support for the understanding and formulation of the preferences leading to the decision; (c) that of organisational analysis in order to study the emergence of different forms of cooperation and the solution of cognitive and decisional conflicts; (d) that of institutional economics, to move into the direction of explaining the rise of economic institutions on the basis of new micro-foundations.

One indirect aim of the project is to develop a research agenda in a coordinate way with various groups sharing the same methodological approach. Among these groups several Italian universities are involved (Cà Bembo at Venice, Political Science at Turin, the University of Genoa, the Bocconi University of Milan, the Universities of Modena and Trento). The Labortory is also cooperating in systematic manner with a number of international research centres, in particular with the following groups: BACH (University of Michigan), CSOM (University of Amsterdam), Dynamics of Computation Group (Palo Alto), SCANCOR (Stanford University), CCE (University of California, Los Angeles).

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More information on Laboratory's research is available on INTERNET at the location: http://black.cs.unitn.it.

Preface

The research project on *Systems Analysis of Technological and Economic Dynamics* at IIASA is concerned with modeling technological and organisational change; the broader economic developments that are associated with technological change, both as cause and effect; the processes by which economic agents – first of all, business firms – acquire and develop the capabilities to generate, imitate and adopt technological and organisational innovations; and the aggregate dynamics – at the levels of single industries and whole economies – engendered by the interactions among agents which are heterogeneous in their innovative abilities, behavioural rules and expectations. The central purpose is to develop stronger theory and better modeling techniques. However, the basic philosophy is that such theoretical and modeling work is most fruitful when attention is paid to the known empirical details of the phenomena the work aims to address: therefore, a considerable effort is put into a better understanding of the 'stylized facts' concerning corporate organisation routines and strategy; industrial evolution and the 'demography' of firms; patterns of macroeconomic growth and trade.

From a modeling perspective, over the last decade considerable progress has been made on various techniques of dynamic modeling. Some of this work has employed ordinary differential and difference equations, and some of it stochastic equations. A number of efforts have taken advantage of the growing power of simulation techniques. Others have employed more traditional mathematics. As a result of this theoretical work, the toolkit for modeling technological and economic dynamics is significantly richer than it was a decade ago.

During the same period, there have been major advances in the empirical understanding. There are now many more detailed technological histories available. Much more is known about the similarities and differences of technical advance in different fields and industries and there is some understanding of the key variables that lie behind those differences. A number of studies have provided rich information about how industry structure co-evolves with technology. In addition to empirical work at the technology or sector level, the last decade has also seen a great deal of empirical research on productivity growth and measured technical advance at the level of whole economies. A considerable body of empirical research now exists on the facts that seem associated with different rates of productivity growth across the range of nations, with the dynamics of convergence and divergence in the levels and rates of growth of income, with the diverse national institutional arrangements in which technological change is embedded.

As a result of this recent empirical work, the questions that successful theory and useful modeling techniques ought to address now are much more clearly defined. The theoretical work has often been undertaken in appreciation of certain stylized facts that needed to be explained. The list of these 'facts' is indeed very long, ranging from the microeconomic evidence concerning for example dynamic increasing returns in learning activities or the persistence of particular sets of problem-solving routines within business firms; the industry-level evidence on entry, exit and size-distributions – approximately log-normal – all the way to the evidence regarding the time-series properties of major economic aggregates. However, the connection between the theoretical work and the empirical phenomena has so far not been very close. The philosophy of this project is that the chances of developing powerful new theory and useful new analytical techniques can be greatly enhanced by performing the work in an environment where scholars who understand the empirical phenomena provide questions and challenges for the theorists and their work.

In particular, the project is meant to pursue an 'evolutionary' interpretation of technological and economic dynamics modeling, first, the processes by which individual agents and organisations learn, search, adapt; second, the economic analogues of 'natural selection' by which interactive environments – often markets – winnow out a population whose members have different attributes and behavioural traits; and, third, the collective emergence of statistical patterns, regularities and higher-level structures as the aggregate outcomes of the two former processes.

Together with a group of researchers located permanently at IIASA, the project coordinates multiple research efforts undertaken in several institutions around the world, organises workshops

and provides a venue of scientific discussion among scholars working on evolutionary modeling, computer simulation and non-linear dynamical systems.

The research focuses upon the following three major areas:

1. Learning Processes and Organisational Competence.
2. Technological and Industrial Dynamics
3. Innovation, Competition and Macrodynamics

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Massimo Egidi

Department of Economics
University of Trento
Via Inama, 1
38100 TRENTO- Italy
Tel: +39-461-882203
Fax: +39-461-882222
megidi@risc1.gelso.unitn.it

1 The choice between organizations and markets

In "The Role of Organizations in an Economy"[1] Herbert Simon focuses on a number of issues which are crucial for clarification of the relationships between economic and organizational theory. In particular he gives a new perspective on what has become a classical question of economic theory: can the firm and the market be regarded as two alternative forms of the organization of economic activity?
The entire question stems from Coase's celebrated article "The Nature of the Firm" written in 1936, in which he compares firm and market and suggests that they are two economic institutions that perform the same task - the coordination of decisions taken by various individuals - in different ways. As in the market, so within the firm dispersed knowledge and different skills are coordinated. Within the firm, Coase notes, coordination takes place through orders and control, in markets through the price system.
In the following pages I will discuss some of the problems arising from Simon's lecture, which, in relation to the New Institutionalist's' interpretation of the problem, offer us a very different and illuminating perspective on the relationship between market and organizations.
In his lecture, Simon observes that a key point in analizing the Coase's intuition is to decide what meaning is to be attributed to the term 'coordination'. We may therefore conveniently begin by examining what common aspects and what differences can be found between coordination by markets (which comes about through competition) and coordination "by managers" within a firm.
It is widely known that analysis of coordination by the market has developed in different versions within the neoclassical school: from Smith's "invisible hand" to Walrasian "tatonnement", to von Hayek's

[1] Mattioli Lectures 1994 . The arguments are partially contained in Simon (1991) and (1993)

"competition as a procedure for discovery of the new", to mention only some. This is not the place to review these various versions; nevertheless it should be pointed out that, despite their differences of emphasis, all schools agree over the fact that coordination is a process by which different plans decided independently by different individuals becomes mutually compatible.

A further feature is ascribed to the coordination process: namely that it is a learning procedure by means of which equilibrium prices are "discovered". This feature, which has been emphasised in particular by the Austrian school, is nevertheless also present in the Walrasian formulation. In Walras' analysis, in fact, coordination takes place through *tatonnement:* the auctioneer receives all information concerning demand excess and issues all information concerning prices. The interaction between auctioneer and agent can be interpeted as a process of collective learning which enables economic agents to discover the equilibrium: that is, the parameter values by which their plans become mutually compatible. Interestingly, this type of learning cannot be assimilated to the process of individual rational choice; on the contrary, it is a multi-actor cooperative process in which the part played by each agent is extremely limited, and the final result is achieved without the individual agent being aware of it; that is, the agent does *not* engage in an individual search for equilibrium prices. This is the third essential feature of coordination.

We may therefore sum up the argument so far by saying that the coordination performed by competition has three important properties:

1. different plans of separate individuals, drawn up independently and rationally, become mutually compatible;
2. the economic system "discovers" the correct parameter values, i.e. the equilibrium prices, which enable coordination to take place;
3. The discovery process is one in which agents are unaware.

Hence, albeit in embryonic form, coordination is interpreted as a *learning procedure* realized through competition.

Let us now turn to the coordination that takes place within economic organizations. Is this process, as Coase suggests, analogous to coordination carried out by the *invisible hand*? Can we consider it to be a competitive process which coordinates the plans of separate individuals through a system of orders and thus induces individuals unwittingly to reach some kind of "internal organizational equilibrium"?

Let us inspect the differences between the two cases. For the first characteristic above to be respected (the mutual compatibility of plans), one must assume that agents within organizations - here employees and managers - take their decisions and formulate their plans entirely independently of one another, like the agents in a Walrasian atomistic economy. That they do *not* behave in this way is a well-established fact.

Thus the description of the coordination process provided by the Walrasian model cannot be realistically extended "inside the black box" without introducing substantial modifications into the most important features that Walras attributed to individual planning.

Instead of trying to define these modifications, as an alternative research strategy we should examine if there exists an organizational set up which provides individuals with all relevant information , as the in the Walrasian picture of "tatonnement".

A model of this kind must have the following features: first, the tasks of the individuals within the organization must be perfectly identified and rigidly separated, as in the tayloristic caricature of the organizational machine; second, individuals (employees and managers) must decide and realize their plans following a general plan issued by a central coordinator.

Only under these conditions can we avoid the unrealistic assumption that individuals are able to perform very complex calculations without costs, because all the computational effort is undertaken by the central coordinator.

This picture of planning, which transfers the Walrasian framework within organization, was provided by Barone at the beginning of the century, when he showed that the Minister of planning in a collectivist society can issue appropriate orders and perfectly govern the economy on the basis of the same principles as the Walrasian general equilibrium model (Barone, 1908).

Agents in this case send information and receive orders via the central coordinator, which, in turn, receives information and send orders. The main problem arising from this model is explaining how it is possible for the central coordinator to obtain and process all relevant information. In fact, whereas the Walrasian auctioneer issues "orders" simply by altering the prices on the basis of the aggregate excess demand, the tasks to be performed by Minister of Planning are more complex: he must transmit the correct order to every producer. Consequently he must have detailed knowledge of the economic system and his evolution over the time. It was the Austrian School in the 1930s (von Wiese, von Mises and von Hayek in particular) that first addressed this question and denied the possibility of central planning in a collectivist society. Even if we may not fully agree with this position, it is be very difficult to admit that such hyper-centralized system would be able to adapt to external changing circumstances: individuals in this context would mechanically execute the orders, without any autonomous capacity to decide or to plan. A business organization based on this kind of rigid and centralized planning would lack in endogenous mechanisms of reaction, and therefore would be unable to change and to survive on a competitive market .

In consequence, a key problem is to understand if , beyond the mechanism of centralized planning, it is possible to model different coordination mechanisms characterized by different degrees of decentralization; and what level of individual knowledge, information processing and planning capacity they require. To move in that direction we must make more realistic assumptions about the individual planning activity, and revise the traditional opinions on the independence and rationality of decisions.

As a first assumption, it is necessary to take into account that individual plans are formulated in a strategic context, i.e. that they depend on the

plans implemented by other individuals; therefore the higher the decentralization of the coordination mechanism the greater is the amount of computation required of individuals to evaluate *all* the consequences of their decisions.
Second, and more important, we must acknowledge that within organizations the separation of knowledge and skills among employees is not total; nor can it be among firms.
This viewpoint seems related to Simon's opinion, where he points out that

> "... neoclassical theory assumes that there are clear boundaries between the elements known as firms. In practice these boundaries are highly ambiguous.....Markets represent only a part, if an important part, of the channels of communication and coordination between organizations".

Indeed, the production of knowledge and information within a firm is not based on a rigid separation of skills and knowledge among economic agents, as happens in the Walrasian market. On the contrary, an organization is usually based on close interaction among its components, on the joint use of competencies, and on the exploitation of the positive externalities which arise from interactions. Within organizations, individuals exchange information and orders, as Coase suggests, but they also exchange knowledge and alter their competences and skills.
This is a crucial difference from Walrasian assumptions, and suggest us to distinguish between "static" and "dynamic" planning.
The former takes place when individual planning does not involve any change into the organizational shape, as in Walras and Barone's accounts. (A more or less centralized coordinating mechanism can render different individual plans reciprocally compatible, by means of orders and information channels.)
The latter takes place when individual plans modify the organizational shape; coordination in this eventuality can be assimilated to a (deliberate, conscious or unconscious) process of organizational design.

The two features I have emphasized - interdependency of individual plans and overlapping competences among individuals - suggest that, to find an explanation of the relationship between economic organizations and individual behaviours, we must move beyond the limits of the Walrasian approach.

2 Bounded Rationality, Coordination and Learning: from Hayek to Simon

Hayek went to the root of the problem of the relationship between individual rationality and the role of the market by incorporating it into the more general problem of the role of knowledge in society, and by examining the nature of economic institutions.

His point of departure was a critique of the manner in which the general equilibrium model had traditionally been interpreted. The model assumed the consumer preferences as "given" and all the technologies as freely available.

In his Presidential Address of 10 November 1936 at the London Economic Club, Hayek contested this aspect of the model. He pointed out that, although technologies and preferences are indeed the givens of the problem, they are unknown to the majority of economic agents: they constitute idiosyncratic, specific, personal information and knowledge whose acquisition by economic agents would require unlimited capacities of memory and calculation.

Under the (Walrasian) hypothesis that agents have consistent preferences sets, know all available technologies, and possess an unlimited capacity for calculation and memorization, they may be able to make fully rational decisions. By removing these unrealistic assumptions, and emphasizing that knowledge is diffused heterogeneously and asymmetrically among individuals Hayek implicitely assumed that the rational and cognitive capacities of the individual are limited. He can be considered a precursor of Simon's bounded human rationality approach, because his major hidden premise to the explanation of why economic institutions exist is that individual have limited capacities and competences.

In restating this point, Simon notes that it is precisely because individuals are incapable of handling all the relevant knowledge and information necessary for rational decision-making that economic institutions exist. He maintains that knowledge is efficiently accumulated and transmitted by institutions, which fulfil tasks which are beyond the individual capacities. The role of the institutions is therefore paramount: they gather knowledge and information in such a way as to reduce the uncertainty of human action and broadly extend its range.

Note that it is not only realistic but logically consistent to assume that no single actor is able to possess a complete and accurate picture of all relevant information and knowledge; should such an actor exist, this would annul the necessity itself of the economic institutions (and particularly of the market). A lucid restatement of this point, as part of a critique of the theory of rational expectations, is to be found in Arrow (1978).

Hayek attributes a broader role to competition than was envisaged by the Walrasian model. In a number of celebrated passages he describes competition as a process of discovery of the new; a process whereby individuals obtain the specific information they need to formulate and implement their plans. The central point, in his view, is that the economic institutions reflect the way in which the division of labour and knowledge among the different individuals in society has come about, and they guarantee its coordination.

> ".... I still believe that, by what is implicit in its reasoning, economics has come nearer than any other social science to an answer to that central question of all social sciences: How can the combinations of fragments of knowledge existing in different minds bring about results which, if they were to be brought about deliberately, would require a knowledge on the part of the

> directing mind which no single person can possess? To show that in this sense the spontaneous actions of individuals will, under conditions which we can define, bring about a distribution of resources which can be understood as if it were made according to a single plan, although nobody has planned it, seems to me an answer to the problems which has sometimes been metaphorically described as that of the "social mind". (Hayek, 1980, p. 54)

According to Hayek, the market is a non-constituted institution. Like language and money, economic institutions are not born of a fully intentional and rational collective decision; nor they are the outcome of a project generated by the mind of a social architect. They are - in his view- the historical and unintentional product of the consolidation of inter-individual relationships. However, Hayek does not address the problem of how institutions emerge, or how "spontaneous" institutions and artificial institutions, i.e. those created by conscious human design, can coexist and interact.

But do completely artificial institutions actually exist? And if they do, in what relation do they stand with "natural" ones? Hayek considered socialist planning to be the limiting case of artificial structures, in direct contrast to the natural mechanism of competition. Much of his work was devoted to demonstration of the impossibility of economic planning, or better to his contention that planning is not an institutional instrument able to replace the market effectively - the planner, unlike the market, is unable to gather all the information and knowledge required to reach an optimum solution.

But, as Coase remarked one year later Hayek' Presidential Address, planning is the characteristic feature of any business organization, and therefore at least up to a certain point planning activity is expected to be efficient.

Organizations, the pioneering book written in 1958 by March and Simon, proposes a different and richer view, where hierarchical planning and designing - which typically are sciences of the artificial - and individual "spontaneous" decisions are interrelated.

Before developing this point, I conclude the discussion about the Walrasian framework by suggesting that the appropriate context to compare market and organization as alternative cooperation devices, is not the Walrasian one, but, more promisingly, the Hayekian one.

The reason for the failure of attempts to apply the Walrasian framework directly to what happens within organizations therefore seems now clear: the Walrasian model assume a world in which the division of labour is given; there is a complete separation of skills and knowledge among economic agents, and the creation or transfer of knowledge and skills is assumed to be either impossible or costless. The previous discussion suggests that coordination requires a more complex explanation, which takes account of the capacity to innovate and learn of individuals and organizations, in a context related to limited rationality and knowledge sharing. Hayek, and later Schumpeter, assume a world in which the creation of knowledge is the fundamental process underlying coordination activities and more generally economic change. But they did not provide clear theoretical microfoundations on which to model

economic change. With bounded rationality theory Simon give us the first important step in that direction. It is therefore convenient to turn to the problem of knowledge acquisition and creation, along the lines of Simon's approach, to evaluate the potentialities of these assumptions in explaining the nature of cooperation within organizations.

3 Organizational learning : microeconomic aspects.

The idea that the learning activity plays a central role in human decision making derives from the pioneering work of Cyert, Simon, March and Newell. In 1956, in a path-breaking article which constituted a first crucial step in analyzing rationality within organizations, Cyert, Simon and Trow carried out an empirical analysis of managerial decisions which revealed an evident "dualism" of behaviour:

> "Decisions in organizations vary widely with respect to the extent to which the decision-making process is programmed. At one extreme we have repetitive, well defined problems (e.g., quality control or production lot-size problems) involving tangible considerations, to which the economic models that call for finding the best among a set of pre-established alternatives can be applied rather literally. In contrast to these highly programmed and usually rather detailed decisions are problems of non-repetitive sort, often involving basic long-range questions about the whole strategy of the firm or some part if it, arising initially in a highly unstructured form and requiring a great deal of the kinds of search processes listed above." (Cyert, Simon and Trow, 1956, p.238)

March and Simon (1958) note that in conditions well-structured from the cognitive and decisional viewpoint, subjects learn to solve problems, achieve a stable behavioural patterns of actions or, if one wishes, their behaviour becomes *routinized*. The sequence of choices confronted by individuals performing an organizational task constitutes a repetitive *procedure* which becomes familiar to those executing it, and presents well-defined alternatives codified according to the variants arising from changing external circumstances.

Most of the human activity within economic organizations takes the form of this procedural and routinized behaviour. Within the organization, we can consider as *routine* any procedure which provides for the execution of a specific task; it is therefore a procedure which solves a set of problems internal to the organization. A procedure can be described as a set of instructions determining the actions to be taken when dealing with a particular circumstance.

It seems natural, therefore, to model a procedure as a *program*, in the specific sense given to the term by computation theory, as a list of instructions in an artificial language. This enables us to represent procedures formally and to model *procedural rationality* (March and Simon, 1958, chap. 6).

If individuals are able automatically to replicate repeated sequences of decisions deriving from their interactions with others, the role of routines becomes clear: they enable individuals to save on "rational computation" and radically reduce the complexity of individual decisions. In consequence a part of everyday decisions becomes to some extent "automatic" and therefore possibly tacit. More precise exploration of this point has been conducted by Nelson and Winter, on the basis of the methodological principles enunciated by M. Polanyi in *Personal Knowledge* (1958). They emphasize that some behavioural sequences consist of actions which are partially tacit; this feature leads the two authors to the problem of how tacit knowledge is formed, transferred and stored in memory.

This is a starting point for exploring how cognitive skills, which arise through experience and cooperation, are stored in the memory and by consequence become building blocks for subjects who have to solve problems. Pursuing this line of research, Cohen and Bacdayan (1991) suggest that routines are stored as *procedural* memory. Following Squire's (1987) distinction between procedural and declarative memory, they claim that

> " *procedural* memory appears to be the form that stores the components of individual skilled actions - for both motor and cognitive skills. It is distinguished from *declarative* memory, which provides the storage of facts, propositions, and events. " (1991, p. 5).

Cohen and Bacdayan use a laboratory experiment to analyze the emergence of procedural behaviour by two subjects involved in a game which requires coordination and cooperation, and its "sedimentation" in memory. The general point at issue here is how the acquisition, and memorization of cognitive skills takes place, and how its transfer is possible, i.e. how skills can be re-used. As Singley and Anderson show (1989), the range of transfer of procedurally encoded skills is very restricted. By consequence, learning requires effort and time, and the transmission of cognitive skills is at least partially opaque.

Moreover, routines memorization is highly local and incomplete, and it therefore pre-supposes the human capacity to *complete missing knowledge*. This feature emerges both in theoretical (Chaitin 1987) and empirical frameworks (Singley and Anderson,1989), (Cohen and Bacdayan, 1991), (Egidi, 1993).

Individuals involved in games which require cooperation, after the initial period of learning, do not memorize the detailed steps of organizational procedures; they do not keep all knowledge and information they need to play stored in memory, but create and memorize sets of simple "meta rules" which allow to re-create the organizational routines. These rules are elementary "Condition-Action" rules (in the standard sense of the cognitive sciences), which are the result of sub-goals identification, i.e. of a spontaneous division of knowledge among agents. Agents store in procedural memory these rules, which embody *mutual relations* and enable them jointly to recreate the routines at any particular moment.

To summarize some of the previous issues: even if we are still far from being able to frame the complex problem of knowledge creation and transmission within a unique theoretical approach, the assumption that procedures are the micro-units of human behaviour in organizations is strongly confirmed by observations, field research and experiments. They are partially tacit, opaque and incomplete. The latter property is particularly relevant because of its consequences on organizational change: the fact that individuals do not usually possess full knowledge of organizational procedures, but are able to recreate its missing components, implies that they have the capacity to solve micro-problems autonomously. The problem is now to clarify the relationship between this kind of micro-innovative activity and top-down planning and designing managerial activity in order to better understand how organizational change take place.

4 Organizational learning and the division of knowledge

When managerial decisions are taken in ill-defined and uncertain conditions, one successful strategy of solution is based on the attempt to decompose the problem to be solved in sub- problems easier to approach. This procedure, carefully analyzed in *Organizations* (7.2. *The process of innovation*) is now became a classic approach to problem solving in Artificial Intelligence. (Newell and Simon (1958) and (1972)).
A well-known feature of this procedure is recursivity: subjects seek to decompose the problem to be solved into sub-problems which they hope will prove easier for them to handle. If some of these sub-problems are still too complex, they are in turn decomposed. The procedure continues recursively until easily solvable sub-problems have been obtained. If successful, the decomposition procedure structures the original problem into a hierarchy of inter-related sub-problems.
This procedure is typical of top-down planning activity within organizations; it gives rise to a recursive division of tasks which, if achieved successfully, can be used by the top management to give a new shape to the division of labour, knowledge and competences within an organization.
This does not mean that the hierarchized structures which perform different but inter-related tasks within organizations are the outcome of a purely artificial and centralized process of planning; on the contrary, planning and organizational design can be, to a certain extent, distributed activities.
It is now convenient to recall the distinction between planning (static planning) and organizational designing (dynamic planning). In the first case an organizational hierarchy is supposed to be "given" with a related division of labour and coordination mechanisms ; individuals, at different hierarchical levels and with different competences, may have discretionary power in realizing a general plan (top-down planning), or

they may actively propose new solutions, new "local" plans, which are coordinated by means of non-centralized mechanisms (for example, bottom-up planning). But they formulate their plans according to a given division of labour.

In the second case the activity is to design new organizational solutions: the problem is to change the organizational structure, i.e. the division of labour and the coordination mechanism.

Turning our attention to the first case, note that, even if they operate through strongly hierarchized structures, organizations in the real world do not require their operational units merely to execute procedures, or blindly to implement plans meticulously set out by the upper levels of the hierarchy; on the contrary, within real organizations people continuously modify procedures and adapt it to external change.

Therefore, even when planning is a top-down centralized activity, it has a "conjectural" character, for *bounded rationality* reasons : on the one hand, in fact, the higher levels of the hierarchy must formulate plans in extremely general and open-ended terms, because the ways to implement general plans into details are not and cannot be known a-priori and computed ; on the other , the lower levels do not merely execute perfectly defined and detailed plans in "mechanical" fashion. Execution of plans requires the ability to interpret and to adapt general ideas, and to solve problems and conflicts that arise so that these ideas can be implemented.

I now turn to the case of organizational design. As in the previous case, consider a situation between the two extreme alternatives, respectively the centralized and the distributed coordination of designing activity. Suppose that the top management puts into place a re-design of the organization is in order to react to some kind of environmental change. Again, the implementation of the new division of labour within the organization which is required by such a change gives rise to a complex process of adaptation which is far from what believed by the traditional theory of planning: from one hand in fact the implementation of a new organizational design requires managers and employees to re-think their jobs and revise their competences; from the other, to be effective, any new design requires local checks and readjustments, i.e. the resolution of cognitive conflicts arising from the match among the general requirements of the project and the specific, idiosyncratic knowledge arising from the personal knowledge of any single agent.

We can conclude that the micro problem solving activity is a fundamental source of organizational change, which displays his effects also beyond the scope of the individual activity within organization. Individuals have very incomplete knowledge of the organizational routines, as we have seen, but they have the ability to recreate the missing parts of it: they can modify and adapt general plans to specific context or micro-innovate, i.e. find new local solutions to the problems, whatever their position in the hierarchical pyramid may be. When applied to organizations, the ability to complete knowledge suggest an explanation of how organizational procedures develop and change, because allow us to attribute to individuals a permanent ability to micro innovate and to modify procedures.

A question implicitly arises from our discussion: why realistic examples of the two extreme situation of coordination, the fully centralized and the distributed one, are so rare? In relation to the first case, we have some historical examples in army organizations, where is easy to see that a fully top-down hierarchized structure is extremely fragile because of its inability to react to external changing circumstances. In the latter, to my knowledge there are no historical examples of economic organizations in which the design of new division of labour is a fully decentralized process (a "spontaneous", Hayekian organization).

Instead, a clear example of distributed design is provided by the Schumpeterian picture of "creative destruction", which can be considered as a form of design activity coordinated by the market. Schumpeter's analysis starts from the "circular flow" condition, where producers and consumer are in equilibrium and profits and interest rates are close to zero. These conditions, which describe approximately the status of the economy during the phase of depression within the business cycle, provide new opportunities for innovators. They create new products or new technologies which are "tested" on the market. If the first innovative wave has successful results, the innovations are adopted by imitators, spread through the entire economic system and give rise to a phase of prosperity. New skills, new competences and a new division of labour among firms are created within the economy. At the end of phase of prosperity the economy exhibit a different division of labour, and a new competences and skills distribution, as the result of the competition among firms and of selection by market. In consequence the outcome of the process of creative destruction can be interpreted as being the result of competition among different projects, undertaken by different rival firms, which are selected by market mechanisms. By this point of view markets operate as a distributed mechanism of project and design coordination.

This phenomenon has many analogies with the organizational learning process which takes place inside firms, and therefore may be interesting to emphasize the differences and try to explain their nature.

The most relevant difference regards the relationship between cooperation and competition. Schumpeter focuses his attention much more narrowly on the rivalry among firms producing similar goods using different technologies than on the effects of innovation on vertical integration, which presupposes cooperation among firms. This point has been analyzed by Williamson in his description of "the fundamental transformation" (Williamson 1985) . Within organization, on the contrary, a high amount of cooperation, based on common knowledge and competence overlapping, is needed to realize new projects: therefore the problem is how the internal relationship must be designed to mediate between the need to maintain a certain degree of rivalry among employees and the need to encourage their collaboration.

Imagine that employees and managers possess - to different extents - the capacities of autonomy and creativity which Schumpeter attributes to entrepreneurs. The problem is why there are not examples of modern business organization where the design of new division of labour is a

fully decentralized process, and employees do have full and autonomous capacity to innovate: this lead us to wonder which relationship exist among authority, decentralisation and control within organization. I will recall some aspects of the problem in the next paragraph, by discussing the relationship between New Institutionalist's and Simon's approach to employment relationship.
I shall not further discuss the features of organizational learning here: the reader is referred to the literature, and in particular to the wide range of works collected in *Decisions and Organizations* by J. March (1988). I limit myself to note that, when considered in its connections with the process of division of labour, the notion of coordination takes a different meaning from the one implicit in neoclassical economics. For the latter coordination means making individual and independent decisions compatible, here instead the problem of coordination concerns the relationship between the top-down activity to design new organizational set-ups and the adaptive, intelligent bottom-up reactions by managers and employees, which should give rise to a better adaptation of the organization to the external environment.

5 Opportunism and loyalty: feed back mechanisms for adjustment.

In order to define and achieve its goals in an open environment, an organization must be able to redefine its internal tasks, and therefore its internal division of labour. Learning, as the adaptation of the organization to changing conditions in the external environment, thus give rise to an internal reorganization undertaken in order to pursue pre-established goals more successfully. As we have seen, this process cannot be rigidly hierarchical ; but on the opposite side, we have no evidence of economic organizations characterized by a fully decentralized process of organizational designing. A key point to focus why the extreme case of centralized and decentralized designing are not working is how competition and cooperation mechanism works to guarantee the creation and constant exchange of information and knowledge within organization. The classical feature of knowledge is his partial inappropriability and the impossibility to evaluate it a priori. Within organizations, by consequence, to evaluate the individual contribution to the achievement of a common goals is a very uncertain and "fuzzy" task. In addition, the division of labour and competences give rise to a strong asymmetry of information and knowledge within organization, and by consequence there is room for opportunistic behaviour and shirking to arise.
In the framework of the so-called New Institutional Economics, to prevent shirking, "principals" must design incentive contracts in such a way that the interest of the firm and the self-interest of the "agent" are made to coincide - to a degree.

In contrast with this view, based on the idea to control opportunistic behaviours, let me recall H. Simon' approach, based on the "identification" principle.
Simon claims that the employee enters the firm on the understanding that he will receive a salary in return for willingness to accept authority. Consequently, Simon maintains that enforcement of employment contracts does not present any particular difficulty. In his view, the key element in an organization is the loyalty of its employees.
Let us briefly examine the boundaries between loyalty and opportunism, and compare New Institutional and Simon's approach on this point. If identification exists, the employee who works loyally must not be frustrated in his expectations : therefore the organization must be able to discover able and creative employees and it must also be able to enhance their abilities. Now, what are the typical features of this kind of employee?
If the organization must be flexible, able to learn and to adapt, the most important quality of its employees is *not* blind obedience to authority but instead the ability to critically and autonomously evaluate new problems, and the ability to deal with disagreements with superiors; this is the typical case of "voice" as analyzed by Hirschman.(1970)
Thus the following abilities are vital to an innovative organization: a high propensity to evaluate autonomously new situations (solve and frame problems), and a high propensity to resort to the "voice" option when conflicting solutions, or opinions arise in a context of loyalty.
Let me add two qualifications to Simon's analysis of the employment relation : first, employees must not only be able to perform a set of tasks but they must be able to learn how to perform new and unexpected tasks. Secondly, although it is true that employees accept authority in exchange for wages, such acceptance must be conditioned and active in the sense of the "voice" option. The organization, for its part, must exercise its authority in such a way that it leaves discretionary margins for decision making by its subordinates so that conflicts of opinion can be resolved by allowing the most competent opinion to prevail, thereby reinforcing the identification mechanism.
I wish to conclude the paragraph with brief discussion of the limits which creative and loyal behaviour may encounter within organizations and therefore the risk that efficient and dynamic organization may lapse into inefficiency or decline. What follows does not pretend to be an exhaustive analysis; it is only a brief sketch based on the points discussed above.
Consider the situations that may arise in the case of decisional conflict between subordinates and their superiors and when authority is blindly enforced.
In many situations, employees have more specific knowledge of the situation, can evaluate it more carefully then the controller, or are simply better able to frame and solve the problems which arise in ongoing activity. Therefore, if contracts require the blind acceptance of authority in exchange for wages, when disagreement arises over how to perform a given task between an employee and his principal, the conflicting

opinions have neither room nor solution. Intelligent employees realize that trying to use the "voice" option will be unsuccessful and that they must therefore accept stupid orders. (thereby being frustrated).
In turn, a mediocre principal will prefer blind obedience to voice, and will try to avoid conflicting situations which could reveal his incompetence. He therefore has a strong incentive to reduce the area of common knowledge and competence between himself and employees.
A similar result arises from the behaviour of inefficient employees, who risk being discovered and punished, or perhaps dismissed. Therefore if an employee chooses the opportunistic strategy of minimizing his effort to reach a high standard of ability and competence, and therefore has low competence, then he has a strong incentive to avoid being discovered and will try to evade control by his superiors.
He can do this by using the same strategy as the incompetent supervisor: reducing the area of common knowledge and competence. In situations of a potential conflict of opinions, he will blindly follow orders. Therefore his principal will not receive useful feed-back on the decisions he has taken.
Thus, on the one hand we have agents who try to avoid control; on the other, principals who do not accept discussion: Both form a group within the hierarchy, a hidden group of mediocre employees who can survive if they are able to increase informatiònal asymmetry or - which is the same thing - reduce the common knowledge area in order to protect themselves. Similar kinds of second-best employees exist at every hierarchical level.
If this group fails to reduce or to avoid controls and disagreements, it cannot expand, and it will survive as a marginal "error" in the process of organizational learning and adaptation: in this case, at any moment, skilful subordinates can challenge incompetent superiors, and able superiors can discover the errors of mediocre employees. Thus an efficient organization applies pressure - and in certain cases also moral pressure - on slack employees and managers. This depicts a possible "virtuous" circle.
Yet the organization may also lapse into decline. As long as the size of the organization increases - despite its internal inefficiency - the dimension of the hidden group expands. Therefore if the hidden group has protected itself satisfactorily, the situation is opaque and it is difficult to detect the causes of and those responsible for inefficiencies. Creative competition thus becomes a very inconvenient way to reach a top position because there is a safe, alternative strategy: joining the second-best group.
Therefore skilful employees may also be tempted to adopt the opportunistic strategy ; advancements, in fact, depend on affiliation and obedience, not on skills, results and managerial ability. Opportunism may spread if the expression of voice and loyalty are systematically frustrated. This gives rise to a strong reduction of the areas of common knowledge between employees and managers and therefore reduces the organization's ability to react to errors and adapt to change. Hence if blind obedience to the authority principle prevails over voice, the

organization may decline into a bureaucratic and inefficient hierarchy. A vicious circle is thus established.

6 Final Remarks: virtuous and adverse selection within organizations.

Summing up, within organizations the virtuous mechanism of competitive selection does not have robust self-enforcing characteristics; under certain conditions, it can be overwhelmed by a mechanism of adverse selection, which can lead the organization toward a very sub-optimal "order" characterized by a strongly authoritarian and scarcely competent hierarchy. The reasons why an adverse selection process can arise have been briefly suggested above: if the area of common knowledge among individuals involved in the realization of a set of common tasks is very restricted, there is room neither for reciprocal control and the prevention of shirking nor for exploiting the positive externalities which follow the emergence of creative behaviour. A tayloristic division of labour, with a rigid separation of competences and a minimization of the common knowledge area among individuals, only apparently simplifies individual activities within the organization: in reality this configuration prevent the working of the most important communication channels among individuals, and therefore prevent the changes from occurring.

The micro roots of this phenomenon have been clearly evidenced by a large set of experimental results in the cognitive sciences : in particular, as we have seen, the transfer of cognitive skills is limited and requires effort, and organizational routines are partially opaque to individuals.

The fact that individuals have incomplete knowledge of the routines involved in their everyday activity, has a twofold consequence: on the one hand, they can complete it either by recreating its missing components or by modifying it, and therefore even during the execution of standard routines the ability to re-create missing parts is a continuous source for potential micro-innovations.

On the other hand the boundaries among different competences and skills cannot be extremely net and clear, and an overlapping competence area is needed. The smaller the overlapping competence areas among individuals within an organization, as in the tayloristic division of labour, the higher the cognitive effort required to cooperate for the fulfilment of a common goal. Consequently, because of a restriction of the common knowledge and competence area, the relationship among individuals become more opaque, and their ability to evaluate the each other's competence and actions is strongly reduced. Now, the difficulty of evaluating the quality and the uses of goods (Akerlof, 1970) is the most important reason which give rise to the adverse selection on the markets. The similarities are clear: exactly as happens in markets, where the areas of competence among consumers and producers of a good are totally separated and by consequence consumers cannot fully evaluate goods,

within tayloristic organizations individuals encounter major difficulties in evaluating the products and the performances of their colleagues (superiors or subordinates). These difficulties, in a organizational context where the common competence area is too restricted, are therefore the main source of opportunistic behaviours.
In order to reinforce loyalty and identification, individuals (employees and managers) must be rewarded by the mechanism of competitive selection. The organizational design, apart from the awareness of the designers, is therefore crucial to determine the virtuous working of the mechanism of competitive selection, since it may allow a transparent common cognitive area to arise. Only on this basis conflicts of opinion (and of interests) can be resolved with the prevalence of the most competent opinion, the identification mechanism can be reinforced and can loyalty overcome opportunism.

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