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Handbook of Knowledge and Economics

Edited by Richard Arena, Agnès Festré and Nathalie Lazaric

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1 Introduction

Richard Arena, Agnès Festré and Nathalie Lazaric

In 1937, Friedrich von Hayek wrote what was to become a very famous article, which was published in *Economica*, on the relations between economics and knowledge. It was admired by the economics profession, but its direct influence on economic theory at the time was limited. Fifty years later, with the emergence of the so-called 'knowledge-based economy', many of von Hayek's preoccupations were revisited, and this has given birth to a large literature dedicated to the role of knowledge within economic relations. The economic reality questions the economic theory. The concept of the knowledge-based economy has generated a new 'economics of knowledge' or 'economics of science'. This has prompted greater reflection on the notion of knowledge in analytical areas such as game theory, innovation theory, organization theory, firm theory, spatial economics and growth theory. However, it is not certain whether the numerous contributions on these issues have contributed to a better understanding of the key questions related to the notion of knowledge in economics.

1.1 THE MICROECONOMICS OF INFORMATION, KNOWLEDGE AND GENERAL ECONOMIC EQUILIBRIUM THEORY

The research programme that dominated economic analysis for more than one hundred years – general economic equilibrium theory (GEET) – did not pay attention to the notion of knowledge, and instead focused on information. The argument put forward to justify this focus was that information could be measured. Information theory (see Shannon, 1948) emphasizes that information can and must be codified in order to be transmitted through a digital system. Van Ha (1999, p. 1) notes:

> information has the property of reducing the uncertainty of a situation. The measurement of information is thus the measurement of the uncertainty. That measurement is called *Entropy*. If entropy is large, then a large amount of information is required to clarify the situation. If entropy is small, then only a small amount of information is required for clarification.

Within this framework, computer scientists interested in measuring the volume or weight of information to be transmitted refer to the minimal number of 'bits' needed to transmit some piece of information (a bit being the measure of the smallest amount of computer information storage).

Microeconomic theorists, on the other hand, tend to maintain that knowledge cannot be measured. They generally do not consider practical means for measuring information, although they do concede that information can be coded and is measurable while knowledge is not. However, it should also be emphasized that some economists do not consider the notion of quantitative information to be relevant. For instance Arrow (1974, p. 38, quoted in Garrouste, 2001) stated:

> this definition of information is qualitative, and so it will remain for the purposes of this volume. The quantitative definition which appears in information theory is probably of only limited value for economic analysis, for reasons pointed out by Marschak; different bits of information equal from the viewpoint of information theory, will usually have very different benefits or costs. Thus let A and B be any two statements about the world, for neither of which is its truth or falsity known a priori. Then a signal that A is true conveys exactly as much information, in the sense of Shannon, as the statement that B is true. But the value of knowing whether or not A is true may be vastly greater than the value of knowing B's truth-value; or it may be that the resources needed to ascertain the truth-value of A are much greater than those for B. In either case, the information-theoretic equivalence of the two possible signals conceals their vast economic difference.

Another reason why GEET research preferred the concept of information over the notion of knowledge is related to the characterization of this concept within Walrasian economics. In such a theoretical context information was considered objective and symmetric, that is, the same for all economic agents. It was seen also as complete, implying that the agents agreed perfectly on a common characterization of all possible states of the world. It was assumed to be perfect because it was being defined in a world where all the data related to problems of agent-individual choices are known. And finally, the combination of these properties was the basis for making individual rational choices.

Even after the GEET research programme was discontinued, information or its equivalent – coded or codified knowledge – continued for some economists to be more attractive than other forms of knowledge. The 'new economics of science' emerged in the 1990s (Dasgupta and David, 1994; David and Foray, 1995; Cowan and Foray, 1997), an approach that combined mainstream microeconomic analysis with contributions from new institutionalism, and identified information as codified knowledge and treated it as a commodity.

1.2 PERSONAL AND TACIT KNOWLEDGE

There were some, however, who could not accept this identification, on the grounds, first, that some knowledge is tacit. In Polanyi's *Personal Knowledge*, tacit knowledge is described as 'unarticulated' knowledge, which underlies 'the aim of a skilful performance' (Polanyi, 1962, chs 4 and 5), which aim 'is achieved by the observance of a set of rules which are not known as such to the person following them' (ibid., p. 49). Tacit knowledge cannot be reduced to these 'rules': 'Rules of art can be useful, but they do not determine the practice of an art; they are maxims, which can serve as a guide to an art only if they can be integrated into the practical knowledge of the art. They cannot replace this knowledge' (ibid., p. 50). There is no clear dichotomy between tacit and explicit forms of knowledge in Polanyi's approach. Polanyi maintains that articulated or explicit knowledge always requires focal awareness since it implies a fully conscious attitude. However, if tacit knowledge requires subsidiary awareness, this is not to imply entirely unconscious behaviour: 'it [tacit knowledge] can exist at any level of consciousness, ranging from the subliminal to the fully conscious. What makes awareness subsidiary is its functional character' (Polanyi, 1975, p. 39). This explains why tacit assessments and judgements are required at every step in the acquisition of – even codified – knowledge (ibid., p. 31). From this point of view, there is no purely explicit knowledge; in other words, knowledge is always personal knowledge.

Second, for Polanyi, the introduction of tacit knowledge is strongly related to 'personal knowledge'. According to Polanyi, knowledge can be seen as the product of subjectivity. 'Personal knowledge' refers to knowledge anchored in individuals and is the product of personal commitment. For example, before the scientist becomes committed to 'pure' research he or she has a personal vision and an intuition, which are constrained by the tradition of the particular discipline. Some of the assumptions made, according to Polanyi, were due largely to the 'logic of tacit inference':

> Upon examining the grounds on which science is pursued, I saw that its progress is determined at every stage by indefinable powers of thoughts. No rule can account for the way a good idea is found for starting an inquiry, and there are no firm rules either for the verification or the refutation of the proposed solution of a problem . . . It appears then that scientific discovery cannot be achieved by explicit inference, nor can its true claims be explicitly stated. Discovery must be arrived at by tacit powers of the mind and its content, so far as it is indeterminate, can be only tacitly known. (Polanyi, 1964, p. 138)

Tacit knowledge, therefore, is rooted in personal knowledge and is generated through the specific engagement of the scientific (or any other) agent

with his or her daily activity. This kind of tacit ('pre-verbal') knowledge is difficult to articulate. The articulation or codification of knowledge has been the subject of intense debate among economists (see Cowan et al., 2000).

1.3 SITUATED AND DISTRIBUTED KNOWLEDGE

The third reason for the refusal to identify knowledge with information or codified knowledge was the distinction between situated and distributed knowledge. The theory of 'situated cognition' states that cognitive resources in the environment complement the cognition of agents and are exploited by them. Knowledge is anchored not only in the mind, but also physically in the environment. This theoretical proposition was developed by Suchman (1987), who emphasized that cognition is rooted inherently in action: that is, the physical, technological or social environment is essential for building human knowledge. Suchman's analysis suggests that the spatial arrangement of the environment (notably a specific division of labour and local division of tasks) is decisive for understanding human problem-solving capabilities (Lorenz, 2001). Nooteboom (Chapter 15 in this volume), demonstrates why situated cognition departs from the representational vision of knowledge described by Newell and Simon (1964). It suggests that cognitive structure is not fixed, but is built in action, and that knowledge is local in character because it can be understood fully only within a specific context. In Chapter 15 Nooteboom quotes Polanyi (1962) in arguing: 'Situated action entails that knowledge and meaning are embedded in specific contexts of action, which yield background knowledge, as part of absorptive capacity, which cannot be fully articulated, and always retain a "tacit dimension".'

This vision is shared by advocates of the notion of 'community of practice' (Brown and Duguid, 1991; Lave and Wenger, 1991, Wenger and Snyder, 2000), proposed by researchers at the Palo Alto Institute for Research on Learning in the 1980s. A community of practice is defined as a group of people bound by informal links, engaged and interested in a common practice. They develop knowledge in action through practice and a shared language and common understandings, which most of the time remain tacit and implicit for most of the community.

In Chapter 18 of this volume Amin and Cohendet discuss why community provides some degree of coordination during knowledge creation:

> Communities are thus 'suppliers' of sense and collective beliefs for the agents and play a central role of coordination in the organization. The community

> framework provides the context within which are built the collective beliefs and the reference systems that structure individual choice. Adopting the idea that knowledge creation is primarily realized in contexts of action and that the action is always collective, the consideration of the intermediate level of communities is thus necessary to focus on the learning in the processes of action (Dupouët and Laguecir, 2001).

Situated and distributed cognition are separate and complementary. What distinguishes these two visions of knowledge is the role of the cultural determinant in the cognitive process (Lorenz, 2001). Edwin Hutchins, a famous American researcher in the field, subscribes to these views. Hutchins (1986) sees cognition as occurring via technological artefacts and social interactions, and human cognition as being mediated by technological artefacts that act as external memory (part of the cultural heritage of humankind). Individuals in interaction with their environment solve problems and perform particular tasks by exploiting these technological tools. Cognition is mediated through such tools and distributed via artefacts through a specific '*agencement*' and social interaction (e.g. in the US navy the channels for the transmission of knowledge are mostly formal rules and organizational relations). External memory affects the process of routinization by introducing new knowledge and new tasks into the division of labour. Artefacts create new kinds of memory that facilitate cognitive activities, and enable the articulation of formerly tacit practices, through common references (Lazaric et al., 2003).

1.4 SUBJECTIVE AND DISPERSED KNOWLEDGE

The division of labour and dispersion of knowledge chimes with the Hayekian vision of cognition. In this perspective, knowledge is conceived not only as being distributed relative to one's sensory-motor system, but also as being distributed in time and space (Lazaric and Lorenz, 2003). According to Hayek (1945), the dispersed and locally contextualized nature of knowledge makes it quite impossible to centralize all economic decision making. Hayek provides a subjectivist interpretation of this dispersion of knowledge based on two main reasons. The first, which is cognitive, is discussed in *The Sensory Order* (Hayek, 1952), where Hayek champions the idea that the brain functions in a connectionist way. This means that the point of departure for a mental representation is not the physical order of things, as 'scientistic objectivism' (to use Hayek's expression – cf. Hayek, 1952, ch. V), would have it, 'but the product of abstractions which the mind must possess in order to be capable of experiencing that richness of the particular [of the reality]' (Hayek, 1978, p. 44). The conscious

experiences that individuals regard as relatively concrete and primary and that are attributed to the intrinsic properties of the physical order 'are the product of a superimposition of many "classifications" of the events perceived according to their significance in many respects' (ibid., p. 36). Thus there are as many subjective forms of knowledge as there are individual 'nervous systems', that is, as there are individual heterogeneous agents. The second justification for Hayekian subjectivism is found in what Hayek calls the 'social division of knowledge'. For Hayek, as a civilization develops, the knowledge of its society becomes more complex and specialized. However, no single agent has access to all this knowledge: it is dispersed within and among the individuals constituting society, who have access to very small parts of this social knowledge and especially to the processes by which social and economic activity is regulated and reproduced globally. Hayek's subjectivist methodological choice led him to investigate the features of a 'cognitive' individual rationality. The cognitive capacities that individual agents must mobilize refer to their 'mental maps'. Hayek describes these 'maps' as a 'semi-permanent apparatus of classification', which 'provides the different generic elements from which the models of particular situations are built' (Hayek, 1952, p. 89). The notion of a mental map conveys the idea of cognitive limits to the mental considerations of individuals. Rather than 'a sort of schematic picture of the environment', mental maps act as 'a sort of inventory of the kinds of things of which the world is built up, a theory of how the world works' (ibid.).

1.5 KNOWLEDGE AND RATIONALITY

Nooteboom (2006) suggests that various visions for considering learning and knowledge can be endorsed. The French philosopher Blaise Pascal, writing in the seventeenth century, made the distinction between '*ésprit de géométrie*', 'which abstracts drastically from reality to enable grip for rigorous formal reasoning and an "*ésprit de finesse*", which stays closer to complex reality, that allows less for formal analysis' (Nooteboom, 2006, p. 3). Simonian and Hayekian interpretations of knowledge and information differ. Alan Newell and Herbert Simon (1964) developed the perfect illustration of '*ésprit de géométrie*', that is, a classic statement of the information-processing or physical symbol system view of human cognition and knowledge. The basic premises of this approach are that knowledge consists of rule-based representations or collections of abstract symbols that are stored in the mind, and that problem solving can be understood in terms of search procedures that select among means to transform the initial into the goal state. This view of human knowledge

and problem solving underlies Newell and Simon's (1964, pp. 282–3) claim that, at the level of information processing, the computer and the human mind are comparable. They justify their epistemological stance by suggesting that computer simulation techniques can be used to provide psychologically realistic characterizations of human problem-solving behaviours, which contrasts with Hayek's vision of knowledge as more strongly rooted in a traditional '*ésprit de finesse*', that is, a vision of knowledge that goes beyond its symbolic representation.

However, it is the Simonian representation of knowledge and the procedural rationality it legitimizes that contributes most to improving our deliberations over decision making. This symbolic approach to cognition is adopted explicitly by several economists, notably Egidi (1992, p. 154), for whom 'a problem is represented by means of a symbolic structure . . . and finding a solution means finding the program or procedure which leads to a solution'. Drawing on Newell and Simon's (1972) classic discussion of human problem solving, Egidi argues that in searching for a solution individuals use conjectures to decompose a problem into a set of presumably solvable sub-problems. This conjectural division of problem solving gives rise to a division of knowledge that is efficient because it economizes on memory and thinking. Herbert Simon's information-processing approach to human cognition naturally gives rise to an understanding of knowledge and learning as symbolic expressions stored within the minds of the organization's members. This symbolic way of storing and representing knowledge at the individual level may explain interference in the decision-making process in a context of bounded rationality. It refers to decision making in a context of incomplete information.

1.5.1 The Frame Effect

In economics, framing effects emerged in relation to observed occurrences of fairness in subjects' behaviour in experiments. Frey and Bohnet (1995) suggest that we need to examine institutionalist elements to observe the impact of fairness on economic outcomes. Framing effects are defined as 'norms, perspectives, contexts and other social cultural elements' (Elliot et al., 1998, p. 456) and refer more generally to the way decisions are presented and how they shape human judgements in specific settings. Kahneman and Tversky (1979) suggest that framing effects are a preliminary stage that precedes the decision problem, the second stage being the period of evaluation. They define framing effects as 'the manner in which the choice problem is presented . . . [according to the] norms, habits, and expectancies of the decision maker' (Kahneman and Tversky, 1981, p. 455). Thus framing effects represent the heuristics interplaying in

the decision-making process before the problem is solved (Gabaix et al., 2001). This means that, underlying many of our intuitive inferences, are representativeness, availability and anchoring.

This is not a new idea. The social sciences refer to it as cognitive frameworks, which result from internal processes and the local and cultural environment (Bandura, 1986; Witt, 1999). Cognitive frameworks are the outcome of the co-constitution of action and perception, proposed in the constructivist approach (see notably Weick, 1979, on this dimension). For Boulding (1956), images play this role of intermediation between the perception of raw data and the internal value system. Every human action is induced by the person's image, which, in turn, may be revised by the action. Images provide a way to interpret information and make sense of the environment. They create temporarily stable cognitive frameworks with individual and collective regularities. For instance, in Chapter 6 of this volume, Patalano says: 'individual imagery has a relevant social function because it enables collective sharing of values and meanings . . . the image has cohesive power that may exert a strategic function in both organizational contexts and cooperative interaction.'

1.6 KNOWLEDGE, LEARNING AND ROUTINES

In the historical evolutionary economics debate, collective learning rests on individual habits, routines and other types of more or less formalized practices (Commons, 1934; Veblen, 1914). Veblen developed an anthropological approach to capitalism and believed that it evolved with technical and social changes (Veblen, 1904, 1914). From this perspective, the question is not how a set of behaviours or actions becomes stable and balanced over time, but how it evolves (Veblen, 1919, p. 8). Individuals have certain habits and behaviours that are conditioned by experience (ibid., p. 79), which is why the cumulative and self-reinforcing process of a set of routines and habits on which the economic order rests needs to be depicted. These habits and propensities, embedded in social structures, tend to reproduce themselves, hence the potential for inertia.

Interest in the notion of routines was reawakened by Nelson and Winter's (1982) work, which highlights the relative permanence of firm behaviours, but also the capacity of firms to innovate. The notion of routine is increasingly used to analyse microeconomic change (Becker et al., 2005). Therefore a re-examination of the role of institutions would allow us to identify and understand the forces behind these changes, which are not related exclusively to cognitive contingencies (Nelson and Sampat, 2001).

The interplay of the individual and the collective levels of action is

far from neutral (Dopfer, 2007). For instance, entrepreneurs shape their judgements, beliefs and acts by themselves, but also in interaction with others. These micro interactions can produce 'recurrent interacting patterns' that need to be observed carefully (Cohen et al., 1996). Commons (1934, 1950) proposed an interactions taxonomy based on the type of knowledge involved (see Dutraive, Chapter 13 this volume). 'Routine transactions' are related to habitual activities involving stabilized knowledge (embodied in rules); 'strategic transactions' are those related to novel situations requiring new practices and implying new opportunities, for which there is no stabilized knowledge or rule of thumb. In other words, routine transactions are stabilized procedures that are deeply entrenched in the entrepreneur's procedural memory, while strategic transactions are related to new ways of doing things, not yet classified by the human mind. For Commons, the processes of deliberation and calculation are not always mobilized, but may rely on past habits when they are appropriate. In certain circumstances, the mind may reveal 'a creative agency looking towards the future and manipulating the external world and other people in view of expected consequences' (Commons, 1934, p. 7; see also Hodgson, 1988). Thus institutions must be understood as the working rules of collective action that may restrain individual deliberation and can play a cognitive role by creating 'institutionalized minds' and 'institutionalized personalities' (Commons, 1934, p. 874).

Both Commons and Veblen invite us to scrutinize the mechanisms of change brought about by the individuals (the 'upward causation' that has an impact on the organization), and the changes within the organization (the 'reconstitutive downward causation' that affects the individual) (Hodgson, 2007, p. 108). Routines lie between these two levels of analysis because they are enacted by individuals in a social context, which regulates the relative level of autonomy (Becker et al., 2005; see also Giddens, 1984).

This interplay of the individual and collective dimensions is described in the literature in terms of entrepreneurs not always able to take the 'best' decision because of the amount of unreliable information. They may need to employ heuristics derived from other contexts in order to analyse the competitive structure of the environment (Porac and Thomas, 1990). The entrepreneur's images are framed by collective actions within the local environment, which may 'tie' them, not because of the entrepreneur's own cognitive limits, but because of the vast quantity of information available that may not be relevant to the decision involved. This may promote the adoption of mimetic behaviours to deal with the uncertainty in forming personal judgements (Greve, 1998). Mimetic local behaviour, in some circumstances, may avoid the necessity of weighing up all the possible actions (Kahneman, 2003), based on voluntary ignorance of some facts and data