

Metaphors of Knowledge in Economics

Wilfred Dolfsma

*Delft University of Technology & International Institute of
Infonomics*

w.a.dolfsma@tbm.tudelft.nl

Abstract “Knowledge” takes a central place in economics. This paper shows that the metaphor pervasively used in neoclassical economics to understand knowledge is that of “capital”. Taking capital as a metaphor of knowledge introduces problems in neoclassical economic theory, as becomes apparent when economics addresses issues of learning and technological development. Instead, it is argued that economists could learn from what philosophers such as Gilbert Ryle and Michael Polanyi have said about how to understand knowledge.

Keywords: Economic theory, knowledge, learning, technology, philosophy of economics

METAPHORS OF KNOWLEDGE IN ECONOMICS¹

the Caterpillar {said} sternly “Explain yourself!”

“I can’t explain myself, I’m afraid, sir,” said Alice “because I’m not myself, you see.”

Lewis Carroll: *Alice’s Adventures in Wonderland*

According to Friedrich Hayek (Nobel Laureate in economics) the concept of “knowledge” is central to economic theory (1937, 1945). Many strands in economics have, however, largely neglected the discussions on the subject of the nature of knowledge: the field of epistemics, while discussed in philosophy and in the other social science, is ignored. As it turns out, the concept of “knowledge” most economists opt for almost by default is incorrect. I draw on ideas proposed by philosophers and psychologists who have studied the concept of “knowledge” to make the case that knowledge is not usefully treated as if it

¹ This paper was written when the author was attached to the Erasmus University, Rotterdam.

were capital, as is the case in neoclassical economic theory. The view on knowledge, whether implicitly subscribed to or explicitly taken, has important consequences for the development of economic theory. The opposite is also true: a scholar's epistemic position relates to the kind of economic theory she adopts.

Because the concept of knowledge is such an elusive one, economists—in search of a way of grasping it—have tried to come to grips with it by employing the known concept of capital in a way that stretches its original use.² To a neoclassical economist, the metaphor of capital seems most useful in dealing with “knowledge”. Such comparisons of knowledge with capital are the cornerstone of human capital theory, as developed by Becker and others. They are at the core of neoclassical economics today. In effect, this concept has come to take on metaphorical meanings. Comparing “knowledge” to the neoclassical economic concept of “capital” is inappropriate, however, as I will argue. Knowledge and knowledge change (learning) being important in explaining economic growth, the discussion in the present paper is a pertinent one (cf. Hodgson 1999a). A consequence for neoclassical economic theory of perceiving of knowledge as if it were capital is that the phenomena of technology and technological change present theoretical difficulties.³

Hayek's views on knowledge were, for instance, as Mirowski (1995) shows, comparable to Polanyi's for some time during the early phases of their intellectual careers. Their views increasingly began to deviate from each other, however. Mirowski argues that because of this growing divergence their views on economics began to be more and more dissimilar. Mirowski's claim is, it seems, that an economist's epistemological position is essential for understanding the views he takes on economic theory, and vice versa. In this paper I will substantiate this claim, and suggest ways for economic theory to proceed from the most recent insights psychology provides. I will not trace historically how capital was used as the metaphor for knowledge used in neoclassical economics (see Kiker 1966). Instead, I will present a theoretical and methodological discussion and critique of perceiving of knowledge as if it were capital, arguing that it results in incorrect or “unrealistic” economic theories.⁴ Trying to

2 Capital as a concept used in economics is not clear and unambiguous in its meaning, as for instance the Cambridge capital debates have shown (Harcourt 1969).

3 At this point, it is important to stress that no direct and unambiguous relation between knowledge, innovation, technology (technological change) and economic growth is suggested here: as these links are complex and in flux almost permanently. My claim would be that a better understanding of knowledge would allow for some of these relations to be clarified (cf. Hodgson 1999b).

4 On the term realisticness, see Mäki (1989).

prove their incorrectness or “unrealisticness” does require a comparison with views on how one may alternatively understand knowledge. I will present and develop one of these views, one that is generally considered to be valuable.

The discussion here is reminiscent of what has become known as the Cambridge capital debates (cf. Harcourt 1969). None the less, the focus and the implications of the present paper are somewhat different, taking on a methodological discussion and focusing on the micro level. The discussion staged here about the knowledge-as-capital fallacy of neoclassical economics has consequences for the possibilities and aims of formulating economic policies. Any direct implications for economic policies would be difficult to draw, however, and certainly within the confines of this article. Economists’ influence on economic policy debates is marginal and unpredictable anyway, to say the least (cf., e.g., Cordes *et al.* 1993).

I. CAPITAL

In order to find a description of what is generally taken as capital by economists, one can perhaps best go back to one of the founding fathers of the science. Marshall (1920) is one of the most influential among them, and, moreover, quite explicit with regard to what is to be regarded as capital. “Capital” is a collection of goods external to the economic agent that can be sold for money and from which (hence) an income can be derived (Marshall 1920: 71). In this regard Marshall is following the lead of Adam Smith in his *Wealth of Nations* (1776: see for instance paragraphs II.i.1 and II.i.17).

Capital is something tangible to these early economists, although Machlup (1984: 403) does not hold that capital is necessarily tangible. Nevertheless, if one is to inquire about the way the concept of capital is used today, the positions taken by these authors still seem to hold their own. Hennings (1987) has provided a lucid overview of the way in which the concept of capital is used in economic theory from the day of its inception to present times. In this article it is argued that capital is considered in the history of the development of the concept to be something tangible, external to the economic agent, that can, moreover, be measured or valued in terms of money.

II. CAPITAL AS A METAPHOR FOR KNOWLEDGE IN NEOCLASSICAL ECONOMICS

Figure 1 is one frame from an animation picture called DaDA. The knowledge that people in the imaginary world of this motion picture have is measured by the number of books that each of them carries on his head. Furthermore, by



Source: DaDA, courtesy of © Gilia van Dijk filmproducties, 1994

Figure 1: The Standard View on Knowledge & Learning

consulting the books, one can easily determine the nature and amount of knowledge somebody has acquired. This is the idea of learning as the linear and uni-directional accumulation of knowledge that inspires human capital theorists. It does not resemble the way of conceiving of knowledge that is generally adhered to in philosophy and psychology, as I will indicate.

Several authors, working in diverse fields of the social sciences, have drawn on ideas propounded in neoclassical economic theory to build theories to explain human behavior. An important concept used in this regard is the concept of “capital” in lieu of the concept of “knowledge”. Especially where the term “human”, “social”, “organizational” or “cultural” is placed in front of it, there seems to me to be some misperception as to what use can be made of the concept of capital. I here refer to such authors as Stigler and Becker (1977), Becker and Murphy (1988), Becker (1996), North (1990), Denzau and North (1994), Coleman (1998) and Bourdieu (1984). Becker’s work (1996) and the work of North (most importantly his article with Denzau) will be focused on primarily here because of the explicit way in which they address the issue of knowledge and learning, and because of the prominence of the authors and these specific works.

Authors use a metaphor in order to come to grips with an elusive concept and thus strengthen or simply make an argument. McCloskey (1983) has argued forcefully that metaphors are essential to (neoclassical economic) theories and arguments, but that they often remain implicit. Vroon and Draaisma (1985) take the argument further in saying that a particular metaphor *directs* human thinking and the development of theories. I will now compare the concept of capital with that of knowledge. In this way, I hope, some of the flaws of conceiving of knowledge as if it were capital will become apparent.

The earliest explicit argument for explicitly treating human knowledge as if it were capital and actually attempting to find more than simply indicative measures for it is expressed by Walsh (1935), to my knowledge. In the present time human capital theory has become so “successful”, that some scholars claim it was “discovered” much earlier. Brahmananda (1988), for instance, claims that Jevons should be credited. Jevons was certainly not the only or the first to have remarked that education can increase a person’s productive capacities.⁵ As it turns out, Smith made similar allusions (1776: book II, Ch. I, 17), and so did Sir William Perry in the late seventeenth century (Kiker 1966). Walsh was, however, to the best of my knowledge, the first to follow the logic of the capital metaphor for knowledge to its end and make calculations. He observes that

the more advanced and prolonged the education, the more exclusively vocational its purpose, the more probable it is that the guiding principle will be that of ordinary economic gain. *If this is true*, it would seem clear that the abilities acquired through strictly professional education *resemble* capital very closely
(1935: 257, emphasis added)

Note that here he does not equate human knowledge with capital, although he applies the same methods in both cases. Even more, he restricts the treatment of knowledge in terms of capital to specific ways of acquiring knowledge, or to specific types of knowledge. Elsewhere in the article, Walsh is less cautious in his statements and speaks of “*other* forms of capital” when referring to machines and the like (1935: 284, emphasis added). The general line of reasoning is clear, however: when the motive of monetary gain is used to assess whether or not to spend money on an education which may yield future monetary benefits, (neoclassical) capital theory should be applied. Stigler and Becker (1977: 83) take one more step in equating knowledge with capital, although they restrict the knowledge they refer to as “specific” knowledge.

⁵ Indeed, as Mosselmans (1998) shows, arguing for the beneficial effects of education was a common thing to do in Jevons’ time and before. Such arguments, however, sit uneasily within the theoretical framework scholars such as Jevons have developed.

As McCloskey has rightly pointed out, the concept of capital was turned into a metaphor when Becker *cum suis* introduced “human capital into the rhetoric (conceptual apparatus) of economics, and the field of economics treating human skills was at a stroke *unified* with the field of treating investment in machines” (1983: 504, emphasis added). While this unification was perhaps illuminating for businessmen in emphasizing the importance of the “human factor” in production, it is mystifying in economic theory. It led to calculations similar to those of ROI (Return On Investment) and Present Value of investment in education (see Stigler and Becker 1977: 79). Calculations such as these can be useful if their importance is not emphasized too much. Much more, however, is involved in education and child-rearing than the acquisition of capabilities useful or valuable in the market place. It is the latter that is stressed when talking about the ROI and Present Value of human capital, often to the neglect of the former.

Most salient in this way of employing the metaphor of capital are Becker and Stigler (1977). In the case of the appreciation and consumption of music, for instance, *exposure* to it will lead to the accumulation of a “capital for the appreciation of music” (*ibid.*: 78) from which an “income” is or can be drawn, although Becker and Stigler do not explicitly use the word “income” as such in this particular case. Boulding (1977: 4) and Becker and Murphy (1988) are, however, more explicit on this count. This income will accrue to the person in the form of reduced shadow prices of listening to music in the future. From the stock of cultural or consumption capital runs a flow of “interest” which will (partly) compensate for the cost of listening to music (*ibid.*: 79).

More recently prominent neoclassical economists are influenced in their thinking by the capital metaphor in their attempts to conceptualize knowledge, cognition and learning. Becker (1996) has been explicit, North, in his often referred to 1990 book, less so, but in later work North has been more elaborate (Denzau and North 1994). These recent studies present interesting and new arguments. I will show, however, that analytically using the metaphor of capital to conceptualize knowledge still does not provide much mileage.

Central to Becker’s approach is what he calls the “extended utility function” (1996: 5):⁶

$$u = u(x_p, y_p, z_p, P, S) \quad (1)$$

where x , y and z stand for “different goods”, while P and S stand for Personal and Social Capital, respectively. According to Becker, this function allows one

6 The discussion of Becker (1996) draws on Dolfma (1997).

to explain both individual learning and the effects of social relations on persons. Becker says “the utility function itself is independent of time, so that it is a stable function over time of the goods consumed and also of the capital goods”. This puzzling statement is clarified later on the same page:

utility does not depend directly on goods and consumer capital stocks, but only on household-produced “commodities,” such as health, social standing and reputation, and pleasures of the senses. The production of these commodities in turn depends on goods, consumer capital, abilities, and other variables.

In terms of utility functions, what this means is that their shape remains the same throughout a person’s life, though somebody may attain higher levels of satisfaction in terms of more fundamental “goods” by investing in his or her social and personal capital. “A person’s personal and social capital form part of his total stock of human capital” (Becker 1996: 4). Learning takes an effort that is like an investment and creates human capital. Economic agents are thought to have a production function internal to themselves for transforming goods into “higher order” commodities.

Now preferences for *particular* goods are no longer fixed and given, but the extended preferences are. Of course, Becker asserts that this is what he had been saying all along (ibid.: 6), and technically he is right. In their *De Gustibus Non Est Disputandum*, he and George Stigler (1977: 77) do not speak of particular goods either. These more basic things are “health, social standing and reputation, and pleasures of the senses” (Becker 1996: 5). What this view boils down to is that people know from the start what kind of person they want to be. We are concerned with the broad picture, of course, not with details. So, Bill Clinton always wanted to be president, and Keith Haring always a painter. Behind Becker’s cold analytical front stage, however, there is an oddly romantic back stage. His view of individuals is the romantic idea that an individual remains an utterly independent and autonomous person.

The most serious problem, however, relates to how Becker perceives information. Not only is this the most serious problem, it is also a crucial part of Becker’s argument—and neoclassical arguments in general. Information speaks for itself: data need no interpretation. The key word is “interpretation”. Different interpretations of a situation can only occur in the Bayesian world that Becker adopts when people are faced with uncertainty. Uncertainty is subsequently translated into incomplete information. As soon as more information is gathered, differences of interpretation disappear in Becker’s view (cf. Dow 1998; Dolfisma 2001). Conceptions of Bayesian learning rest on the assumption that “the laws of logic and probability theory represent the laws of rational reasoning, and that humans actually follow these laws” (Ortmann and Gigerenzer 1997: 700).

Becker's treatment of "culture" is somewhat awkward in this regard. Culture implies differences, differences of interpretation that do not reduce to a lack of information, differences that persist despite the fact that people have the same knowledge. When in the U.S.A. a woman and a man, for instance, walk hand in hand, one can reasonably infer that they are intimately related. They may be in love. When in India a woman and a man walk hand in hand, they are frowned upon. A woman and a man who are in love with each other do not walk hand in hand in India; only two or more women *or* two or more men who are friends walk hand in hand in public. By dealing with culture as though it were a kind of capital with an extremely low depreciation rate (Becker 1996: 16), differences such as these remain puzzling.

A social or institutional economist could analyze these differences in terms of the different institutions or norms that exist in the different societies.⁷ Such an economist would study the emergence, change, and consequences of institutions closely, taking notice of the rich and overwhelming quantitative and qualitative empirical material that bears on the issue. Not so Becker. To him, institutions are created by individuals who stand to gain from them. Since he acknowledges that, in reality, people have imperfect foresight and are not omnipotent, he takes a position that in philosophy is known as "rule-utilitarianism". Not every single action can be utility maximizing because of human fallibility, but people create "optimally imperfect" rules of thumb. The human intellect is then just another constraint, besides budget and time constraints. This is how habits are formed and addictions have started (see also Baumol and Quandt 1964).

When talking about identical people, whose differing interpretations of their environment have no place in this framework, the result would be that everybody adopts the same rule of thumb, were it not for the accumulation of personal and social capital. Were personal and social capital not to interfere, habits would create institutions. If habits were optimally imperfect for one person, others would adopt the same habit, either by themselves or by imitation. As Alchian's (1950) evolutionary argument would have it to make the neoclassical case complete, the most efficient solution would prevail. People who are not efficient would not survive; they must imitate efficient rules of thumb. Thus an individual habit grows into an institution among people of similar personal and social capital.

7 See Albert and Ramstad (1997) for a perception of individuals and their behavior that has inspired institutionalist thinking. For a discussion of how institutional economics might theoretically relate "knowledge" to "institutions", see Boland (1979).

If, however, personal habits and social institutions (culture) are merely perceived as some kind of capital, how ever low their depreciation rate may be, how do we explain the persistence of habits and institutions that are obviously detrimental to the very existence of a person or a social group? How do we explain that people take overdoses of drugs that kill them, and how do we explain that groups of people make large sacrifices for their ideals? Since information is clear-cut, people in their right mind cannot make such mistakes. They might (temporarily) have a distorted perception. Becker indeed does talk of “distorted perceptions”, but he stresses that:

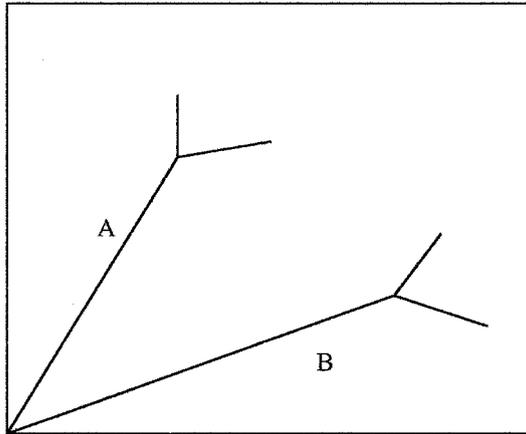
... they may receive excessive attention at the expense of more significant weaknesses in standard models of rational choice for explaining behavior in real, as opposed to experimental, situations. These models typically assume that preferences do not directly depend on either past experiences or social interactions. . . . To highlight these neglected constraints, the book does not emphasize cognitive imperfections, but rather the influence of personal and social capital on choices.

(Becker 1996: 22)

Hence, these phenomena can safely be included in a *ceteris paribus* clause. Becker, nevertheless, has yielded to his many critics by giving a different reason for what he is doing. Instead of (implicitly) relying on Milton Friedman’s methodological argument (1953), which he previously would do, he makes an empirical claim that his problem is the more important one. He thus seems to acknowledge, contrary to what Friedman has advocated, that it is important to have realistic assumptions on which to rest your theoretical framework. At least he is explicit about it.

Yet, the implicit assumption that information does not need interpretation seems unrealistic. Cultural differences cannot be explained from this perspective. Similarly, treating social relations, culture and human knowledge as if they were capital, each with its particular depreciation rate, is unrealistic and raises a number of problems. For one, because tacit knowledge cannot be measured, it complicates the picture tremendously. The factor of time, and consequently that of change, also creates problems. If it can be addressed at all—and I doubt this—it can only be done for gradual changes in time within the economy. Sudden changes would remain baffling from this perspective.

The capital metaphor not only makes one think of the knowledge acquiring process as a uni-directional one, where past knowledge is automatically incorporated into present knowledge, it can also accommodate differences in the perspectives people take only by invoking “noise”. Information in this view is open to just one interpretation—additional information will take away the ambiguity noise creates. With reference to Figure 2, differences between



Source: Dolfsma (2001)

Figure 2: Different Learning Paths

learning paths A and B cannot be accounted for.⁸ Not at the individual level and not at super-individual levels, should one not strictly adhere to the prescripts of methodological individualism as North (1990) has come around to doing.

A Bayesian learning perspective incorporates the idea of information needing no interpretation before being added to the stock of knowledge already in place. It nicely allows for modeling. Denzau and North (1994) are uncomfortable about the assumptions Bayesian learning theory makes. Their suggestion for how to solve the problem is to allow for “punctuated equilibria” in learning. Learning can sometimes be discontinuous, and involve periods of stagnation and spurts. Learning will still develop in one direction in Denzau and North’s view, however, and punctuated equilibria presumably are only temporary breaks in the progression of knowledge towards true knowledge.

III. SOME OBJECTIONS

At this point I want to enumerate some of the difficulties I have with the argument that knowledge can best be conceived of as capital. There is no room for knowledge the individual has but is not aware of. How can one conceive of an income flowing from a stock of “cultural capital” when knowledge is (partly)

⁸ “Noise” is presented in Figure 2 by forkings in the different learning paths.

tacit? How is such tacit knowledge to be measured? Because of the “intimations of an indeterminate range”, as Polanyi phrases it, knowledge on a specific topic cannot be measured. If it can’t be measured, no Return on Investment can be computed. To quote Hayek (1945: 52–54), “the sort of knowledge with which I have been concerned is knowledge of the kind which by its nature cannot enter into statistics”.

Related to this measurement argument, can one think of knowledge as an homogenous good, like capital (cf. Neale 1984)? By learning, information becomes part of a larger framework of knowledge. Within that framework no distinction can always be made between different kinds of knowledge, although qualitative differences remain. It is often impossible to separate where exactly knowledge of one subject ends, and where knowledge of another begins. This makes it difficult, for instance, to write an article without many side steps in footnotes into only somewhat related fields. To use the concept of capital to understand knowledge requires that such clear distinctions be possible. If a “stock” of capital cannot be distinguished, how can one conceive of a “flow” of “income” derived from it? Machlup (1980, 1984) does assume the returns to a stock of knowledge to be measurable in terms of money. His point is that different concepts of capital should be used to address different matters. Rather than illuminating the concept of knowledge, however, Machlup, it seems to me, undermines the strength of that of capital by making this argument.

Further, how can equating knowledge with capital account for changes in a person’s views, interpretation, knowledge and preferences? The argument suggests that once a person is addicted to a particular good that is “beneficial” in some sense, she will not (be able to) change her knowledge, views, preferences, etc. Or is there a “capital for change” included? This is not likely to be the case, since no active involvement of the agent is assumed: capital is accumulated when *exposed* to something. In a recent article Arrow (1994) argues in this vein. Knowledge is gained, according to Arrow, simply by (1) observing nature, or (2) learning from other individuals (intended or unintended). His discussion strongly suggests a rather automatic and unproblematic accumulation of knowledge.

By contrast, I would argue for the inclusion of a concept of volition to account for changes of views, knowledge, interpretations and preferences (cf. Biddle 1990; Dolfsma 1994). In some sense an active involvement of the economic agent has to be assumed. It requires at least some effort to construct the framework of knowledge that Polanyi, Ryle and others speak of. Active involvement of the economic agent introduces unpredictabilities, uncertainties (see also Hodgson 1997). Uncertainty has no place in the capital view of knowledge. Risk—in Frank Knight’s (1921) understanding of the term—does

play a role in the form of “noise”, but genuine uncertainty does not feature in neoclassical economic theory.

In addition, adopting an epistemological view along the lines suggested below, entails not only that differences in kinds of information is discussed, but it also entails that one is able to discuss the possibility of economic agents being different from each other. A concept of a person’s identity is, however, not present in neoclassical economics, and, moreover, cannot be incorporated into the framework (Davis 1995).

Finally, and almost trivially, that in some eras, in some places, monetary gain is one of the motives for a particular group of people to try to acquire knowledge does not mean that the phenomenon can best be understood in terms of neoclassical economic theory of capital which emphasizes self interest as a primary or even the sole source of motivation.

IV. KNOWLEDGE

Besides the fact that the human mind is incapable of encompassing all information that is relevant, the mind is constructed in such a way that it is impossible for humans to put into words or text all the knowledge that they possess on a particular subject. A certain part of knowledge has to be tacit (see Polanyi 1983; Ryle 1966).

Here I use the term tacitness, often used by Polanyi, to refer to a phenomenon that has also been called knowing-how as compared to knowing-that by Ryle. Knowledge-how, alternatively described as the total of unconscious and conscious knowledge, encompasses more than knowledge-that. Knowledge-that may be described as conscious knowledge, as the knowledge that can be articulated. Knowing is used to indicate both practical as well as theoretical knowledge. Neoclassical economists try to deny a tacit element exists in the total of a man’s knowledge. To quote Ryle, they try to “reassimilate knowing *how* to knowing *that*” (Ryle 1966: 29). Nelson (1959: 299) is a telling example. He asserts that “knowledge is of two roughly separable sorts: facts or data observed in reproducible experiments and theories or relationships between facts”. In implying that certain types of knowledge can successfully be distinguished from others, Stigler and Becker (1977: 83) implicitly assume all knowledge to be knowledge-that. In fact, Ryle makes the plausible assertion that knowing-how is more extensive than knowing-that (ibid.: 41) and that knowing-that by no means entails or naturally flows into knowing-how (1966: 56). The unfamiliar (to most neoclassical economists, that is) distinction introduced between knowing-how and knowing-that is useful in thinking about the knowledge an economic agent has at any particular moment. This distinction

does not coincide with the distinction often made in economic literature between complete vs. incomplete or perfect vs. imperfect knowledge. These distinctions imply that somehow a social scientist is able to determine objectively the full and true nature of knowledge. What I take as a starting point here is the knowledge people actually have and how they acquire it. The distinctions will not be further elaborated upon here.

Polanyi has developed a theory of knowledge acquisition that should also be of interest to economists. Polanyi (1983: 7) argues that (tacit) knowledge is acquired in a process he calls “subception”. Any piece of information to be transplanted from one person to somebody else is “recepted” (ibid.: 5) by this other person and integrated or subsumed into a larger framework of knowledge in which meaning is given to this new piece of information (ibid.: 19). To the extent that information is subsumed (and it has to be subsumed if it is to have any meaning) into a larger framework of knowledge, it is interiorized (ibid.: 29), as it were, to become a part of the body (cf. Douglas 1986: 13). From this it follows that man cannot always accurately state what it is that he knows about a certain topic. Such knowledge is typically “fraught with further intimations of an indeterminate range” (Polanyi 1983: 23). Where knowledge relevant to the particular subject becomes irrelevant is difficult to ascertain. The reason that knowing-how is more encompassing than knowing-that is, in my opinion, just this difficulty of separating relevant from irrelevant knowledge. Veblen (1961: 74) goes even farther than this in asserting that man is “a coherent structure of propensities and habits”.

The supposition that there will ever come a time when the economic agent is in possession of all the relevant knowledge—as Lucas (1987) assumes—cannot hold for two reasons. Separating “relevant knowledge” from “irrelevant knowledge”, requires, first, a conception of the totality of knowledge. Without having some idea of the totality of knowledge, no distinction can be made as to what is and what is not “relevant” (see Dolfisma 1994). Humans having limited brain capacity, a conception of the totality of knowledge is not possible. The philosopher Whitehead (1968: 43) says that knowledge about something can only be complete from a limited perspective. He explains by saying that “to feel completion apart from any sense of growth, is in fact to fail in understanding” (ibid.: 48). This argument is similar, though not the same, to the objection against Bayesian learning theory made by, among others, Hargreaves Heap (1993) and Elster (1986). Second, to remain in possession of knowledge on a certain subject in a certain degree requires that no changes in one’s environment occur, or that changes in one’s environment are not faster than changes in knowledge (learning). These are unlikely conditions in the rapidly changing world in which we live.

The ideas of Polanyi and Ryle may be seen to be complementary, and make a useful contribution to an understanding of knowledge and a possible conceptualization of it by economists. At any point in time, what knowledge is tacit depends on the framework in which the particular piece of knowledge is included and on the ability of the particular agent to formulate his or her knowledge in a way that can be understood by other agents. The framework in turn is a product of past learning processes in which pieces of knowledge are fit into the framework present at that particular point in time, thereby altering the framework itself. The totality of knowledge, which is partly tacit, is the intermediate result of a perpetually ongoing process of acquiring knowledge (Ryle 1966: 42). The importance of the element of time needs to be underscored, an element that is usually not incorporated in economic theory (Clark and Juma 1990). Hence, while Ryle stresses the static view of the state of knowledge at any point in time, Polanyi lays more stress on the dynamic process responsible for reaching a particular position. Polanyi thus provides a reason for regarding knowing-how as much more extensive than knowing-that, for it is in the process of acquiring knowledge that the framework of knowledge is constructed. Such a framework has many interconnections that change over time. Ryle's (1966: 45) "inquiry . . . into {human} capacities, skills, habits, liabilities and bents" also points to a very important and often disregarded phenomenon of the human intellect: that knowledge may be acquired without (continuous) intellectual effort. Knowledge can also be acquired in a rather passive way.

It is difficult to understand and conceptualize of knowledge. In this section I have largely drawn on what two philosophers—Ryle and Polanyi—have written about it, although this brief and far from adequate discussion was influenced by the work of psychologist Albert Bandura (1977, 1986) as well (see Dolfsma 1994). "Knowledge" is a concept closely linked to learning and preferences. One could even argue, presumably, that they are theoretically inseparable. In the process of learning, knowledge changes (grows) whereupon people's preferences may change. Bandura's work in social psychology has been successful empirically in explaining how people learn. Social psychology can also explain how people become moral agents, as Rottschaeffer (1991) argues persuasively.⁹ Economists have often tried to use the familiar concept of capital as a metaphor for knowledge. Capital shares some features with knowledge, but conceptually, trying to understand knowledge as if it were capital does not provide much

⁹ Cognitive psychology need not be in conflict with a position that leans more towards social psychology. Cognitive psychologists Holland *et al.* (1989), for example, are strongly influenced by developments in artificial intelligence, but nevertheless develop ideas that are compatible with the ones advocated here.

conceptual mileage. This point is underscored in the subsequent discussion of how technology and technological change is treated in neoclassical economic theory. An inappropriate understanding of knowledge leads inevitably to misunderstandings as to how technology develops and affects economy and society.

V. TECHNOLOGY

In this section a fruitful way of conceiving of technology is presented. It differs from the one most neoclassical economists hold. The common position for neoclassical economists to take when thinking of technology can be illustrated by giving a few examples. Nelson (1981) equates technology with “well-articulated blueprints”, Schmitz (1985) equates it with “machines and labour”, and Teitel and Westphal (1984) with “productivity, total factor productivity”. These positions are understandable in the light of the discussion by Hennings (1987). Mainstream economics generally regards technology as (closely related to) capital. Capital is the monetary value of the material means of production, alternatively technology. Underlying both is the positivistic view of knowledge that Figure 1 depicts and that I have elaborated upon and criticized above. In the introduction, I indicated a relation between the concepts of knowledge, technology and capital (and, relatedly, economic growth). To clarify this complex set of relations, and in light of the previous discussion in the paper, I would, however, take technology more along the lines of what Hayek has suggested according to De Vlieghere (1994):

All the knowledge—tacit and articulable—that is used by an economic entity (agent, firm, organization, etc.) to produce something.

Now this is indeed a very broad definition and it needs to be explained. The concept of technology is broader than the one used in (neo)classical economic theory, which equates technology with physical capital (machines) or blueprints readily available and implementable off a shelf. However, my concept is not so large as to include all possible knowledge, since it restricts itself to knowledge that is *actually used* to produce something for which there is a need (cf. Hayek 1941: 72). Neale (1984: 573), however, flatly equates knowledge with technology, and by doing so loses much of the explanatory strength of his views. To quote Machlup (1980: 10)—one of the very few economists who has given the concept of knowledge its due attention—technology is only “one type of knowledge”.

What exactly is the kind of knowledge to which my argument refers? For illustrative purposes, let me confine the argument to the case of a firm. First of

all it includes the knowledge individuals need to function in a normal way in the firm (whatever that may involve). These individuals include shop-floor laborers as well as managers and even owners. For convenience let us call it “operational knowledge”. Next to this, technology includes the machines and tools with which laborers work to produce output. If one considers these machines as products of other production units (firms), the reason why I categorize machines under the broad heading of knowledge becomes clear. Knowledge has been used to manufacture these machines and tools. As some sort of differentiation seems to be needed, I propose to call the knowledge incorporated in machines and tools “contained knowledge”. One might prefer, from a linguistic point of view, the term “embodied knowledge” (see De Vlieghe 1994), though this may induce an association with the term “embodied technology” current in the discussions of macro-economists building models of the economy. Such associations need to be avoided. As a third, and final, constituent of technology, the organizational set-up of the economic unit is to be mentioned.¹⁰ After giving a brief enumeration of the reasons why I prefer this account of technology, I say something about the kinds of thing that are meant to be excluded by this characterization.¹¹

The knowledge every person involved in the production process uses also needs to be called technology because without such knowledge people would not be in a position to work with machines/contained knowledge. What would be the use of contained knowledge if nobody had the “operational knowledge” to use it? Part of that knowledge cannot be articulated, which provides a good reason for the emphasis on “learning-by-doing” and similar phenomena (e.g. Bell 1984). Thinking of technology in terms of knowledge, including tacit knowledge, helps to explain why shipping technologically advanced machines to the economically less developed countries of the world has not resulted in the expected economic growth. For similar reasons the organizational aspects of economic units are included. No production whatsoever is possible if, for instance, nobody is able to sequence properly the operations that need to be done to produce something. Without an adequate organizational set-up, the opportu-

10 Some metaphorically refer to this as ‘organizational capital’ (cf. Tomer 1999).

11 Rip and Kemp (1998) is an excellent source for up-to-date discussion of technology and technological change, drawing on a vast empirical and theoretical literature. They are not in favor of a definition of technology that emphasizes that inputs need to be transformed into outputs as an important part of the definition of technology. The alternative they present—likening technology to “a grammar” of rules, routines and practices—requires a proviso that indicates where a useful application of the concept of technology stops and where other concepts should be used. On a closer look, Rip and Kemp (1998) and the view in this paper may not be too dissimilar, though. I will not elaborate this now.

ities for division of labor cannot be realized. Thus, for instance, the M-form of organizing a firm or the Just-In-Time way of production is a part of the technology of a firm in the view expressed here.

Thus far I have argued for extending the definition of technology. Now I offer an example of what should not be considered technology. One prominent example is inventions that have not yet been used in a production process. Inventions are only relevant for my definition of technology to the extent that they are (procured and subsequently) used in a production process. Should they be used, but not used to produce an output, they might better be called consumption. Together with all the ways of production that have become extinct, I would call inventions not (yet) used to produce something “potential technology”. As is well known from the disciplinary field of technology studies, many inventions will never be used in a production process. Sen provides a good reason for only considering the knowledge actually used to produce something for which there is a need. He says that “while goods and services are valuable, they are not valuable in themselves. Their value rests on what they can do for people, or rather, what people can do with these goods and services” (Sen 1984: 510). The same line of reasoning holds for technology; it is only valuable to the extent that it is used in a production process.

The conception of technology argued for here is very much related to human knowledge. In fact, it is based on the supposition that human beings are not able to cope with the vast expanse of all potentially relevant information. This makes it, for example, impossible to write handbooks to explain in an exhaustive way how a machine should be used. Handbooks of how to use technologically advanced machines require more than just literacy on the part of the future users (cf. Neale 1984). This inspired people to think that it is possible simply to transfer machines to developing countries in the expectation that they can be used without further problem once the handbook has been studied. Considerable waste has been the result. My way of conceiving of technology is supported by Veblen. Referring to machines as “productive goods”, Veblen (1961: 71) observes that “these productive goods are facts of human knowledge, skill and predilection; that is to say, they are, substantially, prevalent habits of thought, and it is as such that they enter into the process of industrial development”.

VI. CONCLUDING REMARKS

The metaphor generally used in neoclassical economic theory to understand “knowledge” is that of “capital”. By contrasting it with views put forth by such scholars as Polanyi and Ryle regarding how people learn and how knowledge

may alternatively be conceptualized, I show this to be an incorrect way of understanding knowledge. This has consequences for economic theory. Since “knowledge” is such a central concept in economics, as Mirowski (1995) and others have argued, the consequences are potentially profound. Two of those consequences are considered in this paper. They are the use of capital as a metaphor for knowledge in human capital theory and the characterization of technology by neoclassical economists.

The conceptualization of knowledge an economist has influences her theory and, similarly, the theory an economist holds influences her conceptualization of knowledge. Rather than addressing and bringing out all the intricacies that surround the concept of “knowledge” and its consequences for economic theory, in this paper I have restricted myself to pointing out the important issues for economic theory. I do not argue against the use of capital as a metaphor for knowledge per se. The metaphor can be illuminating, especially when one discusses cultural or social capital in the political arena. In academic discourse, however, one should be more cautious and more explicit about how one perceives knowledge. Analytically, conceiving of knowledge as if it were capital can be misleading and provides little conceptual mileage. Misleading and possibly economically disastrous is, for instance, the idea of knowledge underlying many discussions among economists about technology and technological development.

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