# Mathematics and academic finance: the role of paradigms

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## Abstract

**Purpose** – Any adequate analysis of the nature of mathematics and its role in sciences necessarily requires fundamental understanding of the world views underlying the views expressed with respect to the nature and role of mathematics. Aims to discuss four general views with respect to mathematics and its role in sciences, corresponding to four broad worldviews.

**Design/methodology/approach** – This paper starts with the premise that any worldview can be positioned on a continuum formed by four basic paradigms: functionalist, interpretive, radical humanist, and radical structuralist. It looks at the current state of mainstream academic finance and notes that it is founded only on the functionalist paradigm. It argues that any view expressed with respect to the nature of mathematics and its role in sciences is based on one of the four paradigms or worldviews.

**Findings** – Emphasizes that the four views expressed are equally scientific and informative; they look at the nature and role of mathematics from a certain paradigmatic viewpoint.

**Originality/value** – Concludes that there are opportunities for mainstream academic finance to benefit from contributions coming from the other three paradigms, if it respects paradigm diversity.

**Keywords** Finance, Mathematics, Philosophy

**Paper type** General review

## Introduction

An analysis of the nature of mathematics and its role in sciences necessarily requires a fundamental understanding of the worldviews underlying the views expressed with respect to the nature of mathematics and its role. Four general views with respect to mathematics and its role in sciences, corresponding to four broad worldviews, are discussed. These four views with respect to the nature of mathematics and its role are equally scientific and informative; each looks at the nature of mathematics and its role from a certain paradigmatic viewpoint.

The paper takes the case of mathematics as an example and emphasizes that, in general, any phenomenon may be seen and analyzed from different viewpoints and that each viewpoint exposes a certain aspect of the phenomenon under consideration. Collectively, they provide a much broader and deeper understanding of the phenomenon. Therefore, academic finance can benefit much from contributions coming from other paradigms if it respects paradigm diversity.

Any adequate analysis of the role of paradigms in social theory must recognize the assumptions that underwrite that paradigm or worldview. Social theory can usefully be conceived in terms of four key paradigms:

(1) Functionalist.
(2) Interpretive.
(3) Radical humanist.
(4) Radical structuralist.

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The four paradigms are founded upon different views of the social world. Each generates theories, concepts, and analytical tools which are different from those of other paradigms.

The four paradigms are based on different assumptions about; the nature of social science (i.e. the subjective-objective dimension), and the nature of society (i.e. the dimension of regulation-radical change), as in Figure 1 (see Burrell and Morgan, 1979). This can be used as both a classificatory device, or more importantly, as an analytical tool.

The paper is organized as follows. Each section, first, lays down the foundation by discussing one of the four paradigms. Then, it presents the nature of mathematics and its role from the point of view of the paradigm under consideration.

## The functionalist paradigm

In Figure 1, the functionalist paradigm occupies the southeast quadrant. Schools of thought within this paradigm can be located on the objective-subjective continuum. From right to left they are:

- objectivism;
- social system theory;
- integrative theory;
- interactionism; and
- social action theory.

The functionalist paradigm assumes that society has a concrete existence and follows certain order. These assumptions lead to the existence of an objective and value-free social science that can produce true explanatory and predictive knowledge of the reality out there. It assumes that scientific theories can be assessed objectively by reference to empirical evidence. Scientists do not see any roles for themselves within the phenomenon that they analyze through the rigor and technique of the scientific method. It attributes independence to the observer from the observed. That is, an

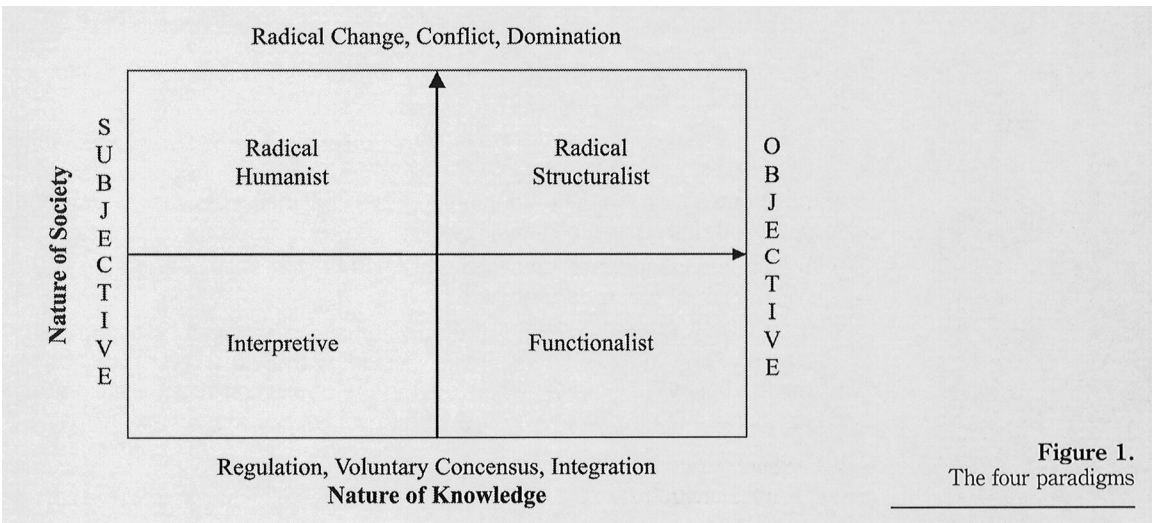


**Figure 1.**
The four paradigms

ability to observe "what is" without affecting it. It assumes there are universal standards of science, which determine what constitutes an adequate explanation of what is observed. It assumes there are external rules and regulations governing the external world. The goal of scientists is to find the orders that prevail within that phenomenon.

The functionalist paradigm seeks to provide rational explanations of social affairs and generates regulative sociology. It emphasizes the importance of understanding order, equilibrium and stability in society and the way in which these can be maintained. Science provides the basis for structuring and ordering the social world, similar to the structure and order in the natural world. The methods of natural science are used to generate explanations of the social world. Their approach to social science is rooted in the tradition of positivism.

Functionalists are individualists. That is, the properties of the aggregate are determined by the properties of its units.

The functionalist paradigm has become dominant in academic sociology and mainstream academic finance. The world of finance is treated as a place of concrete reality, the individual is regarded as taking on a passive role; his or her behavior is being determined by the economic environment.

Theories and policies in current mainstream academic finance may be listed[1] as follows:

- efficient market theory;
- portfolio theory;
- capital asset pricing theory;
- option pricing theory;
- agency theory;
- arbitrage pricing theory;
- capital budgeting policy;
- capital structure policy; and
- dividend policy.

Bettner *et al.* (1994) note that the common threads among theories in mainstream academic finance are:

- there is a cause and effect mechanism underlying all nature and human activity (ontology);
- it is known through the set of nomological connections between initial conditions and final outcomes (epistemology);
- human beings interact with each other and their society in accordance with this mechanism (human nature); and
- information regarding all natural and human activity can be acquired through observations and measurements unaffected by individual perceptual differences (methodology)[2] (page 3), which lead to the conclusion that the current theories in finance are clearly based on the functionalist paradigm.

Functionalists' views with respect to the nature of mathematics and its role in science are presented next[3].

Mathematics is regarded as a language, a universal instrument of representation. The universe is mathematical in structure and behavior, and nature acts in accordance with general laws. Mathematics is a neutral medium into which all statements of each theory, and the statements of all theories, can be translated without modifying them. Mathematics, in this way, is devoid of content. That is, as a result of the conceptual neutrality of the methods and procedures of mathematical formalization, the object of analysis are unaffected by their mathematical manipulation.

Mathematics is uniquely capable of interpreting theory with its ability to separate the rational from the vague intuitional, the essential from the inessential. It is the unique standard of logic, consistency, and proof. Once intuitions are formed, mathematical models can be constructed which prove or disprove the logical consistency of the theory. Other languages are incapable of doing this because the operations of mathematics have an essential truth that other languages do not possess. Mathematics is more important than other languages in that it is uniquely capable of generating truth statements and that it has no impact on what is being thought and communicated. Mathematical statements are based on the necessity of arriving at conclusions as a result of following mathematical rules.

Mathematics eliminates the noise by agreeing on the meaning of symbols that otherwise would vary from one use to another. That is, everyone agrees to recognize the same symbol.

The notion of mathematics as a special code is linked, in turn, to the twin pillars of traditional epistemology: empiricism and rationalism.

Empiricists consider mathematics as a universal instrument of representation. It is used as a tool to express the statements of a discourse that already, always has an essential grasp on the real. It is the universal language by which statements about objects of different economic and social theories can all be expressed.

Theory is compared to the facts in order to examine its validity. The role of mathematics is to express the various intuitive statements of the theorist in a neutral language such that they can be measured against reality.

This is based on the traditional subject-object dichotomy: the passive subject and the active object impressing itself on the knowing subject. The theorist knows how the world works by observing it. He/she then translates the description into a model to check its consistency, its logical thoroughness, and so on. Mathematics merely represents, in a different language, that which was already present in the pre-mathematical intuition.

Rationalists consider logic as the foundation of mathematics and use mathematics for logical abstraction. Thus, the use of formal, mathematical methods is a necessary, although not sufficient, condition for arriving at scientific propositions. Mathematical models are conceived as abstract images or ideal representations of a complex reality. The process of theorizing is identified with the initial elaboration of, and deductive operations on, a set of mathematical models.

Here the subject becomes the active participant in discovering knowledge by operating on the theoretical model of reality. In this sense, the logical structure of theory – not the correspondence of theory to the facts – becomes the privileged or absolute standard of the process of theorizing. Reality, in turn, is said to correspond to the rational order of thought. The laws that govern reality are deduced from the

singular set of mathematical models in and through which the essence of reality can be grasped.

Both empiricists and rationalists conceive of mathematics as a neutral language and as the language singularly privileged over all others. They represent two sides of the same epistemological coin: although each reverses the order of proof of the other, both empiricism and rationalism presume the same fundamental terms and some form of correspondence between them. In this sense, they are variant forms of an essentialist conception of the process of theorizing. Both of them invoke an absolute epistemological standard to guarantee the singular, unique scientific production of knowledge.

## The interpretive paradigm

In Figure 1, the interpretive paradigm occupies the southwest quadrant. Schools of thought within this paradigm can be located on the objective-subjective continuum. From left to right they are:

- solipsism;
- phenomenology;
- phenomenological sociology; and
- hermeneutics.

The interpretive paradigm sees the social world as a process that is created by individuals. Social reality, insofar as it exists outside the consciousness of any individual, is regarded as being a network of assumptions and inter-subjectively shared meanings. This assumption leads to the belief that there are shared multiple realities which are sustained and changed. Researchers recognize their role within the phenomenon under investigation. The goal of the interpretive researchers is to find the orders that prevail within the phenomenon under consideration; however, they are not objective.

The interpretive paradigm believes that in cultural sciences, the subject matter is spiritual in nature. In the cultural sphere, human beings are perceived as free. An understanding of their lives and actions can be obtained by the intuition of the total wholes. Cultural phenomena are seen as the external manifestations of inner experience. The cultural sciences, therefore, need to apply analytical methods based on "understanding"; through which the scientist can seek to understand human beings, their minds, and their feelings, and the way these are expressed in their outward actions.

The interpretive paradigm believes that scientific knowledge is socially constructed and socially sustained; its significance and meaning can only be understood within its immediate social context. Interpretive finance research enables scientists to examine aggregate market behavior together with ethical, cultural, political, and social issues. The interpretive paradigm believes that there are no universally valid rules of finance and financial management.

Interpretive research in academic finance is negligible compared to the functionalist research. The following is a list of examples of interpretive research:

- Baker (1992);
- Baker and Wruck (1989);

- Cray and Haines (1992);
- Frankfurter and Lane (1992);
- Kryzanowski and Roberts (1993a, b);
- Lintner (1956);
- O'Barr and Conley (1992); and
- Rosen (1990).

Interpretive paradigm's views with respect to the nature of mathematics and its role in science are presented next[4].

Mathematics is regarded as an anthropological phenomenon. The foundations of mathematics are the psychological, social, and empirical facts upon which the structure of knowledge is actually raised. Mathematics is the product of instinct, training, and convention. Mathematics is invented rather than discovered.

The compelling force of mathematical procedures does not derive from their being transcendent, but from their being accepted and used by a group of people. The procedures are not accepted because they are correct, or correspond to an ideal; they are correct because they are accepted. Mathematical truth is established by agreement, that is, it is agreed upon as a rule. The basis and cause of these agreements are not matters to be settled by a priori reflection. They must be investigated empirically: one might give an ethnological account of this human institution.

The belief in mathematical essence is a reified perception of social processes. The conventional aspects of the techniques become transmitted in the consciousness into something mysterious. This is the form taken in our consciousness by the social discipline imposed upon their use. It is as if the work that society puts into sustaining a technique returns to its users in the phenomenological form of an essence. The reality behind mathematical techniques is the reality that society has a use for certain techniques: it is an ethnological fact – it is something to do with the way the society lives.

Simple calculations are grounded in certain techniques and the physical and psychological facts that make the techniques possible. But calculations do not state these conditions; they take them for granted.

Of all the indefinitely large number of techniques for manipulating objects that exist, society selects those that provide useful patterns. The operations and techniques that are chosen, and which become memorable patterns, are the ones that become central to the training given to children.

What mathematical techniques for manipulating objects and symbols do is to produce one structure out of another. They are used as paradigm identity but their experimental character disappears when one looks at the process simply as a memorable picture. They are used to define the essential features of a change and see them as yielding relations that are not merely contingent: the calculation are regarded as demonstrating an internal property, a property of the essence.

The emergence of the mathematical out of the physical occurs when the empirical manipulations are put to a certain use; when they become part of a certain technique, and when they become subject to certain conventions and norms.

Starting from the idea of a calculation as a kind of experiment that becomes frozen into a criterion of identity, one may imagine a gradual widening of the range of

experimental procedures so treated. The range of models that might be taken up from experience, and turned into paradigms of identity, has no known limits. What can be said, however, is that available models are exploited by assimilating novelties and problematic cases to them. Models are made applicable to new cases by analogies seen between them. A proof goes in fact step-by-step by means of analogy – by the help of paradigm. Mathematical conviction might be put in the form of recognizing "this as analogous to that." The word "recognize," here, does not mean acknowledging a pre-existing fact: it indicates the acceptance of a convention. The reason proofs are of interest is that it is so easy to reproduce them again and again in different objects. The proof exhibits the generation of one from others.

The proof changes society's concepts. It makes new connections, and it creates the concept of these connections. A sentence asserting an internal relation between two objects, such as mathematical sentences, is not describing objects but constructing concepts. One does not have to accept the conventions thus created. What is regarded by one person as essential may be regarded by another as inessential. They may put an opposite construction on it. But if one does that, one is enabled to recognize one thing as analogous to another. One should not look at a proof as a procedure that is compelling, but as one that is guiding.

**The radical humanist paradigm**

In Figure 1, the radical humanist paradigm occupies the northwest quadrant. Schools of thought within this paradigm can be located on the objective-subjective continuum. From left to right they are:

- solipsism;
- French existentialism;
- anarchistic individualism; and
- critical theory.

The radical humanist paradigm assumes that reality is socially created and sustained. It provides critiques of the status quo. It tends to view society as anti-human. It views the process of reality creation as feeding back on itself; such that individuals and society are prevented from reaching their highest possible potential. That is, the consciousness of human beings is dominated by the ideological superstructures of the social system, which results in their alienation or false consciousness. This, in turn, prevents true human fulfillment. The social theorist regards the orders that prevail in the society as instruments of ideological domination. The major concern for theorists is with the way such ideological domination occurs and finding ways in which human beings can release themselves. They seek to change the social world through a change in consciousness.

Radical humanists believe that everything must be grasped as a whole, because the whole dominates the parts in an all-embracing sense. Moreover, truth is historically specific, relative to a given set of circumstances, so that one should not search for generalizations for the laws of motion of societies.

The focus of the radical humanists upon the "superstructural" aspects of society reflects their attempt to emphasize the Hegelian dialectics. It is through the dialectic that the objective and subjective aspects of social life interact. The superstructure of society is believed to be the medium through which the consciousness of human beings

is controlled and molded to fit the requirements of the social formation as a whole. The radical humanists emphasize the political and repressive nature of purposive rationality, logic of science, positive functions of technology, and neutrality of language.

Radical humanist research in academic finance is non-existent. Examples of radical humanist research, although not even mentioned in academic finance, are:

- Biewener (1999, 2000);
- Cullenberg (1994, 1997, 2000);
- Perelman (1987, 1993, 1999); and
- Tinker *et al.* (1982).

Radical humanists' views with respect to the nature of mathematics and its role in science are presented next[5].

Mathematics is regarded as constituting the core of modern science with its rational, methodical, calculating nature. Modern science has lead to the rationalization of society. Rationalization means the extension of the areas of society subject to the criteria of rational decision. It refers to either the organization of means or choice between alternatives. Planning can be regarded as purposive-rational action at a higher order. It aims at the establishment, improvement, or expansion of systems of purposive-rational action themselves.

The rationalization of society is linked to the institutionalization of scientific and technical development. To the extent that science and technology spread through social institutions and transform them, old legitimations are destroyed.

Rationalization realizes not rationality as such but rather, in the name of rationality, a specific form of unacknowledged political domination. This type of rationality removes the total social framework of interests in which strategies are chosen, technologies applied, and systems established from the scope of analysis. Moreover, this rationality extends only to relations of possible technical control and therefore requires a type of action that implies domination, whether of nature or of society. By its very nature, purposive-rational action is the exercise of control. Rationalization is the institutionalization of a form of domination whose political character becomes unrecognized. However, the technical reason of a social system of purposive-rational action does not lose its political content.

The concept of technical reason is ideological. Not only the application of technology but technology itself is domination, of nature and men. Purposes and interests of domination are not imposed upon technology subjectively and from the outside; they enter the very construction of the technical apparatus. Technology is a historical social project. It reflects what a society and its ruling interests intend to do with men and things.

The growth of the forces of production following from scientific and technical progress surpasses all historical proportions. The ruling class takes advantage of it for legitimizing the existing relations of production. These present themselves as the technically necessary organizational form of a rationalized society. At this stage of their scientific-technical development the forces of production appear to reinforce the relations of production. They no longer function as the basis of a critique of prevailing legitimations in the interest of the ruling class, but become instead the basis of legitimation.

The scientific method, with mathematics at its core, which led to the increasing domination of nature provided the pure concepts as well as the instrumentalities for the increasing domination of man by man through the domination of nature. Now, domination recreates and extends itself not only through technology but as technology, and this provides the legitimation of the expanding political power, which affects all aspects of culture.

Rationalization demonstrates the technical impossibility of one being autonomous, of determining one's own life. For this inability appears neither as irrational nor as political, but rather as submission to the technical apparatus which enlarges the comforts of life and increases the productivity of labor. Technological rationality thus protects the legitimacy of domination and leads to a rational totalitarian society.

Nature, scientifically comprehended and mastered, reappears in the technical apparatus of production that sustains and improves the life of the individuals while subordinating them to the masters of the apparatus. Then the change in the direction of progress, which would require severing this link, would also affect the very structure of science, i.e. the scientific project. Its hypotheses, without losing their rational character, would develop in an essentially different context, would arrive at essentially different concepts of nature, and would establish essentially different facts.

## The radical structuralist paradigm

In Figure 1, the radical structuralist paradigm occupies the northeast quadrant. Schools of thought within this paradigm can be located on the objective-subjective continuum. From right to left they are:

- Russian social theory;
- conflict theory; and
- contemporary Mediterranean Marxism.

The radical structuralist paradigm assumes that reality is objective and concrete. It uses scientific methods to find the order that prevails in the phenomenon. It views society as a potentially dominating force.

This paradigm is based on four central notions. First, there is the notion of totality. This notion emphasizes that the totality shapes and is present in all its constituent parts. Second, there is the notion of structure. The focus is upon the configurations of social relationships, called structures. The third notion is that of contradiction. Structures, or social formations, contain contradictory and antagonistic relationships within them that act as seeds of their own decay. The fourth notion is that of crisis. Contradictions within a given totality reach a point at which they can no longer be contained. The resulting political and economic crises indicate the point of transformation from one totality to another, in which one set of structures is replaced by another of a fundamentally different nature.

To survive and reproduce themselves, human beings transform reality, where material reality is the most important. This transformation takes place through the social division of labor. This division implies that social groups enter into relations with each other to produce, while they use means of production. That is, they enter into production relations. These groups, formed in terms of production relations, are called social classes. A complete definition of a social class encompasses economic, political, and ideological elements, with dialectical relationships. Production relations, under

capitalism, are antagonistic, since they unite two antagonistic poles, defined as owner and non-owner. Therefore, social classes, who are the carriers of contradictory aspects of social relations, are antagonistic too.

Transforming material requires knowledge of doing it. Gaining knowledge of doing it requires dealing with it, i.e. transforming it. This is the materialist basis of epistemology, i.e. science has a materialist nature. Therefore, only classes, identifiable in terms of production relations, have the objective possibility of an independent knowledge of reality. Furthermore, the class that deals with a larger portion of reality, has the greater objective possibility of gaining a correct knowledge of it. Under capitalism, the proletariat[6], which deals with an increasing portion of social reality, has the objective possibility of knowing it correctly. In the context of the constant attempt that classes make to dominate each other, it can only realize itself through ideological class struggle. Knowledge is, thus, in the most fundamental sense, ideological, since it formulates views of reality and solves problems from a class point of view.

Radical structuralist research in academic finance is non-existent. The literature in this area has been, historically, quite extensive, although there has been no mention of its existence in academic finance. Some examples of radical structuralist research are:

- Gill (1999);
- Magdoff and Sweezy (1987);
- Sweezy (1964, 1994, 1997); and
- Sweezy and Magdoff (1972).

Radical structuralists' views with respect to the nature of mathematics and its role in science are presented next[7].

Mathematics is regarded as one of constituents of the social superstructure. It is determined by the social base and affected as one of the constituents of the social superstructure. Mathematics, in turn, influences the social base and the other constituents of the social superstructure. As a matter of fact, mathematics has been influenced by and has influenced agriculture, commerce, manufacture, warfare, engineering, philosophy, physics, and astronomy.

Take the case of calculus, perceiving that it deals with the most profound kernel of the dialectical process, with the essence of change. The invention of calculus, much as the birth of all modern science, followed closely on the birth of capitalism. The great renaissance of commerce and industry in Europe, accompanied by the rise of the capitalist class in the fifteenth, sixteenth, and seventeenth centuries, began to exercise a tremendous influence on mathematics. With the discovery of analytic geometry and the function concept and the invention of calculus, mathematics was transformed from a science of constant quantities to the mathematics of varying quantities.

The introduction of mechanical tools of production, from windmills and cranes to water pumps and machines to drill stones, the development of oceanic navigation, new military techniques, and the natural sciences in general demanded new knowledge – necessitating means of analyzing and calculating motions, i.e. projections, free fall, planetary motion, accelerated motion, etc.

The mathematics of varying quantities constituted the mathematical response to this external stimulation, further enriched by the study of problems arising from the technical, inner development of mathematics, such as the study of abstract curves and

surfaces, including the so-called tangent problem. The mathematics of varying quantities represents the response of mathematics to a profound problem – the analysis of motion.

The socioeconomic pressure to discover adequate mathematical methods makes it easy to understand that the invention of calculus could not have been the work of one or another isolated genius. It was the culmination of the work of four generations of mathematicians. It was through joint work and mutual discussion that they created the differential and integral calculus.

This mathematical tool rapidly won new successes in astronomy and practical applications such as artillery, construction, of fortifications and hydraulics, such as water wheel, turbines, shape of ship hulls, etc.

The refinements of the concepts of calculus in the nineteenth century similarly continued. The French revolution and the Napoleonic period created extremely favorable conditions for the development of mathematics, particularly in France, where there was the greatest ideological break with the past era. A whole series of new technical and scientific problems arose from the industrial revolution, such as the problem of construction of machine parts, transmission of force, friction, precision mechanics, and energy. This brought about a closer linkage between physicists and a number of mathematicians with material production.

At the same time, the concentration of workers in growing industrial cities gave rise to problems of supply of food, water, home heating materials, and problems of street lighting, construction of building, etc. The resolution of these and other problems – to service the process of capitalist production – obliged the natural sciences and mathematics to develop in the corresponding direction.

In general, to a materialist mathematics can be significant and relevant only when it reflects processes of the real world. Its application gains more relevance in a comprehensive study of a phenomenon.

In economics, mathematics may be used to avoid computational errors, to express the economic phenomena in an algebraic form, to grasp the dynamics of economic processes, to deepen the analysis of political economy, and to raise the scientific level of political economy because a science is really developed only when it successfully made use of mathematics.

## Conclusion

This paper briefly discussed four views expressed with respect to the nature of mathematics and its role in sciences. The functionalist paradigm views mathematics as discoveries about a special realm of objects that exist prior to our knowledge of them. The interpretive paradigm views mathematics as a social invention and mathematical proofs as only one part of a larger social process whereby mathematicians come to feel confident about a theorem. The radical humanist paradigm views mathematics as constituting the core of science and that the rationality of science and technology is immanently one of control: the rationality of domination over nature and man. The radical structuralist paradigm views mathematics as being historically specific and class determined, that is, to satisfy the requirements of a social class in an historical period.

This paper noted that scientists often approach their subject from a frame of reference based upon assumptions that are taken-for-granted. Since these assumptions

are continually affirmed and reinforced, they remain not only unquestioned, but also beyond conscious awareness. In this way, most researchers in academic finance tend to favor the functionalist paradigm and its views with respect to the nature of mathematics and its role in sciences.

The partial nature of this view only becomes apparent when the researcher exposes basic assumptions to the challenge of alternative ways of seeing, and starts to appreciate these alternatives in their own terms. To do this, one has to explore other paradigms from within, since the concepts in one paradigm cannot easily be interpreted in terms of those of another. Once each view of mathematics is seen from within the respective paradigm, all four views of mathematics are seen to be equally scientific and informative; they look at the nature of mathematics and its role in sciences from a certain paradigmatic viewpoint.

The diversity of finance research possibilities referred to in this paper is vast. While each paradigm advocates a research strategy that is logically coherent, in terms of underlying assumptions, these vary from paradigm to paradigm. The phenomenon to be researched can be conceptualized and studied in many different ways, each generating distinctive kinds of insight and understanding. There are many different ways of studying the same social phenomenon, and given that the insights generated by any one approach are at best partial and incomplete, the social researcher can gain much by reflecting on the nature and merits of different approaches. It is clear that social scientists, like other generators of knowledge, deal with the realization of possible types of knowledge, which are connected with the particular paradigm adopted.

The paper, therefore, recommends a serious conscious thinking about the social philosophy upon which finance is based and of the alternative avenues for development. The knowledge of the four paradigms is of paramount importance to any scientist, because the process of learning about a favored paradigm is also the process of learning what that paradigm is not. The knowledge of paradigms makes scientists aware of the boundaries within which they approach their subject. Each of the four paradigms implies a different way of social theorizing in general, and finance, in particular.

Academic finance can gain much by exploiting the new perspectives coming from other paradigms. An understanding of different paradigms leads to a better understanding of the multi-faceted nature of finance. Although a researcher may decide to conduct research from the point-of-view of a certain paradigm, an understanding of the nature of other paradigms leads to a better understanding of what one is doing.

Knowledge of finance is ultimately a product of the researcher's paradigmatic approach to this multifaceted phenomenon. Viewed from this angle, the pursuit of financial knowledge is seen as much an ethical, moral, ideological, and political activity, as it is a technical one.

## Notes

1. For overviews of the finance literature, see Smith (1990), Brennan (1995), and Weston (1994).
2. See Bettner *et al.* (1994) and McGoun (1992) for more complete treatments.
3. For classics in this section see Frege (1959) and Russell (1990). Also see Ewald (1996), Hale (1999), Peressini (1999), and Urquhart (1999).

4. For classics in this section see Wittgenstein (1964, 1967, 1976). Also see Carson (1999), Divers (1999), Ewald (1996), Joseph (1998), Lehrer (1999), and Urquhart (1999).
5. For classics in this section see Marcuse (1964, 1968, 1970). Also see Garrison (1999), Smith and Plotnitsky (1997), and Sherratt (1999).
6. The proletariat is defined as all the individuals who participate in the transformation of material, i.e. in the transformation of the social product, while not owning the means necessary for this transformation.
7. For classics in this section see Struik (1948, 1987). Also see Charlton (1994).

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