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**OVERVIEW OF ISSUES RAISED AT THE
IUI SEMINAR "CAPITAL: ITS VALUE, ITS
RATE OF RETURN AND ITS
PRODUCTIVITY"**

by

Michael D. Intriligator

Paper presented at the IUI seminar on **Capital; its Value, its Rate of Return and its Productivity**, at Saltsjöbaden, Stockholm, in March 5–6, 1991. The seminar was held in honour of Techn. Dr. Curt Nicolin, Chairman of the IUI board, on his 70th birthday.

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**OVERVIEW OF ISSUES RAISED AT THE IUI SEMINAR "CAPITAL: ITS
VALUE, ITS RATE OF RETURN AND ITS PRODUCTIVITY"**

by

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The international seminar "CAPITAL: ITS VALUE, ITS RATE OF RETURN AND ITS PRODUCTIVITY," sponsored by IUI, the Industrial Institute for Economic and Social Research, and held in Stockholm March 5-6, 1991, included papers by economists from Sweden, the United Kingdom, and the United States. The topics treated at the seminar covered much of capital theory and used a variety of methodologies, including pure theory, industrial organization, econometrics, microsimulation modeling, and comparative case studies. While there have been seminars and resulting publications on various specialized topics related to capital theory, one would have to go back thirty years, to the International Economic Association conference on capital theory, held on the island of Corfu and published as the 1961 IEA book *The Theory of Capital*, edited by F. A. Lutz and D. C. Hague, to find a comparable meeting and publication dealing with the broad range of issues covered at the IUI seminar.

This paper provides a summary overview of the issues treated at the seminar, their interrelationships, some of the principal findings of the seminar, and some cross-cutting questions that will continue to be of concern to economists and others in their study of capital and its role in the economy. It is organized into five broad issue areas, each posed as a question: (1) What is capital and how is it measured? (2) How is capital

valued? (3) What is the economic life of capital? (4) What is the rate of return on capital? and (5) What is the productivity of capital?

1. What is Capital and How is It Measured?

The issue of capital and its measurement is one with a long and rich history in economics. The basic concept of capital has occupied the attention of some of the greatest economists, as can be seen just from the titles of Adam Smith's *Inquiry into the Nature and Causes of the Wealth of Nations* (1776) and Karl Marx's *Das Kapital* (1867; volumes 2 and 3 published posthumously in 1885 and 1894). Capital theory was a principal concern of such classical economists as David Ricardo in *On the Principles of Political Economy and Taxation* (1817) and John Stuart Mill in *Principles of Political Economy* (1848), who were concerned with the process of accumulation; through the Austrian school, as represented in Eugen Böhm-Bawerk in his *Positive Theory of Capital* (1889), which focused attention on the period of production; to the marginalist school, as in John Bates Clark's *Distribution of Wealth* (1899), which elaborated the marginal productivity theory of distribution. There is also a rich Swedish tradition in the study of capital, as represented in two influential books by Knut Wicksell, *Über Wert, Kapital und Rente* (1893), translated as *Value, Capital and Rent* (1954), and *Geldzins und Güterpreise* (1898), translated as *Interest and Prices* (1936).

In addressing the questions of what capital is and how it is measured, it is first necessary to distinguish various types of capital. A first distinction can be made between financial capital and real capital. *Financial capital* is represented by financial instruments of equity and debt, items on the balance sheet of a firm. By contrast, *real capital* to an economist represents a stock of produced items which are durable and which are themselves inputs into the production of goods and services. The two are

clearly interrelated in that, for example, financial capital in the form of capital stock, bonded indebtedness, and loans is used by corporations and other business entities to finance the acquisition of the real capital needed to produce goods and services. Nevertheless the two types of capital are conceptually distinct.

Real capital can itself be divided into physical capital and human capital. *Physical capital* in market economies includes both *private capital*, taking the form of machinery, plant, equipment, inventories, etc. and *public capital or infrastructure*, taking the form of roads, airports, harbors, water systems, etc. *Human capital*, a concept pioneered by Theodore W. Schultz and summarized in Schultz (1970), includes education and on the job training, which have properties similar to investments in machinery and plant and equipment in yielding durable assets which are inputs to the production process. Human capital has usually been applied to workers, the labor input in the production function. A newer and more controversial concept of capital that is being pioneered at IUI is that of *economic or managerial competence*, which can be treated conceptually as the extension of the concept of human capital from workers to managers. Each type of capital is itself heterogeneous, giving rise to problems of measurement.

Most of these types of capital were treated in papers presented at the IUI seminar. Private physical capital, as represented by depreciable assets used in the business sector, is largely the subject of Charles Hulten's paper, "The Measurement of Capital," which develops a theoretical framework to answer the question of how capital can be measured and aggregated in terms of its level and productivity.

Public infrastructure capital is the subject of the paper by Ernst Berndt and Bengt Hansson, "Measuring the Contribution of Infrastructure

Capital in Sweden." They attempt to measure the level and growth of such capital, and they go on to compare its level to an optimum level of such capital, asking how the ratio of optimal to actual social overhead capital varied in Sweden over the years 1960 to 1988.

The newer concept of economic competence is explored in the paper by Gunnar Eliasson and Paulus Braunerhjelm, "The Nature and Value of Capital." They ask how one can measure the "soft capital" represented by economic competence and determine its impacts on the rate of return and productivity. They have obtained some preliminary estimates of the level of invisible capital in the 17 largest Swedish manufacturing firms, working closely with the firms themselves, and have found that such capital which is, in principle, measurable (excluding soft capital in the form of entrepreneurial and innovative competence) accounts for about half of the total measurable capital. Thus the measurable component of soft capital is itself as large as visible capital in the form of machines, buildings, inventories, etc. The 50 per cent of measurable capital in the form of soft capital is itself disaggregated in their sample of Swedish firms into marketing knowledge (19 per cent of the total), technical knowledge (16 per cent of the total), educational capital (8 per cent of the total), and software (7 per cent of the total). Further work along these lines, aimed at conceptualizing, measuring, and determining the impacts of economic or managerial competence, will be the subject of a future research project at IUI.

2. How is Capital Valued?

Once capital is conceptualized and measured, the next step is to determine its value. Again, this is the subject of much prior work in economics, including John R. Hicks's *Value and Capital* (1946).

Two approaches can be distinguished in determining the value of

capital. One is the *internal valuation*, as represented by the present discounted value of the expected future benefits, net of costs, over the lifetime of the capital. Such an approach to capital valuation can be applied, in principle, to all forms of capital, including physical capital, in the form of private or public capital, and human capital.

The alternative approach to capital valuation is via markets, where the value is determined by the interaction of demand and supply on capital markets. There are, however, various types of markets for capital. One is the *informed market*, such as the market for new or used machinery, where both buyers and sellers are fully informed as to the capital being bought or sold. In a perfectly competitive informed market the value of owning an asset is equal to its internal valuation. Second is the so-called *market for lemons*, in which there is asymmetric information as between buyer and seller. (The name comes from the used car market in the U.S., where, due to less information available to the buyer as to the car and its record of maintenance, prior crashes, etc., he or she can end up with a "lemon," a car which functions poorly) The market for lemons, studied in Akerlof (1971), could apply to markets for various types of capital. A third type of market is that of *thin markets*, where there are few buyers or sellers, leading to isolated bargaining among market participants. In the extreme case there can be a total absence of markets, as in pure socialism (without black markets), where markets for capital may be outlawed.

The implications of alternative market structures are treated in Pavel Pelikan's paper, "Efficient Institutions for Ownership and Allocation of Capital." He raises broad questions about ideal market structures, following the tradition of such works as Joseph Schumpeter's *Capitalism, Socialism, and Democracy*, which are of enormous current relevance in terms of the

movements to market economies in the East Central European nations of Czechoslovakia, Hungary, and Poland; the challenges of integrating the former German Democratic Republic into a unified German state; the continuing problems of the Yugoslav economy; and, above all, the question of the future path of the Soviet economy. Pelikan considers how capital markets or their absence, in a socialist economy, the extreme case of thin markets, influence decisions with regard to the allocation of capital and the organization of production and the resulting implications for economic performance.

3. What is the Economic Life of Capital?

The durability of real capital leads to the issue of how long it lasts. Conceptually, it is possible to distinguish, as is done in Charles Hulten's paper, between *capital deterioration*, a physical concept, and *capital depreciation*, an economic concept.

Markus Asplund's paper, "The Depreciation of Machinery," raises the conceptual issue of the proper rate of depreciation of machinery and its application to Swedish industry. He treats, in particular, the fact that the second-hand market for used machinery tends to function poorly due to high transactions costs and thus is a thin market, with few buyers and sellers. The result is that at the end of its economic lifetime most machinery (as much as 80 percent) is scrapped rather than sold on a second-hand market. As a consequence there is a bias, based on the valuation of that machinery which is sold, as opposed to scrapped, in the depreciation of this form of capital. As a result of this bias machinery tends to be significantly overvalued. It might be noted that one implication of this overvaluation is that buyers may be asking too high a price for machinery, leading to few sales, thin markets, and thereby a feedback type of reinforcement of the

bias in understating depreciation and thus in overestimating the value of capital in the form of machinery.

4. What is the Rate of Return on Capital?

Having conceptualized and measured capital and having determined its value and economic lifetime, the next challenge is to determine its rate of return. The *rate of return on capital* is the flow of income stemming from the stock of capital, expressed, for example, as its annual yield over its lifetime. This rate of return depends on many factors. One, for example, is the composition of capital, as in the Eliasson-Braunerhjelm distinction between "soft" capital and other forms of capital. Among the many other factors determining the rate of return on capital are taxes, the actions of rival firms, and the financial markets.

Two papers treat the influence of taxes on the rate of return on capital. Karl-Markus Modén's paper, "Taxes and Growth by Acquisitions," asks how taxes influence the structure of industry and industrial growth via internal expansion or via mergers and acquisitions and thus influence the return on capital. Vesa Kannianen and Jan Söderström, in their paper, "Corporate Taxation Reconsidered: Monitoring Costs, Accelerated Depreciation, and Expectations," treat the issue at the level of the firm by addressing the puzzle as to why Nordic firms in Sweden and Finland do not exhaust their tax debt capacity and thus fail to make use of what is, in effect, an interest-free loan. They develop a model of monitoring costs, where suppliers of financial capital, whether stockholders or lenders, incur certain costs in monitoring the management of the firm.

The influence of rival firms on the rate of return to capital is the subject of Kenneth Burdett's paper, "Declining an Advantage." He uses a two-seller duopoly model to ask how a new entrant firm would optimally

make decisions affecting capital structure, such as its location and product quality, given the choices made by the established firm.

Financial markets, particularly the stock market, are the subject of Clas Wihlborg's paper, "Are Financial Markets Forcing Myopic Investment Decisions?" He asks whether financial markets force myopic short-term oriented investment decisions, thereby distorting the size and distribution of capital, its allocation, its lifetime, and its rate of return.

5. What is the Productivity of Capital?

The last set of issues treated relate to the productivity of capital, which is connected to its nature, measurement, value, lifetime, and rate of return. A traditional measure of productivity is labor productivity, as measured by output per worker and its rate of change. Of particular interest is how capital, as a complementary factor in the production process, can increase labor productivity. A newer measure of productivity is multifactor (or total factor) productivity, which treats the growth of output after adjusting for the growth of both labor and capital. This measure goes back to Jan Tinbergen's work on productivity in the 1940's, but it was refined in the 1950's and 1960's in connection with the identification and measurement of the "residual" as that part of output growth not attributable to the growth of inputs of labor and capital and the ensuing development of "growth accounting" in the work of Solow (1957), Salter (1960), Kendrick (1961), Denison (1962), Jorgenson and Griliches (1967), Christensen and Jorgenson (1969, 1970, 1973), and others.

Thomas Lindh, in his paper, "Productivity Deceleration when Technical Change Accelerates," tries to explain a central puzzle of growth accounting: the observed slowdown in productivity growth, as discussed in Denison (1979), Bailey (1981), Fischer (1988), Griliches (1988), Jorgenson (1988),

and Abramowitz (1990). In particular, he attempts to explain how the slower rates of growth of labor productivity starting in the late 1960's, as compared to their earlier rates of growth in the 1950's and early 1960's, could be reconciled with accelerating technical change, as witnessed, for example, in the widespread use of computers and electronics in industry. He uses a theoretical model of vintage capital, originally developed in Johansen (1959) and used to explain productivity and economic growth in Solow (1960, 1962), Salter (1960, 1965), and others in order to explain this puzzle. His explanation is based on extensive scrapping of old vintage machines as compared to the level of new investment and the increasing costs of transferring labor to new investment. The capacity distribution at the margin of obsolescence turns out to be of decisive importance in his model. His explanation is related to the classical question as to when to introduce a new machine to replace an old machine, where, at the *Pigou point* of indifference between keeping the old machine or replacing it, the average cost of the new machine equals the marginal cost of the old machine.

Bo Carlsson and Erol Taymaz, in their paper, "The Role of Technological Progress and Economic Competence in Economic Growth: A Micro-to-Macro Analysis," use the newer concept of economic competence at the level of the firm to study macroeconomic growth in the context of the IUI microsimulation model MOSES.

Finally, Michael Boskin, Chairman of the U.S. Council of Economic Advisers in President Bush's administration, and Lawrence Lau, in their paper, "Capital and Productivity: A New View," ask how much of the observed output growth in the U.S., Japan, Germany, France, and the U.K. can be attributed to capital formation and technical change, as opposed to labor growth. They find that over 70 percent of the output change in the U.S. can be

attributed to capital formation and technical change, while over 95 percent of growth in other four OECD nations can be so attributed to capital formation and technical change. This result is, in the opinion of the discussant of the paper, Ragnar Bentzel, "stupendous." They also find that capital growth is capital saving, rather than labor saving, and thus does not by itself lead to (labor) unemployment. Furthermore, they find that technical progress is capital augmenting, rather than labor augmenting, as is usually assumed in the literature on economic growth. Such capital augmenting technical progress has implications that are different from those of labor augmenting technical progress, including, in particular, the possible non-existence of a long-run steady state. Their new methodology also suggests that overall economy-wide production exhibits decreasing returns to scale, so that, for example, doubling inputs leads to a less than doubling of output, and that the elasticity of substitution between labor and capital lies strictly between zero and one, so that some limited replacement of labor by capital or vice-versa is possible.

6. Cross-Cutting Questions

Certain questions cut across many of the papers and the issues treated at the IUI seminar.

One such question is the role of *expectations*, which affects capital formation, capital valuation, capital allocation, the productivity of capital and, in fact, all aspects of capital and its role in the economy. The expectations of those building capital, buying and selling capital, allocating capital, using capital, etc. play a fundamental role in the economy.

A second such question is the role of *prices* in influencing capital formation, capital utilization, etc. Of fundamental importance are *interest rates*, which are determined by the demand for and supply of capital and

which influence capital building and capital allocation.

A third and related question is that of the role of *information* in influencing all aspects of capital and its utilization in the economy.

A fourth question is that of the role of *economic and political institutions* in influencing capital formation and its allocation in the economy.

A fifth question is the role of *economic and managerial competence* as part of the capital stock, which influences allocation decisions and productivity. This area will be the subject of a new research study at IUI.

The IUI seminar thus played a valuable role in bringing together current studies of capital and in identifying broad questions that cut across these studies.

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