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THE ECONOMICS OF COORDINATION, INNOVATION, SELECTION AND LEARNING

– a theoretical framework for research in industrial economics

by

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THE ECONOMICS OF COORDINATION, INNOVATION, SELECTION AND LEARNING*

– a Theoretical Framework for Research in Industrial Economics

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I THEORY AND MEASUREMENT

Theory is needed to organize thoughts and facts into a coherent whole. You cannot, as an individual being up to something, avoid taking a theoretical position that imposes a prior on your thinking; a prior you normally avoid thinking too much about, because it is your personal way of restricting your vision to get intellectually organized. Such boundedly rational thinking is necessary for any businessman, and the market is a powerful test for relevance. Boundedly rational thinking is typical for the scientist, arguing his theory, the only difference being that sciencies, and notably social sciences do not have as powerful a test as the market. A scientist can live with erroneus priors much longer than the business man.

Three phenomena in particular are making life difficult for the economist today. Inputs and outputs of the economic system are increasingly transacted in imperfect or regulated markets and/or are being dominated by quality components that we cannot easily measure. Production technology is increasingly moving economic activities across the statistical categories we have become accustomed to. The economist's representation of a nation – a statistical system interacting with the statistical systems of other nations, each being autonomously controlled through a political authority – is being gradually diffused through the international integration of markets and the increasing presence of the multinational corporation. Thus, we are measuring less and less well what is becoming economically more and more important. A particularly tricky measurement problem is the presence of "tacit" knowledge or "human embodied capital".

I am beginning my story of a dilemma facing current economic analysis in terms of a statistical measurement problem. I do this for several reasons. It is particularly appropriate for an institute like the IUI that has "spent its life" in applied economics trying to integrate theory and measurement. Neither theory nor measurement can develop without each other's support. This observation spells out my personal conviction that economics cannot survive as a science without a solid (read: better) foundation in good measurement. It reveals that we do not have good theory dealing with these phenomena that reduce the information content of our statistical accounts, and suggests that we do not have

a measurement system capable of capturing an advanced market economy in operation, because we lack the adequate guiding theory. As Malthus once observed: "The first business of philosophy is to account for things as they are". This is much more difficult than to understand the mental images that economists cook up.

In my presentation I will use a very broad brush. We are not yet ready to solve any problem of technical detail. But we are ready to recognize what has to be accounted for in order to be relevant and unbiased.

II THE IUI RESEARCH AGENDA IN INDUSTRIAL ECONOMICS

During the last decade or two economics as an academic discipline has been subjected to extensive internal and external criticism. Economic theory – it is argued – is based on empirically unsupportable assumptions. Hence, empirically oriented researchers have travelled down their own roads, or squeezed their analysis into a theory, that does not allow unbiased and relevant interpretations.

Another critical view has been the lack of an acceptable theory to explain economic organization, innovation and long–term supply. One point of criticism has been the lack of a comprehensive theory to link agent behavior (micro) to macro economic development through dynamic markets (the aggregation problem). The subfield of economics presuming to cover the economics of innovation, allocation and economic growth – industrial organization (IO) – has also been subjected to exactly the same criticism; bad contact between theory and empirical research, a gradual disintegration of the dominant static doctrine upon which it was based (the so called Mason–Bain market structure, conduct and performance paradigm), lack of a dynamic theory to understand industrial development and phenomena like mergers and acquisitions (see Scherer 1986). As a consequence the entire field is in fragmentary disarray, even though recent text books and survey articles have narrowed the field back into focus in an attempt to patch it up as a coherent whole (Schmalensee, 1988, Tirole 1988). This appears to mean going back to the standard static model, in a – I agree – refreshing game theoretic garb, supporting the early contention of Stigler (1968) that industrial organization is no separate field. It is traditional core economics, or price and

allocation theory in imperfect markets. However, in doing that certain aspects of economic theory that don't fit in, notably dynamics, have been weeded out, and the criticism against the classical model raised here by me and others is not against the model per se but against its use to "understand" allocation problems and economic growth that are intrinsically dynamic. For example, neither Schmalensee's article nor Tiroles text book includes any references to Schumpeter and the Austrian School (Menger, von Mises, von Hayek). Since dynamics is the essence of most industrial organization phenomena, it has to be brought into industrial organization theory, which will only then become what Stigler argues, the core theory of economics. This will be the main theme or argument of this paper. Industrial economics should be the core theory of economic growth, a central body of thought from which specialized theoretical branches can be derived. Economics will then first of all become the art of selecting and formulating the right model for the problem chosen, and only secondly the skill of carrying out the analysis.

[There is a cost, however, associated with breaking away from the standard IO model. The standard mathematical toolbox may have to be abandoned. Numerical analysis may be the only practical method to deal with the kind of models that have to be designed. Normative welfare or policy conclusions will be difficult or impossible, except through imposing arbitrary political choices on how to trade one individual's welfare today for another (perhaps unknown) individual's welfare tomorrow. We should not, however, fool ourselves into believing that such choices can be objectively made in a different, abstract world, by assuming the problems away.]

In the industrial organization field the IUI has a tradition to carry on. It has always represented the odd man out (Henrikson 1989). Even though the bulk of its resources were committed from the start to studying the growth engine of the Swedish economy, the institute never adopted the static IO tradition, but rather developed its own research profile – under the leadership of Ingvar Svennilson and Erik Dahmén in particular – pushing a strong element of Schumpeterian thinking.

The ambition to bring the entire production machinery into IO analysis, including public service production was there already in the fifties. Industry studies have covered all of manufacturing and its investment and productivity development (e.g. Albinsson 1961, Wohlin 1970, Carlsson 1972, Carlsson et al. 1979, Eliasson

1967, 1968, Höglund–Werin 1963], and large parts of private service production (Kristensson 1946, Artle 1952) as well as income formation and demand for industrial products (Bentzel 1952, 1957, Wallander 1958, Nabseth 1961, Klevmarken 1972, Jakobsson–Normann 1974, etc.). The institute did not approach the public sector as a huge income redistribution device and a (an assumption) burden to be carried by the rest of the economy, which has been the approach for decades of Government long–term surveys of the Swedish economic situation. It rather looked at the public sector as a potential contributor (infrastructure), or a retarder of economic growth (Höök 1962, Ysander 1979). The traditional sector or industry analyses – although dominant to begin with – gave way to the more sophisticated studies of development blocks (Dahmén 1950) or hybrids between sectors, banks and firms.

The notion that dynamic markets played an important role behind economic growth, not only serving as a habitat for monopoly power, was there early in a number of studies of market regulation (Lindbeck 1972, Gulbrandsen–Lindbeck 1973), including Erik Höök's early study on public service production (1962). This broad range of problem oriented inquiries can probably be attributed to the unique organization of research at the IUI, reserving the control of the research agenda for a Board of directors, consisting mainly of problem oriented corporate executives and leaving the choice of research method solely to the staff of the institute. This organization of research has prevented the inward looking search for problems within the already restricted domain of received theory that is so characteristic of academia. It rather forced the staff of the institute to look at a broad range of seemingly unrelated problems at the same time. And the "production problem" of the IUI has all the time been to find a synergistic theory that links the diverse problem agenda of the institute methodologically together. Again this theory must be industrial economics. It has to be dynamic. And there really is no excuse, considering the unique access to internal sources of firm information that the IUI has, not to build the macro explanation on knowledge of firm behavior. The interesting question is what kind of theory such knowledge will inspire.

In the early 70s the institute got involved in research on the importance of the multinational corporation for national export performance (Swedenborg 1973, 1979, Samuelsson 1977) at a time when static trade theory based on land locked exogenous comparative advantages dominated international trade analysis. At the

time, international trade theory allowed no place neither for the firm, nor for the international firm in the economic analysis of macroeconomic phenomena. It was ruled out of existence by the assumptions of the mainstream model.

With increased attention being paid to the dynamics of institutional change in new emerging and turbulent markets since the seventies (exchange markets, oil price shocks and, recently, the markets for corporate control) the dynamics of endogenous firm formation and behavior in markets has been a leading theme of research at the institute. Once firm dynamics has been made the core of market analysis the nature of information processes within firm hierarchies and in markets have had to be dealt with explicitly. The picture of the "theoretical firm" will of course differ, depending upon in which "theoretical market environment" it is supposed to operate. The firm in the static general equilibrium model will have very little to do with the firm in (what I will call) the experimentally organized market economy. And all of a sudden we find – see end of paper – that industrial economics will have its core at the intersection of the imperfect ends of basically three markets; the markets for products (product quality), labor (competence) and capital (the valuation of tacit knowledge in the stock market). There the firm is defined as a financial system based on human competence, operating in a global competitive setting and making a monopoly profit from merging the three markets within its administrative system. This is also the end of each market where we have to come to grasps with the problems of measurement that introduced my paper. And the capital market operating as an allocator of resources and a compensator of compentence will be the dominant market, imposing rate of return requirements on all other markets.

I will now turn to the content of the theory that I see capable of dealing synergistically with the whole range of problems I have listed.

III THE ECONOMICS OF INFORMATION AND OF ORGANIZATION

The static, general equilibrium model is concerned with physical flows of production. This model was refined to perfection both theoretically and in its empirical applications as comprehensive national statistical measurement systems were being designed and developed during and after the second world war. Before, economics was very much social philosophy. It was concerned with, among other

things, the nature of rational behavior in matters economics. Hence, measurement helped to turn economics into an almost "hard" science. Economics still, however, has an intellectual dimension. It can be viewed from two different angles. With intellectual processes imposed on, or integrated with the physical flows of production, it becomes difficult, perhaps impossible or illogical to view matters economics through the glasses of a hardware-based, economic process. This is at least the case when you study the evolving organizational forms of an economy, which is what industrial economics is concerned with. The organizational form very much controls the information processing in the economy, the mix between markets and hierarchies, the balance between goods production and marketing and distribution, etc. And the intellectual economic process draws significant resources. Hence, I want to approach my topic from both the intellectual ("information") and the physical sides simultaneously. This is almost the same as to say that I want the Austrian tradition back into economics.

Adam Smith (1776) coined the concept of productivity advance through division of labor. By breaking the work process down into finer and finer elements economies of scale in the small could be achieved. These scale effects became the drivers of the macro economy. Work specialization, however, came at a cost. It required innovative knowledge to be created.

The more elaborate work specialization the more resources needed to coordinate production. Hence, there are explicit transactions costs associated with organizing a specialized economy. Such organization can be achieved through the market by what Adam Smith called the invisible hand, and through management or administrative method in production units. The relative efficiency of the two methods determines the size structure of hierarchies or firms in the economy, as suggested by Coase (1937), and hence the market structure. Determining the division of labor and thereby the information technology to coordinate economic activities is also a prime function of markets. This choice of organization technology is perhaps the most important choice of all, since it influences the properties of the entire economic system. Adam Smith, himself, was very concerned about freedom of entry in markets as the source of economic rivalry and dynamic competition. Choice of organizational forms, the entry and exit of firms, or the recombination of firms, the movement of people with unique competence between firms and within firms (internal labor markets) is much more fundamental than the classical stereotypes of choosing between a planned

and a market economy. The complexities of the endogenous sorting and selection mechanisms of the markets are in a large measure experimental and characterize the economic system.

Finally, knowledge, once created (innovation) is diffused through the economy through imitation, or through various educational arrangements. Learning, is an important fourth category of economic activity that has to be considered to capture the whole economy at work (see Table 1).

The first conclusion coming right out of Adam Smith's original idea is that macro–economic growth theory has to be based on a theory of organization of markets and of hierarchies to capture what goes on in a growing economy. This theory has to be explicit about the relative efficiencies of coordinating economic activity through markets and through hierarchies, and hence in a truly Coasian (1937) sense explicit about the formation, the growth and the disappearance of market imperfections called firms; i.e., those "imperfections" that beat the market in coordination efficiency.

Having said this, I have placed the entity called a firm in the midst of a dynamic market process, making its ability to beat the market on innovative, coordination and learning accounts the source of economic growth. This firm will be an entity very differently organized from what you would expect to find within the general equilibrium framework.

I have furthermore made four information activities the dominant economic activity. Both the innovation and the selection activities cause theoretical trouble in the standard model: Economic coordination (item 1 in Table 1) – whether it occurs through the markets or through hierarchies – is controlled at each point in time by a structure; a "memory" that embodies the productive capacities of the economy. The properties of that "memory" are changed through "innovation" (item 2) through "selections" of organizational forms (item 3) and through learning (item 4). The development of that organizational memory is largely through the experimental organization of markets, and hence "tacit". It makes the economic system path dependent, and gives economic historians a role to play in economic analysis.

The economics of knowledge and information has its origin in the Austrian School (van Hayek 1940, 1945). But the Austrian element of "unpredictability" was soon lost as "statistical decision theory" and the theory of communication of coded messages we are used to see now began to be formulated (Shannon–Weaver 1949, Marshak 1954, 1968, Stigler 1961, McCall 1982). Modern literature in the field takes "structure" for given (exogenous) and knowledge for codable (= information), and hence avoids both innovation and selection. The modern learning literature, hence, focuses on the gathering and use of asymmetrically distributed information for static coordination purposes. If innovation and selection occur simultaneously and are affected by coordination and learning activities the standard model gives a biased picture of economic processes. It is appropriate in this context, to discuss this particular element of process dynamics, since bringing the Austrian tradition back into economics also means bringing back some original ideas of the Stockholm School tradition, and in particular work by Myrdal (1926) and Svennilson (1938), the latter being a former director of IUI.

None of the information activities in Table 1 takes place without some resource use. It is therefore not satisfactory to assume – as has been common – that information costs are zero, or negligible or of some magnitude that can be perfectly known in advance. Information costs, see Figure 1, rather make up the bulk of costs applications in a modern manufacturing firm. They obviously cannot be perfectly known. With information use being the dominant resource use you have to accept that technological change in a major way originates as advances in the technology of using information. And the technology of using information in a large measure depends on the organization of the economy. This is part of my story today. And technological advance is in a large measure unpredictable. Let me give two illustrations, one from within the firm and one from aggregating from micro to macro level.

Example from within the firm:

The dual (intellectual and physical) nature of economic activity means that all economic activity can be classified as knowledge based information processing (under one of the categories of Table 1) that controls the underlying physical flows. Think of factory automation. Before automation work is performed at decentralized work stations, using the specialized knowledge of skilled workers. To

automate the same production you have to retrieve and code the skills of the specialized workers – which is not easy, very costly and sometimes impossible (Eliasson 1980) – centralize the code and organize the machines and sensors such that the code can run production. What you have done is substitute one information technology for another through reorganizing production. This establishes three facts to keep in mind as we go along. Knowledge based, or information guided information processing runs production. Shifting from one production (or information) technology to another requires knowledge (or information) of a higher order. If it does not exist it must be created (innovation or selection) or learned. When seen in this perspective productivity advance at any level of aggregation, beginning at the factory level has its origin in productivity advance in information processing.

Example of going from micro to macro and back again (dynamic aggregation).

Aggregation in the experimentally organized economy I have in mind can be visualized (at least partly) through some well known concepts. At each point in time the capacities of the economic system (the "memory") can be seen as a set of potential Salter distributions of productivities and rates of return, very much like in Figures 2. At each point in time a firm is represented by a column on both of Figures 2, the height of the column telling its performance rate and the width of the column its size.

To be complete (second) these distributions should include potential productivity (in Figure 2A), the result of potential entrants and the results of innovative activity in existing firms, but there are special problems here (see below).

The slope of the Salter distributions (third) represents potential competition in markets. The firms at the left part of Figures 2 can compete from a position very superior to those occupying the Salter right hand tail. More particularly, the best performers to the left have a considerable capacity to lower prices and/or raise wages to earn more profits and grow faster and put their left-hand competitors in an increasingly precarious position.[1]

[1] They may do that in the long run, rarely in the short run, if not subjected to external competition. It is interesting to ask what happens, if they do, and study the consequences in the IUI micro-to-macro model. See e.g. Eliasson 1984, 1989a.

We are talking both of earnings and financing capacity (in the capital market), wage paying capacity in the labor market and potential price competitiveness in the product market.

Each firm (fourth), however, is only fractionally informed about its competitors and engages in various forms of learning about the shape of the Salter curves in its neighborhood and also (of course) about demand conditions in the market. Firms in Figures 2 looking left at least know that it is feasible to perform up to the best standards they see on their left even though they may not know how. This they have to learn. I have already observed that this learning draws considerable resources, at least 50 percent of total labor costs in the large firms.

On the basis of its perceived performance relative to all other actors the firm (fifth) takes (a) action in the product, labor and capital markets and (b) about internal deficiences in productivity performance. Ex ante price and quantity interactions occur and new prices and quantities are established.

Part of this reestablishment involves (sixth) updating the performance (Salter) distributions for the next period, including new competitive entry in response to perceived profit opportunities and forced exit. The "memory" is updated and the next step on the "path" taken.

So far this is only a description of what goes on in the Swedish micro–to–macro model within a quarterly framework (Eliasson 1977, 1978, 1985, 1989a). The framework is that of asymmetric information on the fundamentals of the economy at each point in time, being represented by the Salter distributions.

One could say that the behavioral setting of the above Salter analysis responds to Arrow's (1959) plea for a generalized model of monopolistic competition in which agents act as both price and quantity setters on the basis of their local monopoly positions. A number of very different problems, however, remains, at least, in the context of relating agent behavior to macro economic growth. This amounts to making dynamic aggregation explicit. The temporary monopoly positions upon which firms base their pricing behavior have to be explained, and I have concluded that the explanation should be looked for in a dominant organizational competence in agents (Eliasson 1988b), that constantly reorganizes the

institutional structure of the entire economy, generating macro economic growth in the process.

Another problem has to do with the time dimension of agent behavior, partly how the future bears on today and partly (a modelling and measurement problem) the units of time by which economic activity should be measured, problems discussed already by the Stockholm School economists. (The first part of the time dimension incorporates the ex ante ex post realization process, On the second problem, an annual model of the economy and a daily (transactions) model of course have to be structured very differently. The finer the time units the more of economic structure represented by the sequencing of activity (as distinct from estimating lag structures in macro models) and the larger the measurement problem. Ideally all economic action should be represented by sequences of local interactions of agents in the markets, based on agents' perceptions of relevant current and future circumstances. Hopefully some systematic patterns ("theory") should be present at that level. Rational expectations and efficient macro theory invoke very strong such assumptions a priori. The Swedish micro–macro process model uses much weaker assumptions and relies on explicit price feedback through markets to control the macroeconomic process.

The technological memory

Information processing is controlled by knowledge. The information technology of an economy is largely embodied in its organizational structure, a "memory" of the model of the economy that organizes information processing. The organizational structure has evolved historically, being influenced by the ongoing economic process. At each point in time the organizational structure sets the limits – very much like an operating language of a computer – of the innovative, coordinating, selecting and learning processes of the economy. (Hence, technical advance originates in the following order; economic organization, information and specific, identified innovations and improved work processes).

The economic forces that push against these limits, and push them outwards, reside as human based competence endowments in business firms. It is very wrong to restrict this analysis to hardware embodied technology. Roughly one third of labor resources in an advanced industrial economy go into private service production, much of it being related to manufacturing goods production. The

other third, public service production is not all consumption, as is often assumed but, infrastructure inputs in goods production. Innovative activity occurs in all sectors. One of the most important sectors in need of innovation is the schooling system, all levels[2].

Much of the competence I have referred to as growth creating factors, unfortunately is tacit and hardly communicable at all though regular educational channels. It occurs on the job, and is transmitted through the movements of people or groups of people in the job market. Such knowledge transmission mixes with job performance and is hardly measureable at all.

To understand technological advance in terms of the four activity types in Table 1 we need a measurable characterization of the organizational structure of the economy. Currently this is close to impossible. Whether we talk about competence at the firm (Eliasson 1988b) or industry levels, it is largely "tacit" and uncodable.[3] It develops through endogenous selection in the market process. The economy becomes – what I call (Eliasson 1986a,b, 1987) experimentally organized or (Pelikan 1986, 1987) self-organized.

The organizational competence at various levels of aggregation both dominates and releases the productivity of physical factors. Hence, to explain macro economic growth one has to understand how changes in the organization of communication and information transfer that controls the physical flows in the economy generates productivity advance at the macro level. You need a theory of dynamic market processes that performs the aggregation. This makes it natural to see industrial economics as the economics of innovation, coordination and learning. These are all typical information activities. The way I have presented economic activity these information activities become the dominant drivers of the macroeconomic growth process. The dynamics of firm behavior in markets becomes the core of the growth engine of the macro economy.

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[2] Eliasson; The Knowledge Base of an Industrial Economy, IUI Research Report No. 33, 1988, and Eliasson, The Firm as a Competent Team, IUI Working Paper No. 207, 1988.

[3] Remember (see above) the difficulties of coding even simple machining and assembly sequences at the workshop level.

It now becomes necessary to address explicitly the nature of resources, including accumulated human or organization–based competence put to use in firms, and the nature of market competition, being determined by all actors in the market; the firms and other institutions, including government. Hence the theory of institutions and of regulation comes in naturally, i.e. all more or less protected (from competitive entry) forms of production; from manufacturing production for open international markets to public service production for protected domestic markets.

I am going through all this to present a rational foundation for the research agenda of the IUI as it looked in the past, as it currently looks and as it might look in the future. The rationale has to do with designing a common methodology to deal with the wide range of problems that has been addressed by IUI research in the past and most likely will be addressed in the future.

IV THE FIRM IN DYNAMIC MARKETS

The firm arises naturally as an endogenuous phenomenon in Table 1 (item 2). Either the visible hand outperforms the invisible hand or vice versa. As relative performance changes over time size structures of hierarchies evolve dynamically over time. This way – in terms of information economics – is the way to understand the (in fact not very) recent merger and take-over development among advanced industrial nations. Thus neither the firm as a behaving entity, nor the market process can be studied in isolation. The total action (and interaction) of all firms makes up the market process; and firms are endogenously formed, expand and exit as a consequence of their interaction with all other firms. (With the size and size distributions of firms in the focus of analysis, one cannot study the behavior of one firm in isolation vis-à-vis an anonymous atomistic or exogenous market environment with given prices). The interactive price and quantity setting among the firms is the game to study.

While most literature on the theory of the firm in one form or another acknowledges the relative transactions cost principle of Coase (1937), almost all modern literature concentrates on the rationale for the existence of a firm as a hierarchy or a team (Marshak–Radner 1972, Alchian–Demsetz 1972, Arrow 1974, p. 33, see also Radner 1986, 1989) within a given price system. The

principal–agent literature, transferred from its original public utility domain (Ross 1973) to the theory of the firm (Jensen 1983) is similarly conceived, as is much of the entry literature (Jenning 1966, Baumol–Panzer–Willig 1982), however, without upsetting the foundations of the standard model. Schumpeter's (1911) notion of a new combination (the innovation, the creation of a monopoly) as the setting up of a new firm disappeared for more than a half century, but is returning. The notion of firm dynamics that I have in mind is very much along the lines of Schumpeter–Coase and Penrose (1957). The latter (almost forgotten in recent IO literature) very carefully verbalized the notion of the firm as a disequilibrium system that continuously exploited internal economies of scale through removing bottlenecks, thereby creating new bottlenecks to remove and so on. (A similar notion of firm dynamics is developed in Marris 1968). A firm, however, has no empirical meaning until it has been delimited by a measurement system, and the most natural such definition is its own internal information system, which is financially defind and organized to support its profit objectives (Eliasson 1976, Ch. XI), i.e. to earn a monopoloy or excess (over the interest rate) rate of return in the capital market. I think there is more content to saying (Eliasson 1988b) that the firm exists on the basis of its competence to earn a monopoly return in the capital market from merging the financial, labor and product markets through an administrative system, than from (Arrow, 1974, p. 33) defining the firm as a market failure. The first formulation gives the dynamic reason for the firm to enter or to be formed, because "it" is better, or thinks it is better than the market on coordinating, innovating, selecting and learning accounts. Once this has been said, only one thing remains, namely to explain how the rent is created – which was Schumpeter's question[4] – and how rent creation occurs over time (dynamics). The "unique asset" that does that is organizational competence which is the dominant capital input that lends productivity (a scale effect) to all other inputs. The natural way is to view the firm as a competent team (Eliasson 1988b). Knowledge is accumulated through learning in various forms, including experimental learning, when knowledge is tacit.

The local, specific knowledge base of the firm, being dominated by the knowledge of the top competent team bounds its competitiveness. Boundedly rational behavior (Simon 1955, Day 1971) in an enormous, only fractionally tractable ("visible") state space of business opportunities necessarily characterizes all agents.

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[4] and answered differently in 1911 and 1942.

Understanding firm behavior then requires understanding the nature of the knowledge put to use in running the firm, which in turn requires understanding the nature of the market environment in which it operates. In the narrow framework of the classical model firms become analytical, information processing machines, while the enormously expanded state space of the model of the experimentally organized economy – featuring also tacit knowledge – turn firms into experimental machines (Eliasson 1988b). The minimum set of "tasks" for the firm to perform collected in Table 2 shows that there is no way of centralizing a coded planning system at the top corporate level – even though some firms in information business have thought so until recently. Top level competence in a firm is almost 100 percent a matter of organizing and reorganizing people with talent, experience and knowledge at lower levels, and to make sure that the firm is organized for a steady upgrading of that knowledge base.

The empirically well founded representation of the firm would be a hierarchical structure of hierarchies, the top structure being a hierarchy of competent teams, that in turn maps onto a monolithically controlled structure of internal information processing activities (innovation, coordination, selection and learning) which in turn controls a lower structure of physical activities, which compete on the margin with the corresponding activities in the market, i.e. in other competing firms. Entry, exit or recombinations occur. None of this is represented in theory as yet and I have not seen any attempt to integrate all four information activities into a synergistic combination that earns a monopoly rent in the capital market. Whatever the difficulties involved this representation of the firm is a must if the macroeconomic effects of the multinational corporation or the mergers and acquisitions activity in western capital markets are to be understood and evaluated.

V LEARNING AND THE ACCUMULATION OF ECONOMIC RESOURCES

The nature of economic learning depends on how one visualizes the environment about which learning takes place. This is a matter of the size and time dimension of state space, the presence of tacit knowledge and the stability of structures about which the agent wishes to know. Obviously learning will differ very much if it occurs in the narrow state space of the classical model or in the wide open space of what I have called the experimentally organized economy.

I have established that the firm exists as a decision unit delimited by its statistical information system on the basis of the ability of its top competent team to beat the (capital) market in earning a return to assets in innovation, coordination and learning (knowledge diffusion). This, I argued, is very much a matter of organizing the filter that selects the top competent team; people with talent, experience and knowledge (the selection item in Table I).

I have tried to get the various categories together within the context of both economic theory and observed facts. This context happens to coincide with the categories of the micro–to–macro model of the IUI.[5] And what causes problems is the presence of "tacit" knowledge accumulated through on–the–job learning. Hence, the three learning categories of Table III.

Outward learning is the classical form of learning in economic theory. The agent reads the price and quantity signals in the market to assess profit opportunities. The notion of rational expectations (or its image in finance theory: the efficient market) has spun off a rapidly growing literature, that is clearly relevant, especially when broadly defined and placed in a dynamic market framework (Frydman 1982, Bray 1989, Lindh 1989).

Inward learning is less obvious since microeconomic theory has traditionally assumed the interior capacities of an agent to be fully known to top management and at no cost. The firm operates on the production function. This is clearly wrong (Eliasson 1976). The problems of central planning literature have, however, been transferred to the study of public utilities, and later to business agents and labor management under the heading of "principal agent theory". Such principal agent, interior information gathering is a major coordination task in firms and draws considerable resources.

Experimental learning is the new item on the agenda. It is the necessary form of learning when knowledge is tacit, and top level organizational knowledge is always tacit. Its recognition signifies the changing notion of the firm from an analytical planning machine, its productivities being embodied in the decision system to a competent team of people, its capacities being embodied in the member of the teams of the firm and the ways members are being selected

[5] See Eliasson (1977, 1985, 1989a).

(careers) and experience accumulated through repeated experimentation (Eliasson 1988b). A significant part of experimental learning relates to the entire economy and occurs through the exit and entry process.

The consequences of experimental learning are far reaching. Its outcome being "tacit" it equips the economic system with a "tacit organizational memory" that at each point in time controls all other information processing activities in the economy. The economic growth process becomes path dependent, and sensitive to initial state variables ("measurement"). Under very reasonable assumptions of the mathematical properties of the models of agent behavior the economy at large will exhibit phases of erratic, unpredictable behavior.

A particularly important aspect of market behavior has to be addressed once we have made "tacit" knowledge and "bounded rationality" a critical behavioral characteristic. Ex ante plans of agents and ex post outcomes will normally deviate making the sorting out (not clearing) of discrepancies dependent on the organization of market information processing. The outcome is unlikely to be a well behaved stationary process bringing in the (since long forgotten) realization function as a critical part of the economic machinery of information processing. This idea originated in the Stockholm School of Economics, beginning with Wicksell (1898), Myrdal (1926), Svennilson (1938), Lindahl (1939)[6] etc., being forgotten for many years, to be invented afresh by Modigliani–Cohen (1961) and elaborated by Eliasson (1967, 1968), only to be forgotten again.

With tacit knowledge and boundedly rational behavior it is virtually impossible to have markets clear as in the classical model. Say's law does not hold. Money is not neutral and the traditional "duality" conditions between prices and quantities are violated. This is disturbing stuff for the analyst, who normally strives to get out of this situation. Rational expectations (RE) is a particularly clever but deceptive design to do so. I want to dwell a moment on the RE hypothesis since the flow of my argument has to result in a yes or no to RE.

Assume that agents in the market can learn (by reading price signals) such that they are all right on average in expectation, and that learning (of type I in Table III) is costless. This is the typical REE set up in learning literature (see Lindh 1989). Assume, in addition, that agents are right on average each period and you

[6] See Palander (1941) for an overview.

have the original RE hypothesis imposed. Very strong learning assumptions have to be introduced to achieve this. RE simply means a restatement of the static general equilibrium conditions, establishing a density function of prices, or a well behaved equilibrium price distribution, instead of a single price.

It has been generally believed that the innovator, entrepreneur who introduced the "new combinations" that changed the parameters of the production system, and shifted the production functions, meant a rejection of Say's law. This may be true argues Morishima–Catephores (1988), but this proposition was voiced already by Walras (1874) himself, and – as shown by Arrow (1962a) – the entrepreneur can be made to behave nicely, very much as Schumpeter (1942) himself argued, to restore Say's law and equilibrium conditions. Schumpeter's "greatest contribution" according to M–C was to introduce "the banker" in the general equilibrium system (an influence of Marx). This new intermediator can either be seen as allowing the separation of ownership, management and financing in a truly Fisherian (1907, 1930) way and hence restore the neutrality of money, perhaps at given, negligible and perfectly predictable transactions costs. Alternatively you can tag on to Wicksell (1898) and introduce the possibility of a perpetuated difference between the ex ante rate of return on investment and the market interest rate. As long as the capital market does not clear, Say's law does not hold up and money is not neutral. Fisherian separation between the financial and real dimensions does not hold up. The only explanation (my interpretation) to such non–clearing is a deficient information process in markets including the inability to foresee. This, however, is the normal situation under the assumptions of the experimentally organized economy. It raises the question who – if anyone – monitors the experimental process. Who can learn and understand enough to carry on policy. The Austrian–Stockholm School–Schumpeterian argument above makes the capital market the ultimate monitor of the economic process.

Who is the capital market? The capital market is the joint interaction of all holders of tradable resources, including bits and pieces of, or whole firms, or "competent teams". Rejection of Say's law and the neutrality of money means rejection of the possibility of a capital market equilibrium.

Approaching the firm from the labor market end as a competent team (Eliasson 1988b), the dominant capital base being built on "tacit", non tradable knowledge confirms this conclusion. The market will never be able to assess the value of

assets such that markets are cleared in a RE sense. The capital market will have "lemon" characteristics, and the more so, the less of insider trading that is allowed to take place. Insider trading turns the impossible task for the narrow market specialist of evaluating the tacit knowledge base of a corporation, into the perfectly operational task of tracking down the trades of insiders.

The disturbing conclusion is that the discipline exercising forces of the entire economy of the capital market, or rather on each individual nation and firm of the international capital market will be governed by an intractable mass of experimentally organized, not well informed micro agents that exhibit strong non–linear features with expansionary and contractionary tendencies. Hence the capital markets will show typically erratic (unpredictable) behavior, or phases of chaos. The Wicksellian disequilibrium capital market process will be the normal mode of economic behavior. It integrates the financial and real dimensions of the economy, determining both the distribution of real rates of return (Figure 2D) and the interest rate in the process (cf. Solow 1963, 1989). This is the normal characteristic of a vibrant and growing economy (Eliasson 1988a), that has to be part of the industrial economics model. It is, however, a property of the economic system that makes neither management nor individuals or politicians comfortable. All economies are therefore replete with institutions that exercise restraint to reduce the freedom of economic agents.

VI THE ECONOMICS OF REGULATION

The dynamic market story told in the previous section removes the standard presumption of the perfect market as a social welfare optimum. The reason is not only that the information costs needed to get there may be excessive. The basic reason is that the perfect market may not be a socially desired state in a dynamic economy. We might not want to be there, even if the Walrasian auctioneer entered and told us, at no cost how to get there. The disorderly conditions of general monopolistic competition in the experimentally organized economy may be needed to keep the growth process going. Monpolistic rents reveal superior business competence and may be needed incentives to create and put that competence into gear. We have to accept that proposition until a credible alternative has been presented.

Among the institutions that influence the competitive adjustment process Government in all its manifestations figures most prominently, without necessarily exercising the greatest influence. Government as a regulator of the market process, and its competence to do so, therefore becomes a necessary element of industrial economics.

I have presented the market process as essentially experimental in the sense of being fuelled by agents with tacit knowledge, excercizing constraint on each other through competition, together generating an economic environment for both producers and individuals that is in a large measure unpredictable, and particularly so when it comes to the local micro environment of each actor.

Framed this way there would be two composite functions at work in the economy

(1) the potential to make a profit of each agent (local competence, technology) and

(2) access to the market.

During certain periods of "exogenous" inflow of technology into an economy unrestricted competitive access to markets might generate such rapid and locally unpredictable change that it would not be socially or politically acceptable (change might even be so rapid as to destabilize the entire economic system of a nation). Hence, economic history is replete with institutions serving the function of intermediators, as a rule to hold back change, and hence possibly macro economic growth, but also to facilitate the adjustment needed for economic growth [the Swedish Policy Model is one such example (Eliasson 1988a)].

The guild system of Continental Europe during the middle ages served that purpose, namely to guarantee quality of work and to establish the artificial restrictions to entry needed for monopoly rents. While arguments and documentation always emphasized the first aspect, a realistic analysis tends to come out in favor of the second explanation. Exactly the same situation currently characterizes the public sector in Sweden, being systematically protected from outside competition (health, education, labor market arbitrage, a large part of retirement insurance), the arguments, however, emphasizing quality of output.

Eli Hecksher (see in particular 1953) can be named the typical exponent for the view that the abolishment of the "privileges of the crafts" (the guild system) was the main initiator of the industrial revolution. Similar arguments have been voiced in the context of deregulation of markets in the US and in the UK and represent a current controversy in the US trade policy debate. One should not fail to recognize, however, that this is all Adam Smith (1776) who strongly argued in favor of free entry in market, as the only source of dynamic competition and economic growth.

VII CONCLUSIONS ON RESEARCH POLICY IN INDUSTRIAL ECONOMICS

The main reason for this essay has been to outline an agenda for innovative research in industrial economics, an agenda that links back to a 50–year tradition at the IUI and that points forward to developing a set of analytical or (!) numerical tools that will allow research to enjoy synergistic effects in addressing a wide range of problems of the kind the institute – given its mandate – will have to be prepared to address at some point in time or another.

To my mind this ambition takes us out of the static mainstream tradition. It most probably will confirm my suspicion that the static tool box will be of little help in understanding dynamic phenomena and that we should be very reluctant to jump onto partial analysis without being explicit about in which context they are to apply. Context in this context means the total model that we have not yet seen.

I have approached my task, not by testing various alternative theories against each other but by contradicting the priors of the general equilibrium model. This – I argue – spells out the necessity to put life into the Walrasian–Arrow–Debreu model if we aspire to understand economic growth.

This amounts to placing the theory of the firm at the intersection of the imperfect ends of the markets for products (international), labor (competence) and capital (see Figure 3). This in turn amounts to solving the problems of measurement introducing the paper.

In addition, there is a substructure of resources underneath the circles representing nature (of course) but most importantly the accumulation of resources, notably human competence, and thereby the time dimensions of the experimentally organized economy.

In addition, again, there is a superstructure on top of the circles, representing political and social regulatory institutions that interact with the economic processes. Table IV summarizes the six areas of inquiry in industrial economics.

Getting this on a quantitative footing is on a far away horizon. But it helps a lot to keep the intellectual framework I have verbalized in this essay in mind when carrying out partial analysis and giving policy advice. The results may turn out to be just the opposite if the context is slightly and unnoticably changed. Hence, I do not hesitate, in deciding to allocate scarce research resources in further elaboration of the well known, that may be wrong or pushing daringly in new directions that hold promise of new insights, but may not be tractable by the tool kits known.

I hesitate to bring in a story often argued by Assar Lindbeck, namely that of the endogenous politician, removing the exogeneity of the superstructure of regulatory institutions. The economist would then have to work together with sociologists, political scientists and economic historians. This proposition, broadened to the entire regulatory and cultural superstructure of the economy, however, represent a truly "rational expectations hypothesis", namely the hypothesis that the modern industrial and democratic society, with all its information processing institutions will develop into an increasingly informed state. To reject this story would be disastrous for the Western intellectual and democratic tradition. But to assume it to be right would be wrong.

Table I THE ELEMENTS OF THE KNOWLEDGE-BASED INFORMATION ECONOMY

1.	COORDINATION (organizational structure)	The invisible and visible hands at work – competition (in markets, Smith 1776) – management (of hierarchies, Chandler 1977)
2.	INNOVATION (exploring state space)	Creation and exploitation of new business opportunities (Schumpeter 1911) – innovation – entrepreneurship – technical development
3.	SELECTION (organizational change)	Incentives for change – entry – exit – mobility
4.	LEARNING	Knowledge transfer (Mill 1848) – education – imitation – diffusion

Source: Modified version of Eliasson, 1987, Technological Competition and Trade in the Experimentally Organized Economy, IUI Research Report No. 32, pp. 12 f).

Table II THE MAIN OPERATIONAL TASKS OF THE FIRM

CREATION OF NEW KNOWLEDGE

1) Innovation
2) Internal reorganization

COORDINATION

3) Investment bank portfolio management
4) Risk management
5) Product development & promotion
6) Commerical bank (cash management)
7) Insurance
8) Materials processing
9) Purchasing
10) Marketing and distribution

KNOWLEDGE TRANSFER

11) Learning and knowledge transfer
12) Welfare

Source: Eliasson, G., 1987, Technological Competition and Trade in the Experimentally Organized Economy, IUI Research Report No. 32, p. 55.

Table III DIFFERENT FORMS OF LEARNING AT AGENT LEVELS

1. **OUTWARD LEARNING**	assessing the markets environment
2. **INWARD LEARNING**	assessing the internal capacities (targeting)
3. **EXPERIMENTAL LEARNING**	on–the–job learning – orientation (what to do) – self organization (experimental) – selection (careers) – exit/entry

Source: Eliasson, G., 1989, Boundedly Rational Behavior, Dynamic Market Coordination and the Limits of Organizations, IUI mimeograph.

Table IV THE INDUSTRIAL ECONOMICS FIELD

I **THE FIRM IN THE MARKET**
(developing theory in the intersection
of the market circles in Figure 3)

II **RESOURCES**
(Technology, Innovations)

III THE FIRM AND (INTERNATIONAL) PRODUCT MARKETS

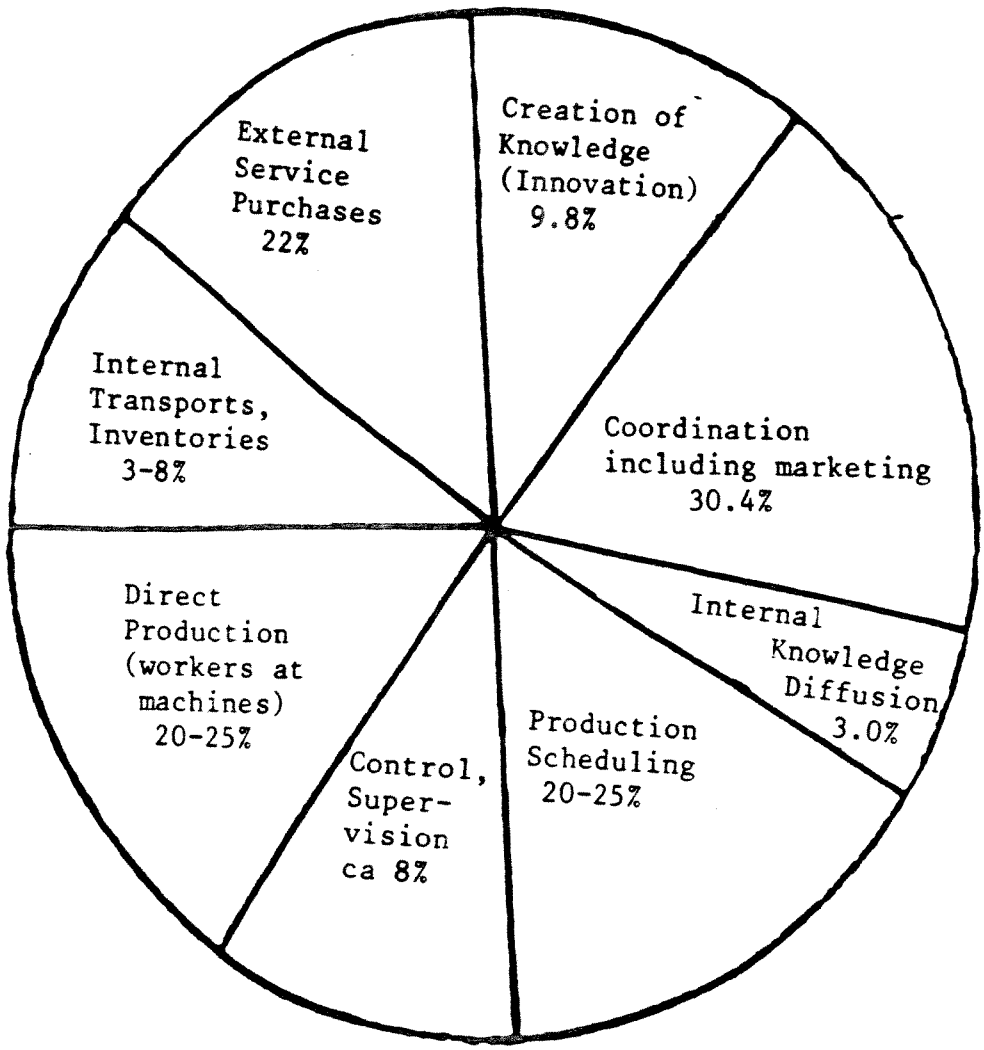
IV THE MARKETS FOR OWNERSHIP AND CONTROLL

V THE MARKETS FOR LABOR AND COMPETENCE

VI POLICY AND PUBLIC ECONOMICS

Figure 1 DISTRIBUTION OF LABOR COSTS

– Large Swedish firms
– Global operations
– Percent



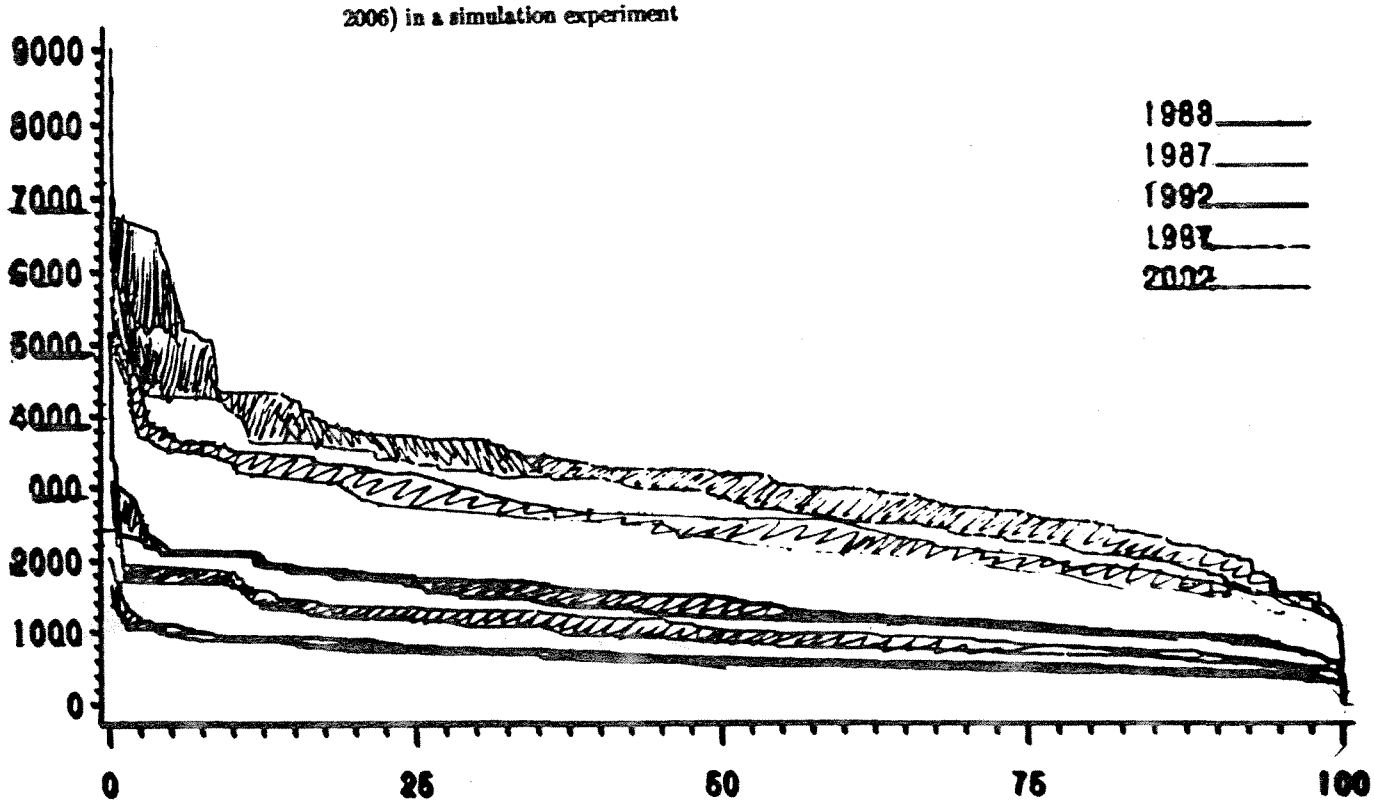
Goods processing: 56.7%
Total: 122%

Source: Eliasson, 1989, Modeling Long–Term Macroeconomic Growth as a micro-based, path dependent, experimentally organized economic process, IUI Working Paper No. 220.

Figure 2 STATE DESCRIPTIONS OF THE SWEDISH ECONOMY

2 A Potential and simulated productivity distributions

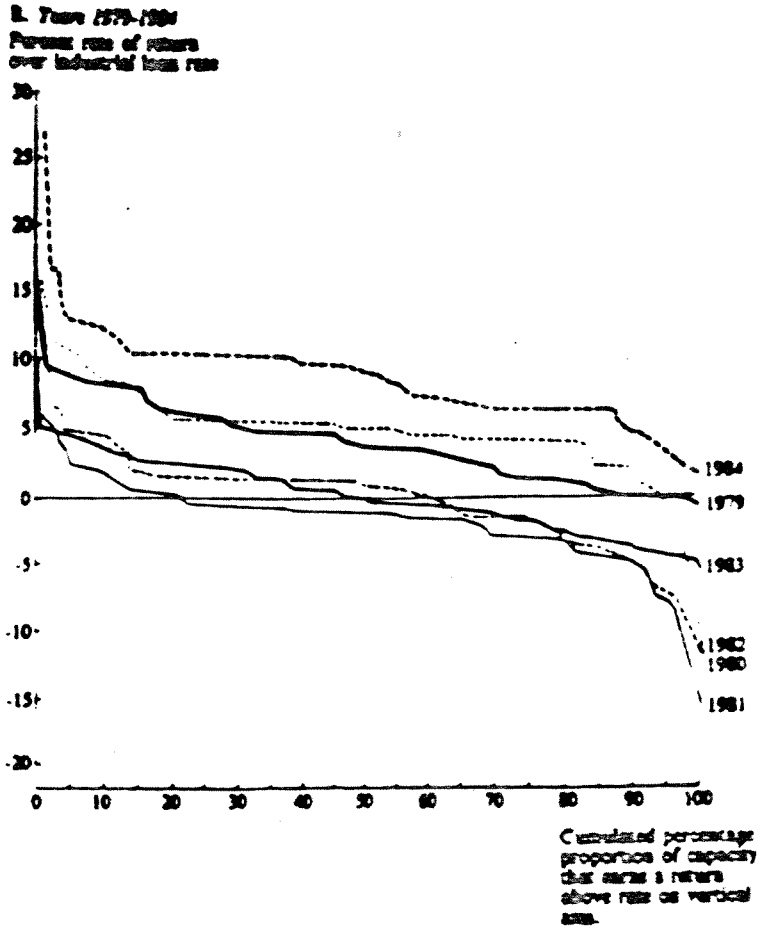
Figure VI.B **Simulated actual and potential (Salter) productivity distributions over firms for selected years (1983, 1987, 1992, 1997, 2006) in a simulation experiment**



Note: Shaded areas show difference between potential and actual distributions. The corresponding macro development can be seen in Figures V.

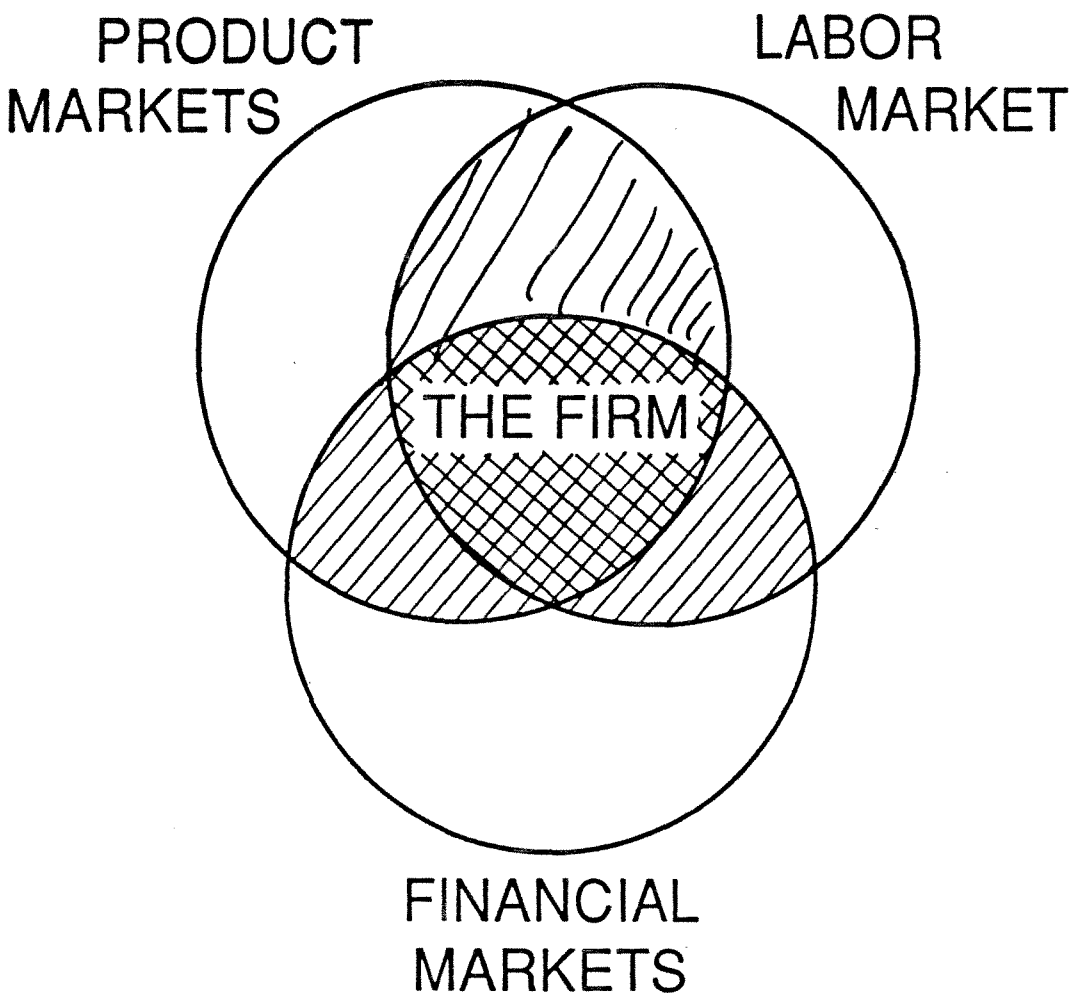
Source: Eliasson, G., 1989, Modeling Long–Term Macroeconomic Growth as a microbased, path dependent experimentaly organized process, IUI Working Paper No. 220.

2 B Rate of Return Distribution



Source: Eliasson, G., 1988, Schumpeterian Innovation, Market Structure, and the Stability of Industrial Development, in Hanusch (ed.) Evolutionary Economics, Applications of Schumpeter's Ideas, Cambridge University Press, Cambridge (p. 162).

Figure 3 THE CORE OF INDUSTRIAL ECONOMICS THEORY



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