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INNOVATIVE CHANGE, DYNAMIC MARKET ALLOCATION AND LONG-TERM STABILITY OF ECONOMIC GROWTH

by

Gunnar Eliasson

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The Industrial Institute for Economic and Social Research (IUI)

Contents

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Abstract

Market competition is central to innovative activity, the diffusion process and macro-economic productivity growth. Productivity growth at all levels comes about through institutional reconfiguration in response to the ongoing market process. Stable and sustained long-term growth in output requires the continuous creation of new technological and commercial solutions to production and marketing problems and exits of outmoded institutions. What is needed, in short, is a continuous turnover of monopoly rents that preserves diversity of economic structure. This means, most importantly, that innovative activity or technical change at the micro market level cannot be treated as an exogenous force, independent of the market process. Hence, discussion of socially optimal choices of technology becomes irrelevant.

New entrants and innovators within existing firms pose a competition threat to established monopoly positions. This allows us to present the growth economy as a process of general monopolistic competition fuelled by "innovation" in a broad sense. We demonstrate by reference to statistical data and simulation experiments on a micro-based macro model that a growth economy, in fact, may exhibit these features. We also observe that the implementation stage between the innovation and production for markets represent a major cost application. To understand how new technologies are created and transformed into macroeconomic growth in output it then becomes important to understand both how innovations occur in the economy and how viable markets populated by "implementors" carry new ideas into full scale production. The market for implementations has to be interpreted broadly, including implementation(1) by the inventor himself, (2) within large companies as "intrapreneurial activity" as well as (3) in the form of outright transactions between inventors, traders in innovative markets and producers, including the whole range of institutional solutions in between.

1 Elements of a growth theory[1]

1 a) Institutional reconfiguration as the moving force

The Swedish economist Johan Åkerman once (1950) noted that the four fundamental elements of economics are:

- interdependence
- welfare
- process
- institutions.

These four elements serve as the building blocks for any comprehensive system of industrial economics.

Åkerman's four elements have also become guidelines for the IUI research orientation during recent years. Market interdependency in a static environment is the foundation of Walrasian general equilibrium theory and received welfare economics. We have attempted in the micro-to-macro(M-M) model, that I will use for illustrative purposes, to put dynamics ("process") into the Walrasian system. In one sense I have adopted the young Schumpeter's (1912) notion of exogenizing technical change through entrepreneurial innovative behavior at the micro level. Hence, the M-M model is a system of general monopolistic competition, in which quasi rents are constantly created through innovative behavior in firms, as well as competed away through innovative behavior in other firms, thus moving the system through a Wicksellian disequilibrium in the capital market (Eliasson 1984a, 1985a). Building a model of industrial economics is much the same thing as putting dynamics into general equilibrium theory in the form of a capital accumula-

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[1] This paper has benefitted significantly from discussions with Erik Dahmén, Ove Granstrand, Ken Hanson, Lars Jagrén, Pavel Pelikan and Steve Turner.

tion process that generates quasi monopoly rents to producers.[1] Much of this paper is addressed to this task.

The main issue is explaining innovative behavior, and the institutional organization under which it occurs and is efficiently disseminated through the economy.

Innovative behavior and macroeconomic productivity change is normally seen as the accumulated outcome of the diffusion of innovations, relating primarily to new processes and new products. I explore the combined outcome of the organization of markets (the Market regime (Eliasson, 1984a) to be explained further in Section 2a) and the entrepreneurial innovative process (the technological regime of Nelson-Winter 1982). In doing so we will distinguish between three phases of the innovation process preceding the stage of large scale production; invention, innovation and implementation, each being associated with different groups of people, talent and management techniques. The invention is the technical solution to a product or a process. The innovation carries the invention up to the first stage of commercial (market) introduction. The implementation means starting production and taking on a major market risk. The entrepreneur is the one who sees the market opportunity of the invention and carries it all the way up to, and through this stage. I distinguish - somewhat unconventionally - between the innovation and the implementation stage because it highlights the transfer of the "prototype design" into commercial introduction, a stage (the implementation stage) when the major financial risks are taken on by the entrepreneurs.

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[1] I hope it is self-explanatory from what follows that by general monopolistic competition I do not mean the departures in pricing from the pure norm of perfect competition studied by Chamberlin and Robinson. Neither is dynamics in general equilibrium theory the same thing as "steady state economics". To avoid misunderstanding by association, Erik Dahmén suggested that I enter this qualification.

Only successfully implemented products go on into large scale production.[1]

It is important to recognize that we will use the firm or the division - a financial decision unit with profit and loss statement and balance sheet - as the unit of observation. At that level of aggregation one cannot empirically distinguish between innovative, technical, technological, organizational and institutional change, except institutional change through entry and exit of entire units and through differences in investment in and growth of existing financial units in the capital market. Since institutional change blurs the borderline between the firm and the market we have a conceptual problem. There are at least two reasons. First, institutional reorganization is the main vehicle for significant productivity advances at the firm or division levels (Eliasson 1985a, Jagrén 1986). Hence, any study of innovative behavior, the transmission of new innovations and economic growth has to make institutional change a natural part of the growth process that is to be explained. Second, improved market techniques is a major element in product related innovative behavior, much of it involving various forms of non-market links between producers and customers in specialized markets for advanced products (Eliasson 1985b). The fact that the bulk of innovative behavior is product oriented and takes place at lower levels than the division level is discussed in the companion paper by Granstrand. As a consequence I have to be explicit about aggregation up to the market level through both organizational hierarchies and through markets.

Based on a series of recent IUI studies of the modern firm, we recognize the difficulties involved in explaining innovation and implementation at the micro level, and diffusion to the macro level. However, improvements at the micro level are implemented through the administrative systems called firms, and through the

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[1] One could then say that the invention has been technically successful, the innovation commercially successful and finally the implementation phase is carried through to economic success.

market process. The ultimate outcome, macroeconomic productivity change appears to depend more on how firms are restructured to exploit innovations and how the market regime is organized, than on the initial technical innovation. Some market regimes are unable to exploit, and to cope with technological change, others are very good at it and the difference also explains the differences in macroeconomic growth (Eliasson 1983). The latter distinction is important. As a rule, there is a world of difference, a long time and the bulk of investment expenses between a tested technical invention, and a prototype being ready for mass production, and the market test (its commercial stage).

Exogenous, episodic new innovations were made the moving force of the growth cycle of the young (1912) Schumpeter. In his later (1942), more pessimistic notion of entrepreneurial activity organized within large industrial concerns, technical change was endogenized and explained as an outcome of routinized R&D. As a consequence, the entrepreneur was no longer needed, business firms and the political system grew together and the capitalistic market economy - for Schumpeter the guardian of democracy and individualism - gave way to monopolistic control and perhaps even a dictatorial socialist regime.

Giant firms of today may be efficient improvers and implementors of new techniques. They account for the bulk of R&D spending in industry, and according to some studies, also the bulk of innovations in industry (see companion paper by Granstrand). However, the giant firms are rarely well organized to perform innovative and entrepreneurial tasks (Eliasson-Granstrand 1981, 1986). Innovation implementation by large firms depends on the efficiency of their internal administrative system and marketing skills.

Making the efficiency of competition dependent on innovative entry or internal reorganization of firms - the prime creators of temporary rents that force dynamic market competition - we can explain why growth rates differ so much for decades, or centuries between countries, despite a "freely" available pool of international, industrial know-how. Information is not enough (see below under 2a). It is necessary, even imperative, for entrepreneurs to implement the new ideas. This requires industrial knowledge and favorable entry conditions.

We cannot explain where, when and how individual, new and successful combinations occur. The political and cultural environment, of which the market regime is a part, and the stock of industrial knowledge that resides in a country, explains the macro level of innovative activity of an economy, and hence the frequency with which new, successful innovations occur somewhere and reach the level of commercial applications (Dahmén-Eliasson 1980).

This paper at first takes innovations as given and traces the effects through the market process, up to the macro level. I particularly discuss the hypothesis that diversity of structure is necessary to support a fast and reasonably stable macroeconomic growth process (Eliasson 1984a) and its welfare implications. Diversity of structure diminishes through competitive exit, but is restored through innovative entry and internal rejuvenation of business units. If diversity of structures - to be more exactly defined below - or continuous micro transformation is necessary for stable, long-term macroeconomic growth, it becomes essential to understand how and under what circumstances innovative activity creates such diversity. Since this creative process cannot be discussed independently of the cultural, political and economic environment in which it takes place, we have to see the process of innovation, diffusion and economic growth in the context of the complete economic and institutional system of Åkerman (1950).

This paper is organized in the following way. The next section discusses the M-M dynamics of macroeconomic growth under the "erroneous" assumption of exogenous innovative activities at the micro level. The macroeconomic effects of microeconomic (temporary) rent creation is illustrated and analyzed within the framework of the Swedish M-M model. In section 3 the empirical nature of temporary rent creation in private firms is briefly presented from data on Swedish manufacturing used in the same model. These two sections summarize a number of IUI studies, or IUI related research. On the basis of this empirical evidence we finally (section 4) discuss how the markets for new ideas and information - or rather the institutions that make up the markets for new ideas and information - could be organized. We conclude that the existence of viable markets for innovations, with traders that are eager to spot, and competent to implement new ideas commercially is critical both in promoting and in implementing innovations.

1 b) The market as an experimental learning process

A key notion in this paper is that the opportunities to improve always run far ahead of the competence to improve, and that each realized improvement means a further upgrading of the opportunity set, that others can learn from.

The value of what has been learned can, however, only be assessed in the market. Hence, learning about new products or process techniques is the same thing as trying them, improving them and shutting them down if the market responds unfavorably. As a rule, new administrative organizations, or new institutions are created in the ongoing experimental process. Observing and understanding this experimental market activity must be the main concern of industrial economics.

One particular instance of the new institutional configurations in the advanced industrial economies is the shift from a process based industry towards a product based industrial technology (Eliasson et al. 1984, 1985b). Empirically this can be observed as a relatively larger share than before of investment going into R&D spending on product development and into marketing in individual firms, and a relatively faster growth in those firms that exhibit those features (Eliasson 1985). The result is faster value added creation through product quality improvements, rather than factor saving and larger volumes of the same quality. Theoretically both can be said to be price competition, because product quality improvements should mean more production volume and a lower price, if the price for the product is not lowered. There is, however, a profound difference in competing in the sense of Schumpeter (1912) and Clark (1961) by adding more value to the product, compared to lowering the price of an existing product. An illustration of how value added is created through product quality upgrading is given in the companion paper by Granstrand. The product quality improvement is exhibited through improved process performance with the customers, where the product is installed. Hence, the customer is willing to pay a higher price for that extra quality. Granstrand (1984) discusses models and tests innovative behavior through new entry.

The distinction between an internationally defined opportunity set of possible, but mostly unknown business combinations, and a local ability to see the commercially successful combinations makes it possible to reconcile the supply based innovation-growth process associated with Schumpeter and the "demand alternative" of induced innovations suggested by for instance Schmookler (1966).[1] The actual exploitation of the opportunity set depends - of course - on both competence and incentives. Incentives might quite well be related to cyclical conditions. Hence, the two "theories" are not really alternatives to one another. Both factors are at work and empirical tests where the one is set against the other should be inconclusive.[2]

[1] Also cf the parallel related but macro-oriented discussion of "induced innovations" in Samuelson (1965), Fellner (1971), and others.

[2] See Scherer, 1981. For a recent summary of empirical evidence see Papachristodoulou (1986, p. 23 ff.).

2. Inventive activity, the market regime and macroeconomic growth

2 a) The nature of the market regime

The market process can be no more than the aggregate action of its institutions. Even though we will be primarily concerned with the producers, the institutions of the market is a much more varied set, including individuals/households, various forms of non-market collective bodies like the Government, and all the rules that control their behavior and their interactions, signifying together the three elements "interdependence, process and institutions" of Åkerman (1950).

The term market regime has been introduced to represent the competitive process in the markets and the incentive system that generates technical inventions. In Eliasson (1984a) its use was restricted to the adjustment speeds of quantities and prices in product-labor and capital markets. Here we widen the concept to include the degree of freedom of competitive entry through innovation or imitation which is the only clear distinguishing feature - as pointed out by Pelikan (1985) - of the capitalist market process. For the time being we lack empirical substance to be more explicit about the incentive system and the degree of freedom for profit motivated entry. The reader should note that growing shares of regulated public service production - free competitive entry being typically prohibited or made impossible by other means - as well as growing economies of scale and barriers to entry in industrial production making entrepreneurs obsolete - Schumpeter's (1942) worry - means changing the characteristics of the market regime away from a free market economy.

With a given set of actors/producers striving to increase their wealth, with endogenous exit and with endogenous innovative entry, the markets - as in the Swedish M-M model - can be characterized as a non-cooperative game, or an ongoing process of general monopolistic competition, with no traditional equilibrium characteristics. Prices generated by the ongoing process will not generally be unbiased predictors of future prices. Aggregation then cannot be represented by stable aggregation functions, and macroeconomic behavior like production growth and productivity growth will be decisively influenced by the dynamics of market pricing.

The absence of traditional equilibrium properties of the economic system we envision, will make clear policy conclusions, or simple welfare predictions impossible. This analytical situation becomes even more pronounced if we leave our M-M model economy and allow the number of institutions to vary, existing institutions to change as to outer boundaries and interior content of activities, to fragment and to recombine with other institutions as an endogenous result of the ongoing economic process. (Shubik 1985, Eliasson 1985). This possibility will be introduced in the next section.

2 b) The nature of the administrative regime - coping with innovation and organizational change

We have introduced the administrative regimes, or financial organizations called firms as fundamentally information processors. This presentation does not conflict with the picture of a firm as engaged in factory production. It only highlights the fact that any one task of the many tasks that the firm may engage in, requires the application of knowledge and that the use of knowledge is costly. Some of these information costs can be statistically separated from the cost accounts of firms. Figure I illustrates "three quality levels" of knowledge required to operate a business entity. At the third, lowest level, work skills are needed and investment is applied to rationalize factor use at individual work stations. The middle level is concerned with dynamic coordination of flows of work, including capital accumulation through investment, still essentially doing the same thing, only in different mixes. At the middle, coordination level, the firm as an administrative system competes directly with the market coordination process outside its financial boundaries on the same terms as the market (as described in the previous section). Its internal coordination must be more efficient in the longer term than that of the market, otherwise competition for funds in the market will cause it to split or leak funds. A stylized representation of this is present in the Swedish M-M model.

At the first level, institutional or organizational change enters in the sense of Schumpeter. We do not have to decide whether it is possible to predict, or has to be entered exogenously as in the M-M model according to Schumpeter (1912). The important thing is that the really large innovative returns over the market loan rate (later to be called ϵ) are created at this level though institutional fragmentation, reorganization and recombination in response to market competition. If negative ϵ are generated, the firm, if small, soon exits, if large, it begins to contract or fragment.

Several IUI studies have noted how institutional reorganization is the major means of raising productive efficiency in response to new competition. Firms that do not succeed contract in relative size or exit, which is also a form of productivity increasing institutional change.

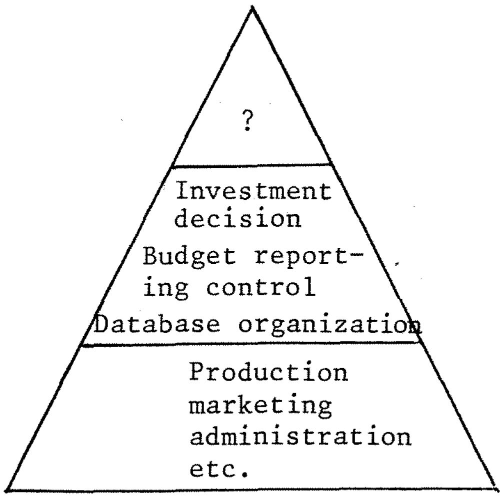
In this administrative activity within the firm a constant conflict is maintained between top level innovative and organizational change that contributes to long-term dynamic efficiency (doing the right things, being in the right markets), on the one hand, and, on the other, short-term static, coordinating efficiency, managed at the middle level of Figure I. Institutional change diminishes or biases the information content of management targeting, reporting and control systems used to achieve short-term flow efficiency over a given organizational structure (Eliasson 1976, 1984).

A typical organizational change during the post-war period has been the continuous shifting of industrial structures from a base in domestic process efficiency towards an internationally based product technology, emphasizing again the dominance of various forms of information use in total production costs, product-oriented R&D and international marketing being the statistically most visible items.

This institutional change has occurred within existing firms, and between firms in the sense that those who have succeeded have also experienced faster growth in value and output.

Again, this institutional change has meant a change in both firm and market behavior. New, knowledge-dependent production is decisive for business success. Furthermore, product-oriented firm activities in many respects mean that activities that were earlier carried out by independent traders in the market (like marketing, distribution, service networks etc.) are becoming internalized within the firms, being part of their product specification, and moving the producer in close contact with the customer, while other activities are being separated off into the market, notably on the input side (subcontractors, high quality technological expertise, etc.). This development has already created a statistical float, that makes macroeconomic modeling on standard, official data empirically very difficult, and soon not meaningful. For the theoreticians it is currently confusing the borderlines between the market process, the market rules and its institutions, so to speak, making producers and customers grow together administratively.

Figure I Level of decision and quality of know-how



Level of decision	Quality of know-how
1. Strategic (Affecting structures)	1. Competence and experience
2. Tactical (Coordination and) control)	2. Competence and organization
3. Operational (Rationalization)	3. Skills

2 c) Quasi micro rents and the macroeconomy - a formal analysis

The rent is most generally introduced as a capital market imperfection, or as a return to capital above the loan rate. This corresponds to Wicksell's (1898) notion of a capital market disequilibrium, defined here at the micro level. Such a monopoly rent can occur for the following reasons:[1]

(1) - superior products, marketing or production techniques,

(2) - product market control. A price leader position (traditional monopoly),

(3) - imperfections in other markets, e.g., the labor market.

In order to achieve a clean analysis we assume that all markets, except for the credit markets, are in equilibrium.[2] To simplify further we assume all producers to be price takers in the credit market, facing the same exogenous interest rate i. We disregard all forms of product market monopolies except those dependent on superior market knowledge or marketing techniques under (1). Hence, the customer gets the same value for his money from all

[1] Wicksell (1898) introduces an ex ante macro difference between expected returns to investment and the loan rate (defined below) that generated a cumulative inflationary or deflationary process, as long as the difference persisted. His idea is presented in Hicks (1977, especially p.65). We reformulate Wicksell's idea at the micro level and reinterpret it in the long-term context of investment behavior of individual firms being made dependent on the rate of return, interest rate differences of the firms (called ϵ) (see Eliasson 1984a). However, we have a problem in the sense that the dynamic micro processes that we are discussing work in terms of micro distributions of such ϵ_i, some of which are perfectly compatible with the existence of an ex ante macro $\epsilon = 0$.

[2] This means that labor is not paid more than its marginal value product on each job location, and hence is not, for instance, exploiting the profits of a monopoly firm. We recognize that this distinction can be principally wrong to make in firms where the productivity of labor cannot be distinguished from the productivity of capital, or when labor is cartelized, which is normal, rather than an exception. But we, nevertheless, disregard this problem.

producers in the market, even though he may be paying more for an item in Omaha, Nebraska, than a New Yorker pays for a better item on Park Avenue. Somehow, information costs in the market prevent the better product from being available at a lower price to the Omaha user, and information cost is a production cost as all other costs. As a consequence, monopoly rents that we call (ϵ_i) generated under (1) will appear in the accounts of the firms in the following manner:

$$\epsilon = R - i > 0$$

where the nominal rate of return to total capital, R_i is[1]:

$$R = M\alpha - \rho + \frac{\Delta p^I}{p^I}$$

$\frac{\Delta p^I}{p^I}$ = that rate of change in investment goods price

M = operating profits (π) in percent of value added (PQ). Hence,

P = value added price index

Q = volume of production.

$$M = 1 - \frac{w}{p} * \frac{1}{Q/L}$$

where w = wage costs, and L = labor input. Note: that M is a "price corrected" labor productivity measure

α = value added in percent of capital (K) valued at reproduction costs (= PQ/K). Note: that Q divided by a deflated K is a capital productivity measure (see further Eliasson, 1985a p. 257).

ρ = the fraction of K that is depreciated per period.

i = the nominal interest rate

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[1] This is a standard expression that can be derived from the definition:

$$R = \frac{PQ - W \cdot L - \rho \cdot K + \frac{\Delta p^I}{p^I} \cdot K}{K}$$

2 d) Dynamics of competition, diversity and stability

Joseph Schumpeter (1942) assumed for the sake of the argument that the economy could initially be positioned in a Walrasian general equilibrium. Innovators of type (1) above with superior products and marketing or production techniques then disturbed that equilibrium, through creating positive ϵ, in effect a Wicksellian disequilibrium processes. Kirzner (1973) on the other hand, rather thought of ϵ-creating entrepreneurs, as equilibrating forces[1], the normal economic situation (state) being in fact a Wicksellian, cumulative or contractive disequilibrium process. By our presentation innovators perform both the disturbing and the equilibrating function in a process of general monopolistic competition, that may never be able to come to rest in the Walrasian equilibrium state, in which all $\epsilon = 0$, used by Schumpeter as the initial state, for didactic purposes.

General monopolistic competition consists in the delicate balancing of innovative forces originating in institutions that create new ϵ to support structural diversity, at the same time providing control through competition of excessive growth of old monopoly agents, or the tendencies towards concentration that Schumpeter and others have worried about. It is important to note that the incentives to create new ϵ, somehow depend on the monopoly positions entertained by old ϵ-holders. For such dynamic competition to persist, new competitive entry and free unhindered exit as a result of competition, ("creative destruction"), generated a steady micro turnover of (ϵ) rents, are the critical characteristics, both of a market economy and of macroeconomic growth (see Eliasson

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[1] As pointed out by Pelikan (1985b) Kirzner sees entrepreneurs as alert people who notice profit opportunities, that innovators may not notice. Schumpeter's entrepreneurs (or innovators), on the other hand, appear on the supply side. They see new technical combinations and break old routines. Of course, that distinction becomes utterly subtle if, as we will find in the next section, information costs in developing and marketing products is the major cost item in total cost applications of the modern manufacturing firm. Then trading in the market becomes indistinguishable from innovative production activities.

1985a, part III). The underlying necessary assumptions for such competition to occur is that innovative activity is potentially profitable in the sense that the opportunity set of new profitable, commercial initiatives is always far ahead of actual economic performance, and that the expected payoff function is such that enough of real, innovative ϵ are generated. Our principal hypothesis is that the very nature of this exploitation process is experimental (trial and error, not analytical), but that the critical analytical faculties have to do with spotting the "good draws" in time, and terminating the "bad draws" early. Firms are more or less badly organized to cope with this situation (Eliasson et al. 1984). As a consequence we expect a healthy, competitive market process to exhibit wide distributions of rents over the firm population that persist over time. The interior ϵ-ranking positions among firms should, however, vary considerably.

The Swedish M-M model introduces this competitive process through making

(a) new entry positively dependent on market ϵ,

(b) investment and, hence, the introduction of new technology in existing firms dependent on its own ϵ,

(c) exit dependent upon the persistent experience of negative ϵ, until net worth is exhausted.

A crucial question for further analysis is how ϵ are competed away, and what happens when they grow excessively, or are competed away such that $\epsilon_i \to 0$. Both developments can be simulated on the Swedish Micro-to-Macro (M-M) model.

The first case is that of dynamic competition in the sense of Schumpeter (1912) and Clark (1961) and the competitive entry of entrepreneurs as an equilibrating force discussed by Kirzner (1973). The second case is that of concentration, discussed by Schumpeter (1942) and others. The third is that of lack of sufficient innovative entry and/or a too speedy market process, making the economy come too close to a static equilibrium state. Both quasi-rents and (hence) incentives to entry in terms of (ϵ) are competed away.

This notion of competition is that of Schumpeter (1912), and Clark (1961). Innovating firms with large ϵ gain market position, thus both generating economic growth through lowering prices per unit of output and increasing income, and through forcing old ϵ-holders to contract relatively, or exit if they cannot compensate by in turn innovating and improving their productivity. This competitive process is easily illustrated on the Swedish Micro-to-Macro model. Even though the model does not distinguish explicitly between new product competition through value added increases and price competition through improvements in process performance[1], we can reason verbally about competition in terms of product innovation and upgrading, since this appears to be the method of competition that is growing in importance (see above, section d).

The exit and the investment decisions are easily captured in theoretical terms, since they are "guided" by the firms' own ϵ. The innovative entry process is more difficult to handle in principle. New entrants may know their own technical performance characteristics, but they would have to learn about market prices to transform them into profit performance characteristics. Their familiarity with the market environment they are about to enter should be less, or at best equal to that of the established competitors. At the same time, new entrants may entertain beliefs about their own superior performance characteristics that can, however, only be checked in an actual market trial. If this is true, new entrants should be expected to react on perceptions about their relative (ϵ) characteristics in the markets they are

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[1] Increasing product quality through investment and marketing the product at the old price is, of course, formally also price competition. Empirically, however, it is something entirely different from the kind of competition presented in economics text books and associated with bulk producers in basic industries.

about to enter, on a presumption that they can do better technically. Whether new entrants are optimistic gamblers or well-informed professionals cannot be settled a priori. Hence, we can think of an above average ex ante and realized ϵ for the group of entrants as well as a positive ex ante average and a negative ex post average, with a very wide spread, and a very high proportion of exits (see companion paper by Granstrand). The latter case would be that of a lottery luring innovators to participate by the sheer, minuscule possibility of a very large pay-off.

Natural and artificial barriers to entry, on the other hand, may be a factor behind too stable rankings of firms, concentration tendencies and insufficient competition. A typical barrier to entry is a slow exit process due to industrial subsidies, or sheer financial resources with large competitive firms. We have studied the negative allocation effects of such factors in the Swedish M-M model (Eliasson-Bergholm-Lindberg 1981, Eliasson-Lindberg 1981).

In the context of the Swedish M-M model we have so far been able to demonstrate that the absence of new entry, introducing now and then some firm units that are superior in profit performance to existing firms, albeit smaller, generates both concentration in industry - which is obvious - and eventually destabilization of macroeconomic behavior. The latter is more pronounced the "faster the market arbitrage process", i.e., the faster the economy moves towards a situation similar to static equilibrium conditions, when $\epsilon_i \rightarrow 0$ (Eliasson 1983, 1984a).

(So far, we have not had the time to investigate to what extent concentration tendencies and instabilities disappear when diversity of structures is maintained through innovative new entry.)

It can be demonstrated that the existence of positive ϵ for a group of firms is synonymous with positive shifts in the macro production function for that group, or positive total factor productivity change. It has also been demonstrated within the context of the Swedish M-M model, that when all $\epsilon \rightarrow 0$, the whole production system becomes destabilized and the macro production function can no longer be identified empirically (Eliasson 1985a, p. 291).

2 e) The notion of costless productivity advance - introducing the markets for information

The notion of a costless shift in the macro production function has been around for considerable time. I won't elaborate that point, except bringing in a micro-macro version of Griliches-Jorgenson's (1967) method of correcting factor prices through an imputation method to remove the residual shift-factor of the macro production function. Their key notion is the proper pricing of factors of production. Their method highlights the fact that prices matter for any aggregate measure of productivity or technical change. My key notion is that the dynamics of market pricing (the market regime), or resource allocation is the prime mover of macroeconomic productivity change. The creation, the use and the remuneration of unique industrial knowledge through the capital market in particular will be related to productivity change.

The creation of knowledge capital is not costless, but its use may be cheap. And the creation of knowledge does not have to take place in, or be charged to the accounts of the same sector or agent, where its application occurs. A common notion has been to view the public sector as an infrastructure builder on which the private sector can draw services free of charge. If these services are significant factor inputs, but not accounted for, total factor productivity increases, as conventionally measured, will be registered in the receiving private sector, as a result of free factor inputs from the public sector (Eliasson 1985c).[1]

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[1] The suggestion of Arrow (1962) - see further section 4 - to maximize economic growth through subsidizing innovations and making them available as "free goods" to industry, would produce exactly that effect on a production function for industry. If, however, "socialization of innovative activity" is less efficient than a private, market supported innovative activity, the substitution of the former for the latter would produce the paradoxical result of raising total factor productivity growth in industry, while lowering productivity growth in industry and innovative activity combined.

I consider the fact that each innovating private firm offers a potential innovative input to all other firms through imitation. Each innovating firm, or entrant, hence, represent a form of "infrastructure" capital for the rest of industry - the opportunity set mentioned above - that in principle serves the same, upgrading function as subsidized infrastructure capital provided by the public sector. The more knowledge residing in all firms, the faster the new knowledge in the innovating firm spreads to its competitors. Innovating competitors, hence, both provide an opportunity for imitation and presents a competitive threat.

Even if the innovating firm has spent considerable resources on creating that knowledge, its adoptation throughout an industry may be quite inexpensive, provided the requisite industrial knowledge base or competence ("capital") to imitate, and to implement commercially is there. Total factor productivity change will be recorded, since the services from the "technological knowledge capital" in all firms initiating the new knowledge, are not properly recorded in the cost accounts. Exactly how this knowledge capital is accumulated is virtually unknown, and should be a prime concern of economics (Eliasson 1986a). Suffice it here to note (1) that the bulk of R&D budgets in private firms seems to be devoted to imitating knowledge, having been created elsewhere, rather than engaging in basic research, (2) that by this interpretation R&D, being part of the market trading of information is a very profitable activity and (3) that most of innovative activities in modern industry appears to be allocated on product quality upgrading, rather than on increasing the process efficiency of own production.

If technical know-how, competence or information or knowledge capital[1] is an important factor input in production that flows between agents in the market, it becomes important to understand how the markets for invention and information are organized. This boils down to the same thing as to understand who captures the profits from innovation, or the ϵ, and the role of ϵ as a stimulus for innovations.

[1] The distinction between these concepts is not clear in literature. I use the term "information" as knowledge separable from humans, for instance, the content of databases. Knowledge that cannot be separated from the humans, or the organization that, so to speak, cannot be communicated, we can call "tacit knowlege", using Polanyi's (1967) terminology. When "information" combines with human competence to use it, or know-how, we have knowledge which is embodied with the individual, a team or an institution. Hence, the innovative process in the market enlarges the base of technological information that individual firms can tap according to their competence.

3. The empirical nature of temporary rents

3 a) Diversity of capital market performance

The actual empirical ϵ-state is illustrated by the following set of figures. This time we, of course, have to recognize that all kinds of market imperfections may be responsible for the ϵ-rents observed. Figure II shows the distribution of real rates of return on total assets (R) less the Fisher deflated interest rate on industrial loans over installed machine capital in Swedish industry for 11 consecutive years.

Very clearly the ϵ-distributions exhibit considerable dynamics of behavior over the disorderly 70s. That something unusual occurred in the mid-70s is illustrated by the corresponding macroeconomic development in Figure III. (Note that the figure shows the real rate of return to net worth, not R.)

Since the (ϵ) controls innovative behavior in our theory through new entry, investment and exit, the outcome of the late 70s has been no, or little investment and/or increases in productivity, something that is also exhibited in Figure IV, showing Salter curves for Swedish manufacturing for the years 1976 through 1983. Potential, full capacity productivity distributions moved only marginally over the period. No increase in average, potential productivity was observed. As a consequence, the ϵ - distributions shifted because of variations in capacity utilization (that were surprisingly small), in wage cost levels and in interest rates. A comparison made also with the corresponding Salter distributions of actual productivity (not shown) suggests that all significant variations in the ϵ distributions of Figure II, had to do with changes in relative prices, telling the straightforward story that what matters is doing the right things, not so much doing it efficiently in factor use terms[1] - indicating the importance of the

[1] See Eliasson, 1985a, Figures VIII:A & B and accompanying text.

high level, long-term decisions taken at the top of the pyramid in Figure I.

3 b) Market dynamics and ε-turnover

The statistical presentation of the earlier section illustrates a phenomenon that we have frequently observed in simulation experiments on the Swedish M-M model. When healthy ε- distributions cannot be maintained, macro development is destabilized. In Sweden, a complete standstill in manufacturing output occurred for 10 years, after 1974. Post 1974 ε-distributions developed extended thresholds for which the R was only marginally above, or below, the interest rate (i) for a significant part of total capacity installed. As a consequence, the growth process was easily disturbed by external or internal "shocks" (see Figures II and Eliasson 1983, 1984a).

If innovative entry and renewal of old industrial structures slow down, the upper left part of the ε-distribution slides down. If exit is slow, the lower parts of the Salter curves with $R < i$ begin to dominate capital structures making a larger part of total capital vulnerable to adverse price movements. This situation was reinforced in Swedish industry through the industrial subsidy program, making it possible for "defunct" industry capital not only to stay in production, but also to pay the highest wages in industry (Table 1), a circumstance that also propped up the overall wage level, depressing the left part of the ε-distribution even further.

The distribution of ε-rents for a subset of firms and the movements of these distributions over time have been illustrated in Figure II. To get an empirical grasp of the turnover of ε is far more difficult, since it requires that we have data on the entire population of business units, as well as on new entrants and on exits. This has not been possible, and, in fact, a true representation of the diversity creation process should be presented on a much finer resolution than financial decision units. Figures V tell what we currently know from Swedish data. They show the stability of individual firm rate of return deviations from the group average for three consecutive five year periods. These deviations can be seen as approximations[1] of ε. An observation on the 45^{o} line means that the individual firm deviation for the group average is the same both 5-year periods. Obviously, the sample of large firms shown exhibits considerable turnover of relative profitability positions. Correlation coefficients are very low and tend to decrease with time. However, the sharp spreading of points between 1970/74 and 1975/79 is due to the oil crisis situation, suddenly shifting several Swedish basic materials producers into a critical situation (cf. Figure III). These were all large firms. Some closed down, some were absorbed by other large firms and are not shown in the figures. The basic materials producers surviving as independent firms recovered somewhat during 1980/84, thus moving the scatter slightly closer to the 45^{o} line. Since exiting and entering firms are not shown, the spreading of the scatters has probably been significantly reduced.

Table 1 **Relative wages in crisis industries**
Index 100 = Other industry

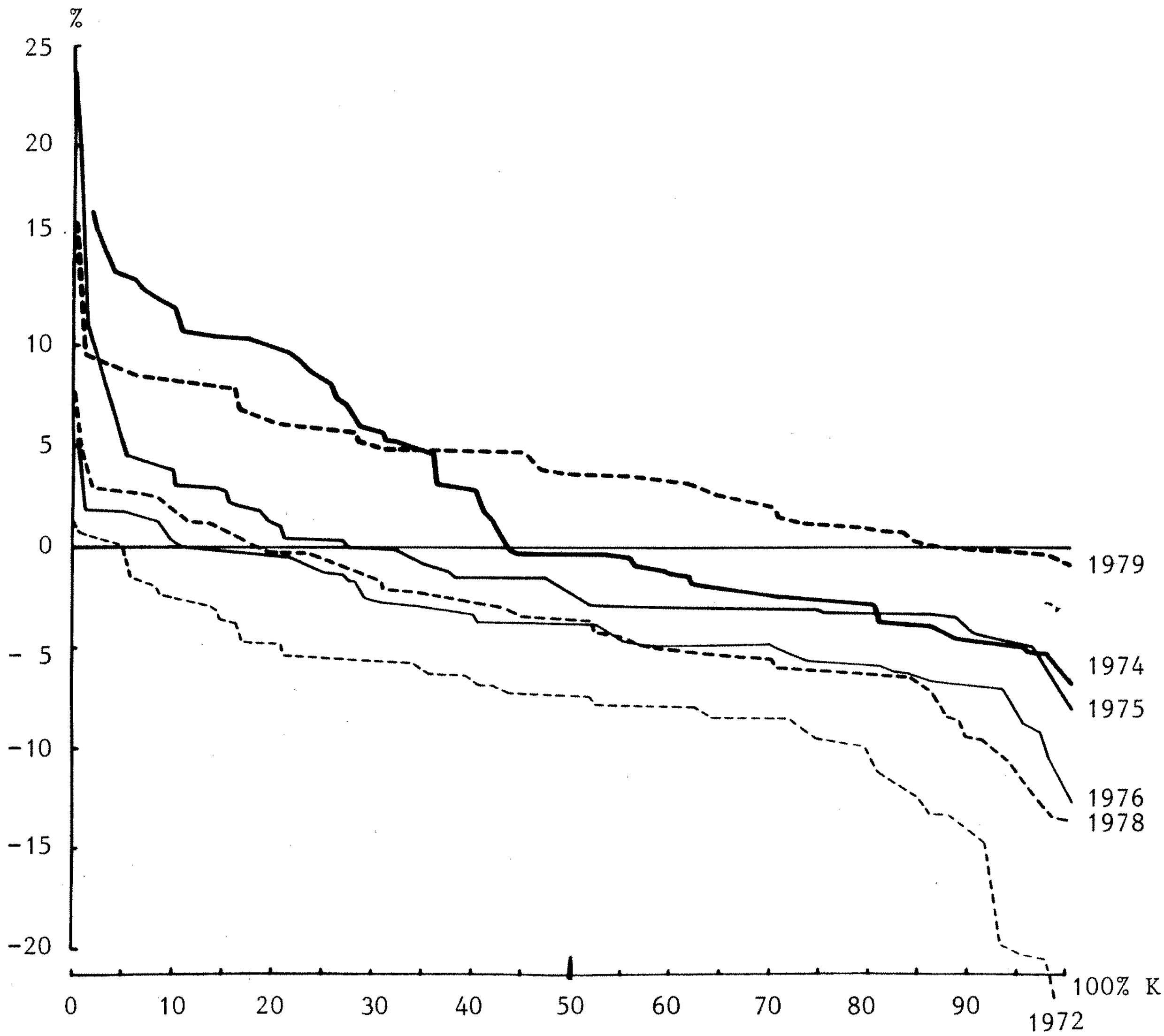
	1970/72	1974/76	1980/82
Iron ore	119	127	125
Steel	114	122	114
Shipyards	109	109	106
Other	100	100	100

Source: Örtengren (1986).

[1] If the group R average equals the real interest rate, the deviation equals ε.

Figure II **ε-distribution of difference between real rates of return and Fisher deflated loan rate for industrial bonds over installed machine capacity in Swedish industry, 1974-84**

(A) Years 1974-1979

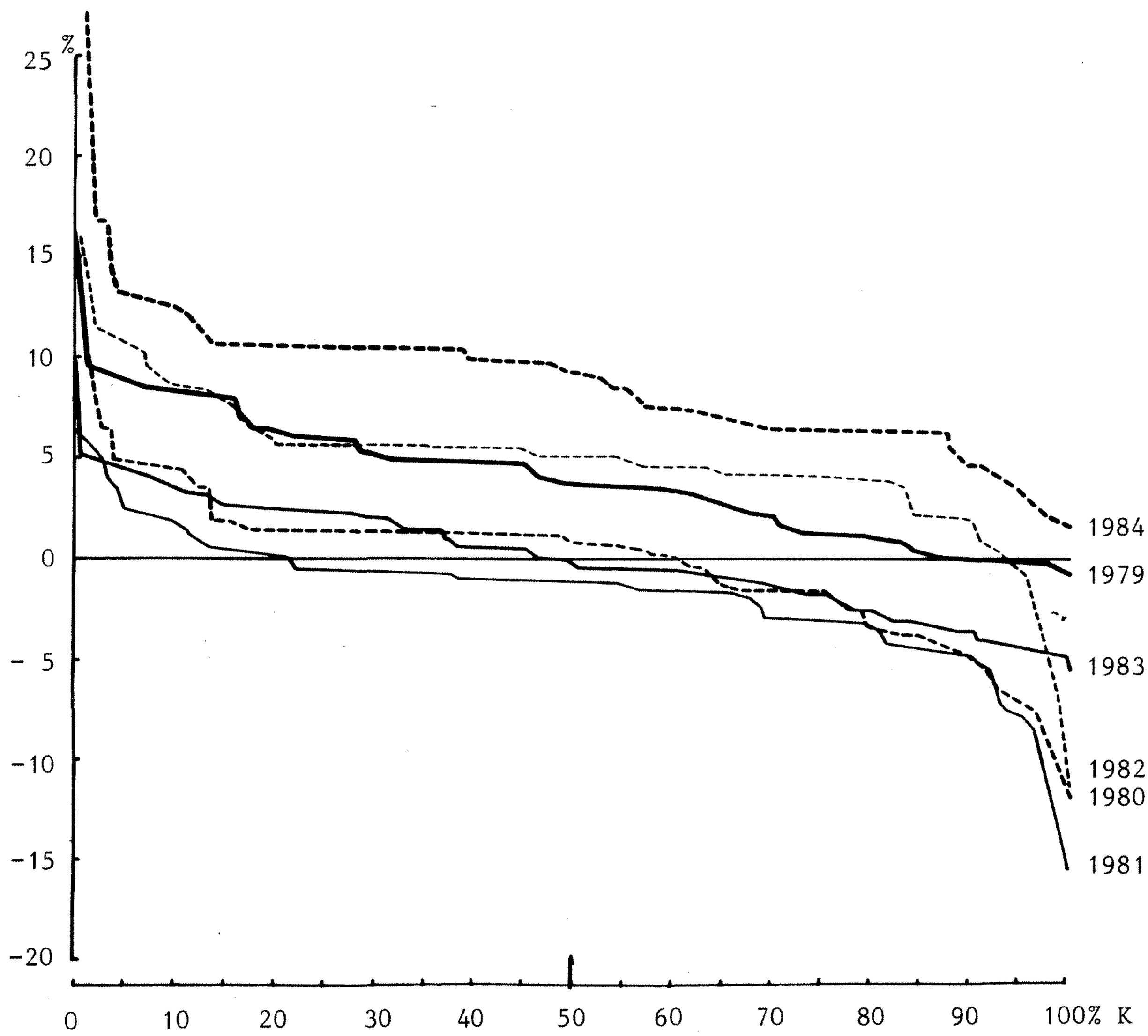


Note: R-i = ε as defined in the text.

Source: MOSES Database / Thomas Lindberg, IUI.

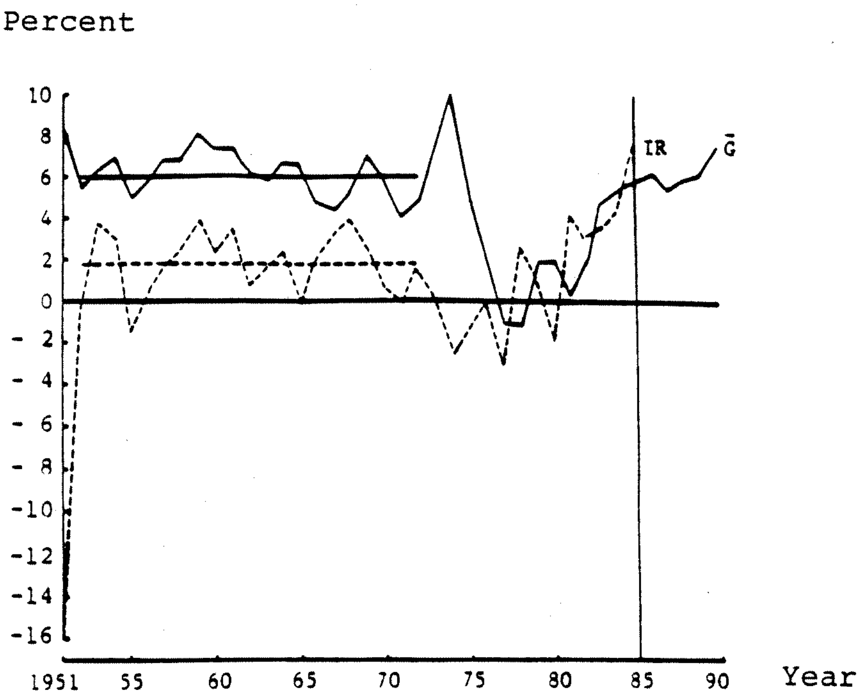
Figure II (continued)

(B) Years 1979-1984



Source: MOSES Data base / Thomas Lindberg, IUI.

Figure III **Real rates of return on equity in manufacturing ($\bar{G}$) and the nominal interest rate on industrial bonds, deflated by the consumer price index (IR), 1951–90**

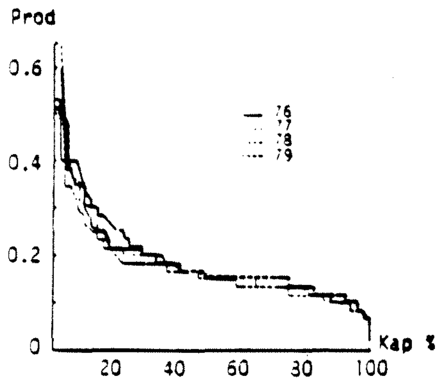


Note: Horizontal lines are averages for 1952-72. Note that $\bar{G}$ has been corrected for temporary capital gains because of inflation as in equations (III:10A) and (III:4) in Eliasson (1985a). Also see description of method in Södersten (1985).

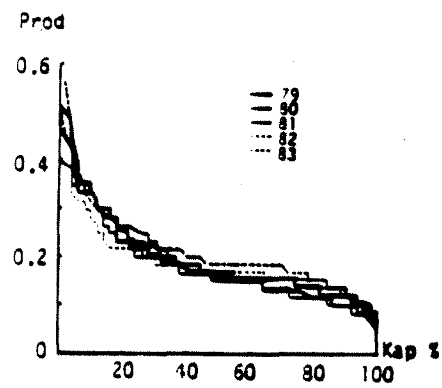
Source: MOSES Database / Thomas Lindberg, IUI.

Figure IV **Potential labor productivity distributed over installed production capacity in Swedish industry, 1976–83**

(1) Years 1976–1979
Potential productivity



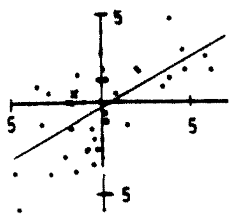
(2) Years 1979–1983
Potential productivity



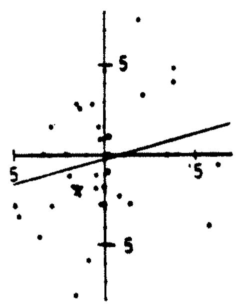
Source: MOSES Database / Thomas Lindberg, IUI.

Figure V **Rates of return today and tomorrow – the stability of relative profitability rankings among large, surviving Swedish firms**

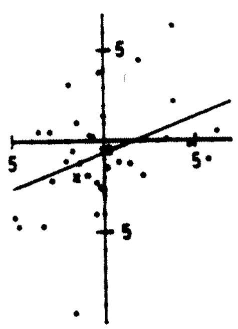
A. Years 1967/70 compared with 1970/74



B. Years 1967/70 compared with 1975/79



C. Years 1967/70 compared with 1980/84



Note: The scatter shows rate of return deviations from group average for four consecutive 5 year periods.

Source: MOSES Database /Thomas Lindberg, IUI.

4. The Markets for new ideas and information

4 a) How do innovators get their ideas implemented with a profit?

Our earlier argument concluded with the proposition that dynamic markets characterized by general monopolistic competition are needed to sustain a long-term stable growth process. In addition, there is a need for viable innovative entry and competitive exit processes to support market competition. The question raised in this final section is how market incentives should be organized and rents distributed to sustain a viable, innovative entry process.

Innovative activity can be viewed simultaneously as the creation of new industrial knowledge (opportunities), and the competence to use the new information thereby made available. The continued expansion of the opportunity set and the upgrading of local competence are necessary conditions for innovative rents in the economy. There are also other conditions needed to keep the innovative process in motion, which this section is concerned with. We look at the role of implementors, and the market for inventions.

von Weizsäcker (1984) offers a three level classification of economic activity. The three levels are:

(I) consumption,
(II) production and

a new, third level, namely

(III) "innovation"

as the creation of something new. The principal question of von Weizsäcker is: To what extent are inflexible rules, like patent legislation necessary safeguards for the beneficial conduct of the "innovative" function? von Weizsäcker offers no clear conclusion:

We don't know, but since in doubt we should rather opt for more innovation competition than less, and protect innovators from imitators to make sure there are enough incentives to keep society's attention to long-term concerns alive, and innovation mechanisms going. Protection is interpreted as protection by patent, law, etc. Hirschleifer (1971), on the other hand, pointed to the possibility of duplication and overinvestment in innovations if too much protection was offered. However, Ungern-Sternberg (1984) - using a version of the Arrow (1962) model - modifies these conclusions. With an assumed inelastic supply of R&D resources too short a period of protection may reduce incentives to innovate - the standard argument in favor of dynamic efficiency (Nordhaus 1969) - but too long a period of protection may make imitative R&D investments aimed at circumventing protection more profitable and hence stimulate a shift of scarce resources away from growth promoting innovative research, towards - it is argued - not so useful imitative research.

Arrow (1962) observed that protection prevents or prolongs the distribution of potential welfare created by the innovation to consumers and suggests that innovative activity should be subsidized by government. This procedure optimizes welfare in a static model. Innovations are immediately made ready for production for markets at (assumed) no costs and increases technical progress. Similar conclusions can probably be derived in a more dynamic setting if it is assumed (a) that subsidized innovative activity is as efficient as innovative activity generated in the market and (b) that the implementation phase draws insignificant resources. As Demsetz (1969) suggests, the first assumption is probably wrong. We will argue - and support empirically - that the bulk of investment expenditures in the modern firm is devoted to making the innovation ready for full scale production and that most R&D spending in manufacturing is imitative, aimed at improving existing processes, designs and products in a piecemeal fashion. This is the important part of the innovative process and it makes the distinction between basic, innovative and imitative research empirically dubious. As a consequence the second assumption as well is wrong. Hence, - by Arrow's (1962) own argument - the nature of the transfer of an innovative idea into full scale production for markets is critical for a discussion of both incentives for innovative activity and of patent protection.

On the one hand the innovator has prior knowledge of his innovation. He therefore has an information advantage (a lead) in its exploitation. On the other hand protection prevents other producers from imitating and distributing the "surplus" created by the innovation to consumers in the form of better and/or cheaper products, before the innovator has earned enough of a return to keep him in innovation business. The balance in favor of, or against protection cannot be settled without more empirical evidence than we currently have.

To discuss this trade-off we have to distinguish between autonomous inventors (individuals), small company innovative entry and "intrapreneurial" activity within large business organizations. The individual inventor is most removed from the implementation stage. The large business organization, on the other hand, internalizes both innovative activity and implementation. One could even say that salaried research within the large business organizations does internally what Arrow (1962) suggested, that the Government should do for the whole economy: subsidize and, hence allocate R&D money. My argument is that the socially optimal arrangement for the generation of technical advances in production and growth in output, for one thing requires the existence of viable implementors' markets and secondly, that it is doubtful that sufficient innovative activity can be generated through a non-market scheme.

I suggest by reference to empirical studies that the transfer of a new idea from the stage of an "innovation" to production for markets (the implementation stage) represents <u>the major investment expense</u> both on "innovative", "capacity installation" and "marketing" accounts. Hence, the existence of viable markets for users of innovators' ideas - markets populated by implementors or imitators

- becomes critical not only for the efficient distribution of technological rents to consumers, but also for the value and the existence of innovative activity. However, (1) would such markets exist if the "innovation" could not be made available exclusively to one, or a few of all potential users? (2) Will innovative incentives be created if implementors' markets are imperfect? Finally, (3) can innovations with a market potential be efficiently generated through a government subsidy program?

The first question moves the argument for protection one step ahead to the implementation and imitation stages. The second question - if the answer is yes - makes the existence of vital implementors' markets critical. The third question - if the answer is yes - means that government can choose ex post flows of innovative output as part of a technological or industrial policy program. Evidence does not suggest that this is a feasible policy option, but rather points to an abundance of non-market failures (Eliasson 1984b).

4 b) How do we organize dynamic markets for innovations: What role do patents have in the trade of innovations?

Property rights, or patent rights can be natural or legal. But whether they are natural or legal, they may be less than perfect, or badly defined. If so, we are discussing a market for property rights with externalities.

An important question, hence, is whether patents both protect the innovators incentive and - at the same time - promote a socially optimal application of innovations, because without such protection an active market would not exist. I will address this issue in the context of a market for innovations. In some cases of innovations, patents do not protect adequately. We then often find that the innovation and implementation stages are internalized within the administrative system of the firm. The market for innovations consists of implementors on the look-out for new ideas and inventions in the "open market" as well as within large business firms. Without the implementors there won't be much commercial value in the new ideas, since the inventor is rarely also an industrialist, competent to realize his idea in the form of production.

History exhibits a steady increase in the importance of innovative activities and "a corresponding change in society's institutions" to deal with exactly this problem. von Weizsäcker (1984) notes that the most significant such change is the growth of government as a protector of innovators' "level III" monopoly rights, most importantly in the form of the patent institution to prevent free riders from exploiting new ideas before the inventors and the innovators have reaped a profit. More recently, large amonts of government subsidies have been spent to promote and finance innovations (cf Arrow 1962), and make them available as public goods (see Eliasson 1984b).

In former times the market itself took care of the protective functions by the endogenous creation of monopolies. Traders colluded and paid mercenaries to protect them against physical assault. They formed city states (like medieval Venice, Milan, Florence, etc.) or conglomerates, city states (like the Hansa) or the large multinational corporations of today that incorporate important innovator protective or insurance functions. The protective function was, so to speak, internalized through hiearchies or through the formation of a "firm". In fact, the patent institution in a legal meaning was first used in Venice in 1477. Craftsmen were granted a 10 year exclusive right to products they had invented. What exactly is the "protective need" of an innovator that cannot be organized privately by the market or be internalized within a firm? Is the government the most efficient, or the right protector?

Speedy imitation of new ideas robs the innovator of his profits from exploiting, selling or licensing his idea, and we know that many large firms are organized precisely to be efficient imitators (Mansfield et al. 1981). Their strength then lies in picking up new ideas from the set of opportunities, combining them with their competence to implement them both effectively and profitably in the form of "level II" production. As a result they can be innovative in the "routine" sense of the old 1942 Schumpeter, meaning imitation and further development. (But, by this very action they also expand the opportunity set for other firms.) More innovative infrastructure, so to speak, is created by imitators for new imitators to copy, and so on.

Sometimes industrial secrets cannot be protected anyway because patent rights are badly defined. There appears to be a certain leakage flow related to innovations whatever is done (Mansfield, 1985). In a broad range of manufacturing activities imitation costs appear to rise only slightly because of patents. Sometimes the complexity of the product, however, ensures "self-protection" from imitators. Complex "development blocks" using Dahmén's (1950, 1984) term is a case in point. You can neither protect nor steal the idea of a development block. But it requires time and resources to build, and the firm that is ahead has a lead, and its very existence - if it is successful - is a formidable barrier to entry. The development of various forms of market networks, knitting many purchases and customers together, is another form of protection extensively used by the modern firms (Eliasson 1985b, 1986a). With a global and efficient marketing network, it may not matter so much that a technical innovation can only be kept secret for a brief period. The inventing company will have the new product in the global market and have time to get developed money back with a return before competitors-imitators get their claws out. Another example of this is to build a product quality image through a brand name.

A particular instance of privately created externalities, or public goods is the formation of standards. IBM's entry into the PC market is one example. This can perhaps be said to have been done through sheer commercial strength. IBM may benefit. The whole industry and the consumers certainly do. There are numerous other examples in the small and in the large (e.g. casette tapes). Should such standards rather be instituted through government? I am not sure. A very active experimental activity certainly has preceded the market introduction of standards. If it is done through government it is preceded by investigations, research and bureaucratic action. It is impossible to tell which method is most efficient. It is sometimes argued that government should step in when the market cannot collude on a common standard. But one could also argue that if the market is unable to find a winning standard, time is not yet ripe, and further experimentation is needed.

It is interesting at this stage to ask to what extent Arrow's (1962) suggestion applies to salaried innovative activities within large business oranizations. How does such R&D activity compare in efficiency with Government subsidized R&D activity? If it is efficient, and if the large corporations are the efficient implementors, what is the economic function of legal protection of new ideas?

One rationale for government is the avoidance of double work that comes with experimentation through competition. However, for truly innovative research duplication can hardly be defined. It is all very experimental in orientation. Hence, search is part of the method of research, and the more basic research, the more of search and trial and error you have, and the less viable the duplication argument and the standard efficiency argument. This argument becomes viable when the research activity becomes well defined and moves into the imitation stages, the stage that Arrow (1962) argues should be freed of protection. However, at this "implementation" stage, imitative R&D is very close to duplication of investment for production, which we normally call competition. Furthermore, the idea of centrally subsidized or organized industrial R&D to avoid duplication and/or negative incentive effects, refutes the idea that the nature of the R part of R&D is experimentation and learning through mistakes and, hence, has to be run in a decentralized fashion to be efficient.

The case for centralized and subsidized R&D has to be found elsewhere and the financing risks associated with giant research programs into untried technologies may be the rare type of examples we have to look for. However, also here the logics is not straightforward. It is unclear, whether - excepting urgencies like the Manhattan project - giant, focussed research ventures is really the efficient way to do it in industry. Such organization of research for one thing has a bad track record of good commercial and economic focussing (read "Concorde"). The enormous, dispersed R&D spending programs of some twenty large high technology firms to create the as yet undefined, comprehensive "business information system" currently in progress (Eliasson-Fries et al., 1984, pp. 87 ff) may be the most efficient organization of industrial R&D when it comes to commercial focussing and actual carrying out of R&D work. This is so despite the fact that the total ongoing activity may look very wasteful because before the race is over a significant number of large players will most certainly be out of the business.

The ability to finance efficient and fast implementation of new ideas nevertheless constitutes protection for innovators. Experience, however, is that innovativeness, on the one hand, and financial capacity and efficiency of implementation, on the other, cannot easily be managed under the same roof (see Figure I, and accompanying text. Also see Eliasson-Granstrand 1981, 1986). Hence, separation of inventive and innovative activity, on the one hand, and execution, production, and distribution, on the other is the normal organizational mode within large business units. To transform a successful invention from a tested prototype to mass-production within a firm where all necessary information is freely available is, in fact, one of the most difficult management problems of large business organizations. Dominant and conservative business organizations that base their economic life on routine factory production often reject new, for their operations disturbing innovations (Eliasson-Granstrand 1986). Hence, firms strive hard to find organizational solutions to achieve fast <u>internal trans-</u>

mission of innovations, from idea to realized implementation, or in our terms, to create a viable internal market for implementation.

Organizational inertia, hence, often is a highly efficient protective shield for the diffusion of new innovations in a bad sense. Quite often the problem of the single inventor is not so much that someone will steal his idea as soon as he mentions it, but rather the complete absence of attention and interest among potential users. The exposure to rapid, commercial imitation does not come until the invention has been put into production and when the market has exhibited a positive response. At this stage a significant addition of investment has normally been sunk into the original idea, often far more than what had been expended up to the prototype stage (see companion paper by Granstrand). This explains why autonomous inventors often find it optimal first to build a company first to develop, produce and sell the new product on a small scale before some larger firm is willing to acquire his company and his idea. This behavior is similar to those observed with producers of large and complex systems products, like digital switching and communications gear, namely to find ways to clinch a first contract fast, and to build a reference installation to demonstrate that the product works. This observation highlights the importance of venture capital markets and venture capitalists as initiators of the implementation phase.

If this observation could be generalized, patent protection from imitators would not be a protection for the original inventor from imitators. The problem is rather how the inventor should be able to find a buyer/implementor of his idea, that would pay him enough to keep him inventing. Would such buyers exist, if the invention, the exclusive use of which he purchases, is not protected from imitation by law?

Presented in this fashion, it is the buyer of the invention that needs protection from third party imitators. The buyer can easily protect himself from double use by the original inventor through a normal sales contract. If this is accepted, we only have to repeat what we just said, that the best protection for the buyer is being more efficient in implementation than potential third party imitators. The larger the number of competitors, the easier for the original inventor to find a competent implementor that pays him so well that he will keep inventing, or to use Demsetz' (1969) words that if two "free loaders are allowed to use successful research" of one inventor, without paying him "he will reduce his research efforts. But then the two free loaders will find it in their interest to buy additional research from the inventor" and the requested market has been established.

In fact, the market place offers plenty of examples of how this problem can be solved. Quite often business organizations with large financial resources, that have developed, or bought a new product design, start immediately on a very large production scale, to recoup monopoly rents fast through high prices, and then go down in price to counter emerging imitators, and prevent them from capturing large market shares to enjoy economies of scale. The question for the inventor is rather at what stage it is most profitable for him/her to reveal his secret and sell it to a buyer - implementor. If he is bad at implementation, or in a hurry to do something else, he should sell early, thus unloading most of the commercial development, production and marketing risk on the buyer. Compensation would be low. But the more developed venture capital markets the easier for him to unload his idea fast, at a satisfactory profit and to someone who is more efficient than he is to carry the project further. He may, nevertheless, want to go a little further, starting up small scale production, secretly, and then offer a product invention tested in the market at a higher price. This, in fact, has become very common, especially in the U.S., with small innovation firms taking their ideas - often quite sophisticated - as close to the market as they can and dare, and then offering the whole firm to large scale producers with production facilities and a marketing network for rapid implementation. This established buyer may - for reasons mentioned earlier - lack new competitive products, despite a very large financial capacity. Several large U.S. pharmaceutical companies are currently in exactly this situation (see Business Week 1985).

Even IBM has gone through three stages attempting to acquire the knowledge needed for digital switching and transmission. They first attempted inhouse R&D to catch up (read imitate and improve) on competitors technology. This approach was not fast enough. It then tried cooperating with another company and, finally, purchased a highly advanced, established producer (Rolm) in this field. This was considered by them to be the fastest, least risky and least expensive way to acquire the competence. Part of the risk was commerical in the sense of being late in offering the needed technology in their new complex information products (see Business Week, Nov. 19, 1984).

When innovator output is complex and unfamiliar enough imitation is both costly and time consuming. This allows the innovator either to commercialize his inventions if he has the implementary competence to do it. Perhaps innovator's need for protection from rapid imitation primarily applies for coca-cola type inventions when well defined "recipes" are available, and the market is free of externalities. Artist signatures are similar examples where rapid imitation is sometimes easy. And it is possible to protect some of these "recipe-like" inventions from direct copying and reproduction, even though it took long for some important cases to receive legal protection in some countries. I am thinking of "brand names" and - a recent example - electronic circuit designs.

As one moves further away from directly "copyable" inventions, externalities emerge and the possibility to protect them by law diminishes rapidly. They are difficult to specify and, hence, to communicate. Licencies are difficult to define, and hence to sell. Innovators, or firms, often attempt to protect themselves through internalizing the implementation stage, or part of it. However, the need for protection then also diminishes, and for the same reasons.

It is, therefore, difficult to develop a general rationale for protecting the unique "information" of an inventor, or a team of innovators from theft by imitators. Isn't it his problem to rush his invention into stage II implementation? He has an important knowledge lead, and if the profit outlook is promising there should be market solutions. The key notion is that a major entrepreneurial and implementation effort comes in between the idea and production. Hence, the best protection for the idea man (the inventor-innovator) must be a rich variety of market services for the further development of his product. Is there an obvious need for the government to step in as a protector of innovators, beyond its task to protect and to stimulate a broad range of market opportunities, to remove barriers to competitive entry and the forming of artificial monopolies that keep competitors out of the market?

As Granstrand suggests on the basis of both theoretical discussion and empirical examples (in his companion paper), zero legal protection is not the inevitable policy conclusion. Since there are cases when the absence of legal protection may be a disincentive to innovative activity, even though implementors' markets are lively, the question is really, since we don't know, what harm is there in being somewhat overprotective to innovators (cf. von Weizsäcker's, 1984, conclusion)? Perhaps not much. At most you force the consumers to wait a few years longer for the full benefit of the consumption potential of the new innovation. In a society that takes a long term view on its economic welfare the present value of the total output lost through slow imitation will be small compared to the present value of the extra future output generated by new innovative activity financed by the quasi monopoly rents received through patent protection. What matters is the existence of many competing, efficient implementors, and as Granstrand also indicates in his companion paper, the diffusion of unprotected new ideas and innovations appears not to be faster than the diffusion of protected ones.

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