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by

Gunnar Eliasson

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PRELIMINARY

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INNOVATION, INDUSTRIAL COMPETENCE AND THE MICRO FOUNDATIONS OF ECONOMIC EXPANSION

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Gunnar Eliasson

The Industrial Institute of Economic and Social Research (IUI), Stockholm

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1. INTRODUCTION.

Three phenomena in particular are making life difficult for the economist today. First, 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. Second, production technology is increasingly moving economic activities across the statistical categories we have become accustomed to. Third, 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, IUI the institute I come from, 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.

My introduction moves the focus of economic growth analysis into the imperfect parts of markets, notably product markets, more and more characterized by competition with technological product innovations, the labor market more and more concerned with allocating human embodied competence – not labor – and the stock market end of the capital market which exercises an increasing pressure on the structural reorganization of business firms. This is where firms reside. This is where the core of the growth engine of the economy is.

The business firm lives on its competence to achieve synergy effects out of integrating markets through its administrative system. Sometimes the market is most efficient and firms break up, sometimes administrative systems outperform markets and larger and larger firms emerge. The relative rates of innovative activity in financial markets and in administrative technology determine the outcome.

This presentation[1] introduces the theme of my paper, the firms in dynamic markets as the driving forces behind firm formation, expansion and death, together constituting the growth engine of the economy that drives the macroeconomy through what Schumpeter called innovations, entrepreneurship and creative destruction. These economic processes are experimentally organized and unpredictable, as they are represented for instance in the micro–macro simulation model of the Swedish economy, developed at the IUI. Economic growth ultimately rests on human based competence that has to be steadily upgraded and diffused through the economy. Therefore it becomes natural to begin to discuss economic growth under the heading of The Knowledge Based Information Economy and then to proceed with the aggregation problem and present the processes that link competence based micro behavior with growth in macroeconomic output.

Concentration caused by economies of scale is a classical problem within the classical, static general equilibrium model. It is a theoretical concern there. It is a practical concern in U.S. anti–trust policy and German cartel legislation. It was a political problem for Joseph Schumpeter (1942) who saw the technology of routinized innovative activity breed superior firms that first took over markets, reducing or eliminating competition, then merging with Government destroying democracy. The political problem is gone at least temporarily for two reasons. In the experimentally organized economy, no player, not even IBM is safe. The global integration of markets for technological competition has made market concentration a less relevant problem. Technology is pushing for smaller scale in a variety of markets, where economics of scale had earlier ruled. Technological competition in global markets currently is intensifying competition to the extent that whole industrial nations think of themselves as suffering. In this context it is interesting to observe Bo Carlson's results[2] that while most industrial nations register a decline in the average size of their firms and manufacturing plants

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[1] My presentation and my paper draw directly on several studies at the IUI: most importantly a forthcoming IUI book under the title **The Knowledge Based Information Economy**, but also Eliasson, **Technological Competition and Trade in The Experimentally Organized Economy**, IUI Research Report No. 33, Stockholm 1987, Eliasson, **The Firm as A Competent Team**, IUI Working Paper No. 207, 1988, Eliasson, **Modeling Long–Term Macroeconomic Growth**, IUI Working Paper No. 220, 1989 and Eliasson, **The Economics of Coordination, Innovation, Selection and Learning** – a theoretical framework for Research in Industrial Economics, IUI Working Paper No. 235, 1989.

[2] See Carlsson 1988, **The Evolution of Manufacturing Technology and its Impact on Industrial Structure**: An international study, IUI Working Paper No. 203.

across industries, Sweden is exhibiting exactly the opposite development, emerging out of the crisis years of the 70s with very large, and very competitive multinational firms operating in mature markets and dominating the production system of[3] the Swedish economy. The knowhow to efficiently operate and to successfully reorganize large business enterprises is an important part of the industrial competence upon which industrial nations base their economic wealth.

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[3]See **De svenska storföretagen**, (**The Swedish giant corporations**), IUI, Stockholm 1985.

II THE KNOWLEDGE BASED INFORMATION ECONOMY[4]

Classical economics is concerned with physical flows of production. As comprehensive national statistical measurement systems were being designed and developed during and after the second world war, theories dealing with physical quanteties that could be measured were refined to perfection both theoretically and in its empirical applications. 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 look at economics as 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 has to be concerned with. The organizational structure very much controls the information processing of 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

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[4] This section draws largely on a forthcomming IUI book with the same title.

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. This choice, 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 activities 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 "selection" of organizational forms (item 3) and through learning (item 4). The development of that organizational memory occurs largely through the experimental organization of markets, and is 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 my institute, 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 over Salter curves).

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.[5]

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.

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[5] 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.

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 <u>future</u> bears on today and partly (a modelling and measurement problem) the <u>units of time</u> by which economic activity should be measured, problems discussed already by the Stockholm School economists. (The first part of the time dimension incorporates the <u>ex ante ex post realization process</u>, 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 market 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 people with competence and 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 – on the innovative, coordinating, selecting and learning processes of the economy. 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[6].

Much of the competence I have refered 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 measurable at all.

To understand technological advance in terms of the four activity types in Table 1, on the other hand, 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.[7] 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.

[6] Eliasson; **The Knowledge base of an Industrial Economy**, IUI Research Report No. 33, 1988.

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

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.

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.

III. THE MICRO FOUNDATION OF ECONOMIC GROWTH

The above principal analysis places the dynamics of firm (innovative) behavior in the core of the economic growth process. The Salter curve examples essentially remove the foundations for static aggregation. There is no stable macro theory of economic growth, beyond the descriptive value of production function measurement. Growth has to be built explicitly on micro behavioral assumptions, i.e. dynamic aggregation in markets has to be an explicit part of theory. The minimum stable unit of measurement that can be measured in the sense that ready made statistical systems exist is the firm or the division. This is the main idea of the IUI micro–to–macro model of the Swedish economy. It models firms as financially defined entities with financial objectives that operate on the basis of their own information systems, that serve as the statistical source for the model, (Eliasson 1985, Chapter VIII).

Firms in the model occupy positions on the Salter curves. They learn about themselves and their environment. They invest and they make production and hiring decisions. In the process prices and quantities are set and the Salter curves (the organizational structure of the economy) are updated, thus setting the stage for price and quantity decisions in the next period and so on. A significant part of the performance upgrading of entire economies comes via the selection process (see Table I) i.e. through entry of new firms and exit of inferior firms, together representing the Schumpeterian innovative and creative destruction processes. The outcome is a path dependent evolution of the economy, a development that exhibits phases of erratic or chaotic behavior, a development that is very difficult to control or manipulate centrally as proposed by classical theory. To influence such an economy, or such a model of an economy, a very different "policy technology" has to be designed than the classical repertoire, that neglects the problem of how to be sufficiently informed about the economy to be policed[8].

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[8] A brief, but more explicit presentation of the Swedish micro–to–macro model, including its properties can be found in Eliasson, (1989).

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).

IV ECONOMIC SYSTEMS PROPERTIES

The dynamics of learning and competing that leads to the updating of the upper left hand section of the Salter curves and the creative destruction of its lower right hand tail is the essence of the growth machinery of the MOSES micro–to–macro model. The spread of the Salter curves determines the intensity of competition. The intensity of competition determines the macro productivity properties of the entire economy.

First I study long–term growth and productivity performance of the model under stable market conditions, when quantity change does not disrupt the price system unduly and vice versa. I then investigate technical change under more or less rapid market regimes to see under what circumstances long–term, very rapid and stable macroeconomic growth can be achieved. This will all be a verbal summary of a large number of published studies. I conclude with some quantitative illustrations of the micro dynamics of variously designed macro growth processes.

IV.1 Close to steady state growth experiments – the business cycle

To understand the relationship between technical change at the micro level, productivity growth and growth in output three distinctions have to be made.

First, technical change is diffused gradually. The market organization determines the delay before new technology affects productivity growth. A classical way of illustrating this is through measuring production at best–practice technology and compare with the productivity distributions of installed capacity (Salter curves).

Second, aggregate productivity is not improved if best–practice technology is allocated in the wrong markets or the wrong production lines. The efficiency of the allocation of investment matters.

Third, productivity per se is not the right goal variable to be concerned with. Firms are not and economic advisors should not. Long–term economic growth is more adequately related to profitability, the competence to produce the right, highly priced goods and services for the right markets, and the ability to maintain a high rate of return and a high growth rate for long periods. The rate of return is in turn a price weighted productivity measure.

To begin with all the diffusion of best–practice technology ("learning") depends on economic factors. It is asymmetric and usually slow (Eliasson 1980).

<u>Increases</u> is best–practice technology take a long time to show up as productivity advance. Intensive market competition speeds up the process somewhat. In Eliasson (1987, Chapter IV) a domestic market protected form foreign price competition and a regime with price elastic foreign trade is compared, holding best–practice technology constant. The specialization effect on the macro economy from price elastic output competition is slow to come but very strong in the long run. If exogenous best–practice technology is <u>decreasing</u> in productivity (we can impose that unusual situation) the negative effects on productivity are much faster to come, everything else the same (Eliasson 1981, p. 86).

We have demonstrated that rates of return are price weighted productivity measures. Hence, from an economical point of view the choice of right price environment (market, product) is as important for profit and welfare as productivity performance.

If firms overinvest in high productivity production techniques in the wrong markets a negative correlation between advance in best–practice techniques and aggregate productivity growth may occur. As Carlsson (1987) shows the allocation of investment normally means much more for macro productivity advance than the increase in best–practice technology (the shifts of production frontiers). Generally speaking, from an economic growth point of view the economy should allocate its resources to areas where they produce maximum value to end uses, as they show up in relative product prices. From a welfare point of view it may be optimal to see growth occur in typically low productivity service production rather than in high productivity manufacturing.

Under normal circumstances (orderly pricing in markets) the model economy exhibits standard neoclassical behavior. Increases in interest rates (Eliasson 1984, p. 27) reduce long–term growth rates monotonically. When market speeds have been calibrated such that the economy behaves well (the reference case) a typical business cycle is exhibited around the long–term growth trend[9].

IV.2 Structural diversity and stability of economic growth – the growth cycle

The Swedish micro–to–macro model is strongly non–linear and market prices are easily perturbed by sudden quantity adjustments sending off trails of more or less dramatic price quantity interactions in the economy. The size of quantity shocks and the speed of markets are decisive. This means that the model exhibits as a typical property phases of seemingly unpredictable behavior ("chaos"). Individual business mistakes is a normal micro property and can be seen – in a macro context – as a normal cost of economic growth. Under disorderly market conditions, however, such mistakes can result in dramatic macro behavior.

If you attempt to remove mistakes by forcing markets to perform more efficiently in a static sense, through speeding up market transactions, you can – for long periods – increase productivity growth through eliminating slack and mistakes (Eliasson 1983, 1984, see Figure 5a in particular). However, the closer to a steady state characterization of the economy you get the more potentially unstable the system. Wages become the same across the market; productivity rates are the same (the Salter curves become flat), rates of return are becoming equal across the markets and diversity of structure disappears. The less diversity in the economy the more sensitive it is to small adjustments at the micro level which push actors over broad flat surfaces with no natural stopping places. In a dynamic model diversity of structure corresponds to the convexity assumption in the static model. Once the extremely rapid macroeconomic growth rate achieved through fast market processes get slightly upset a growing instability of the adjustment process, and possibly collapse can be observed (Eliasson 1978, 1983, 1985, p. 292).

This macroeconomic behavior has been numerically simulated (Eliasson 1978, p. 105 ff, 1983, 1984) and a half baked theoretical analysis if found in Eliasson (1985). The collapse means a temporary – a couple of decades – close down of parts of the economy, diversity of structure is restored and when the prices

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[9] The coefficients have been calibrated such that the model tracks historic macroeconomic variables. See Eliasson (1985, chapter VIII).

have eventually been stabilized to reflect to the new quantity structures of the system, macroeconomic growth is gradually resumed. In a historic perspective the long–term growth of this bumpy market regime appears to be inferior to a more constrained ("slower") market regime. Economic growth may in fact never really come back for very, very long. On the other hand if market competition is very much reduced, eventually the allocation machinery will be so inefficient that long–term economic growth virtually vanishes. There is an optimal intermediate growth path corresponding to an orderly experimental market process (Eliasson 1983).

With macro productivity and output growth mainly generated by economic forces, under the constraint of an upper technological best–practice limit, it becomes interesting to understand the dynamics of resource allocation that positions the economy somewhere underneath this maximum growth path. (It is determined by the balance of innovating, coordinating and learning (new knowledge diffusion) processes of the economy, or in short improving the technology of economic information processing.)

In a first round of experiments (reported extensively elsewhere; Eliasson 1983, 1984), the state of technology – available best–practice productivity technology – was held constant. A series of simulation experiments varying the "market regime" characteristics only were run. I found that the speed of adjustment to price signals was far more important for productivity performance than the parallel development of best–practice technology, since the economy was always operating far below best–practice capacity, as long as price signals were reliable predictors of long–term future prices.

This predictability depend on sufficient slack, to smooth the adjustment process. If speed of allocation was increased the economy operated as a car on a narrow road; as long as it stayed on the road arrival time got closer and closer,but the margin of errors decreased. In the economy flow performance could be increased until all of a sudden a small disturbance tipped the entire economy. Once this had happened the price system was in complete disorder, price signals misguiding output and investment decisions causing further disorder. A period of some 10 to 20 years was needed to stabilize the price system, and in the meantime productivity and growth performance were down. The robustness of the model economy has increased as the database has been improved, meaning a more detailed specification of the structure of the economy (cf. Eliasson 1978b, 1983, 1984). Still, however, the absence of an entry feature has meant that concentration tendencies have eventually taken over, reducing diversity of structures.

IV.4 Price instability, price reliability and efficiency

Efficiency of market coordination largely rests on the reliability of market price and quantity signals as predictors of future prices and quantities.

Destabilized (relative) prices, prices that are systematically pegged differently from what a free market would set (regulation), or wedges due to taxes and subsidies distort allocation mechanisms and cause a deterioration in productivity performance.

A particularly interesting case is to study the systems response to the price shock that occurs when a regulated price structure is removed and replaced by a free price adjustment. A case in point is the adjustment disorder that the centrally planned Chinese and Russian economies are currently experiencing when being opened up to free market competition. Similar, but more gradual experiences occur when barriers to trade are removed and a common price system imposed on a wider area through competition. (Also cf. Eliasson 1978b),

Removing the constraint of regulated prices should generate a long–term improvement in allocative and process efficiency of the economy. However, during the intense period of adjustment when agents are experimenting with price, cost and quantity combinations to find an "equilibrium alignment", macro productivity might very well deteriorate. We have found (through simulation experiments) that this adjustment period is very long, that performance comes down on average, but not very much, but that quantity development is very unstable during the adjustment period. This instability is a parallel to the deficiencies in structural diversity discussed in the previous section.

The macroeconomic effects of three different kinds of price distortions have been analyzed on the model; (1) tax wedges in the investment allocation process (Eliasson–Lindberg 1981), (2) industrial subsidies (Carlsson 1983a, b, Carlsson–Bergholm–Lindberg 1981) and (3) price overshooting, notably wage overshooting (Eliasson 1977a, 1978b, c, 1983a, Eliasson–Lindberg 1987).

These experiments fall into two categories, one where price distortions are permanent, and one where they are temporary and endogenously self correcting.

Price overshooting is a temporary price distortion. A seemingly paradoxical result from model experiments is that the faster price adjustments in markets, the more prone to price overshooting the economy and the longer it takes for prices – after a disturbance – to return to normal, cost aligned (equilibrium) rates. The reason is that once the quantities of the model has been affected by "erroneous" price signals, then the entire price and quantity adjustment structure of the economy gets disorderly, and no "rational expectations" algorithms – that we have found – exist that allow the disorganized economic machinery to become dynamically transparent fast. In fact, once significantly disturbed by the cost crisis in the 70s the model economy took more than a decade to get the price system back in order. At the time we "learned that" this was not part of current economic wisdom. Since economists at large expressed disbelief, we were unduly cautious in formulating the results (Eliasson 1978b, c). The long adjustment period has been confirmed by empirical analyses on similar structured price data (Genberg 1983).

The price adjustment of the Swedish economy was significantly aggravated by the industrial subsidies of the mid–70s, inserting temporary price wedges, especially on the wage setting mechanisms, but also in the mechanisms controlling the allocation of investment. Several different policy scenarios, the actual subsidization scheme of long–term production growth and employment was – as expected – the actual subsidization scheme. The next best scheme would have been to lower wage taxes across the firm population, the total tax reduction being equal to total subsidies. There would have been local, intermediate and raumatic unemployment experiences when crisis firms were shut down, but most unemployed were reemployed in other firms after three to four years. The precision of the model is illustrated by the fact that crisis firms survived until "today" (the time of the experiment) on more or less exactly the "subsidy handout". With 10 percent less all subsidized firms were closed before "today". h
The best macro outcome came when subsidies where reallocated in favor of high profitability firms, signifying that high profits today increase the probability of a

high rate of return tomorrow. Allocating subsidies in favor of firms with fast export growth did not increase macroeconomic growth as much, indicating that rapid export growth is not necessarily a good predictor of future high rates of return and productivity growth.

We thought of an additional scenario, implementing the phasing out of crisis firms more slowly, to smooth the local unemployment situation, but still very much faster than what actually occurred. We thought that some intermediate rate of phase out would be optimal, with a minimum of price disturbances, but were unable, at the time to design the appropriate experiment.

Finally, the allocative effects of the plow back features of the Swedish corporate income tax system were tested on the model (Eliasson–Lindberg 1981). The intention was to evaluate the negative effects on internal rate of return targets and investment allocation of the corporate income "tax wedge". Results were as expected. The tax stimulated retained earnings (as against dividends) in firms where profits had been generated. As long as relative (product) prices did not change, this policy was clearly growth stimulating, since a high rate of return today was on the average a signal of future high rates of return. The slow pivoting of relative prices against basic industries compared to an alternative scenario with unchanged relative prices, turned out a slow deterioration in growth from relative price change, and the more so the higher the tax wedge.

This effect became dramatic when we reenacted the cost crisis years of the 70s. As a result of high corporate income taxes basic industries entered the second half of the 70s with new, modern production capacity to face a catastrophic market slump. In retrospect, the best scenario would of course have been to have the resources invested elsewhere. A strong revaluation of the currency or even a floating rate, would probably have helped eliminate some of the temporary inflation profits in basic industries 1973/74. However, as we learned from the experiments, from an economic point of view it was alright to invest in the wrong markets – the actual investment was a minor cost to the economy. The large macroeconomic effects came from carrying on production in the new factories, taking labor away from the labor market and significantly increasing the general wage level. This detrimental effect on economic growth from price wedges that raises the general wage level has been reconfirmed in later experiments. We have in fact found (Eliasson–Lindberg 1986) that the high real interest rate, partly propped up by Swedish exchange controls (Oxelheim 1988) lowers investment and raises profit margin targets in firms. The latter means that wage inflation and wage oveshooting tendencies are checked. The negative investment effect is minor, since the allocation of investments is improved by the high interest rate.

IV.4 Is big bad or good?

Economies of scale is a classical problem in economics. The classical static model was phrased in terms of atomistic competition. In "applications" like computable equilibrium models the size of firms was concealed through aggregation, or controlled through convenient assumptions, as in contestable market theory, to overcome the problem that the static general equilibrium model cannot cope with economies of scale or scope.

Scale introduces the firm as a market imperfection as a (temporary) monopoly. In MOSES scale effects originate in superior organization competence (Eliasson 1988d). Competition (among the few) through learning and upgrading of competence, checks excessive monopoly profits and concentration endogenously.

Size and concentration is the classical problem in industrial organization theory. Facing severe problems of sagging industrial competitiveness a discussion of whether big is good or bad has been carried on in business journals. One argument is that "oversized" firms have become sloppy because of past successes, and the protection of accumulated financial wealth.

This issue cannot be resolved within the framework of the micro–to–macro model. The model, however, features a competitive market process, that checks concentration tendencies, which are not matched by superior competitive performance.

Model firms operate as temporary monopolies on the basis of their ability to maintain scale advantages. Scale advantages in turn arise out of their ability to create new competence (innovation) or through rapidly imitating new technology created elsewhere. This is the essence of technological competition and economic growth. Such a model specification requires an explicit market process that checks (bounds) concentration endogenously. This is the needed substitute mechanism for the convexity assumption in the static model.

With no new entry and exit I naturally found a steady concentration of output to a smaller and smaller number of firms, even though this process turned out to be very slow, (See Figure VII and VIII). Concentration was checked by competition which in turn depends on the spread of the Salter curves, the high end producers' suppressing prices to the detriment of the tail end of the Salter curves. However, in the end the initially superior producers tended to take over. New entry prevented the flattening of Salter distributions, though increasing entry in markets where monopoly profits were earned. Empirical evidence and analytical results, however, still pose questions.

Economies of scale can be demonstrated to exhibit superior process performance in existing lines of business, but large firms tend to be less efficient innovators, even though the definition on innovative performance remains to be operationally defined (see Eliasson 1989). Conventional wisdom would suggest, that allowing scale ("bigness") to take over through forcing low end producers to exit would enhance medium–term process efficiently, but reduce the long–term creation of innovative, new best–practice production techniques

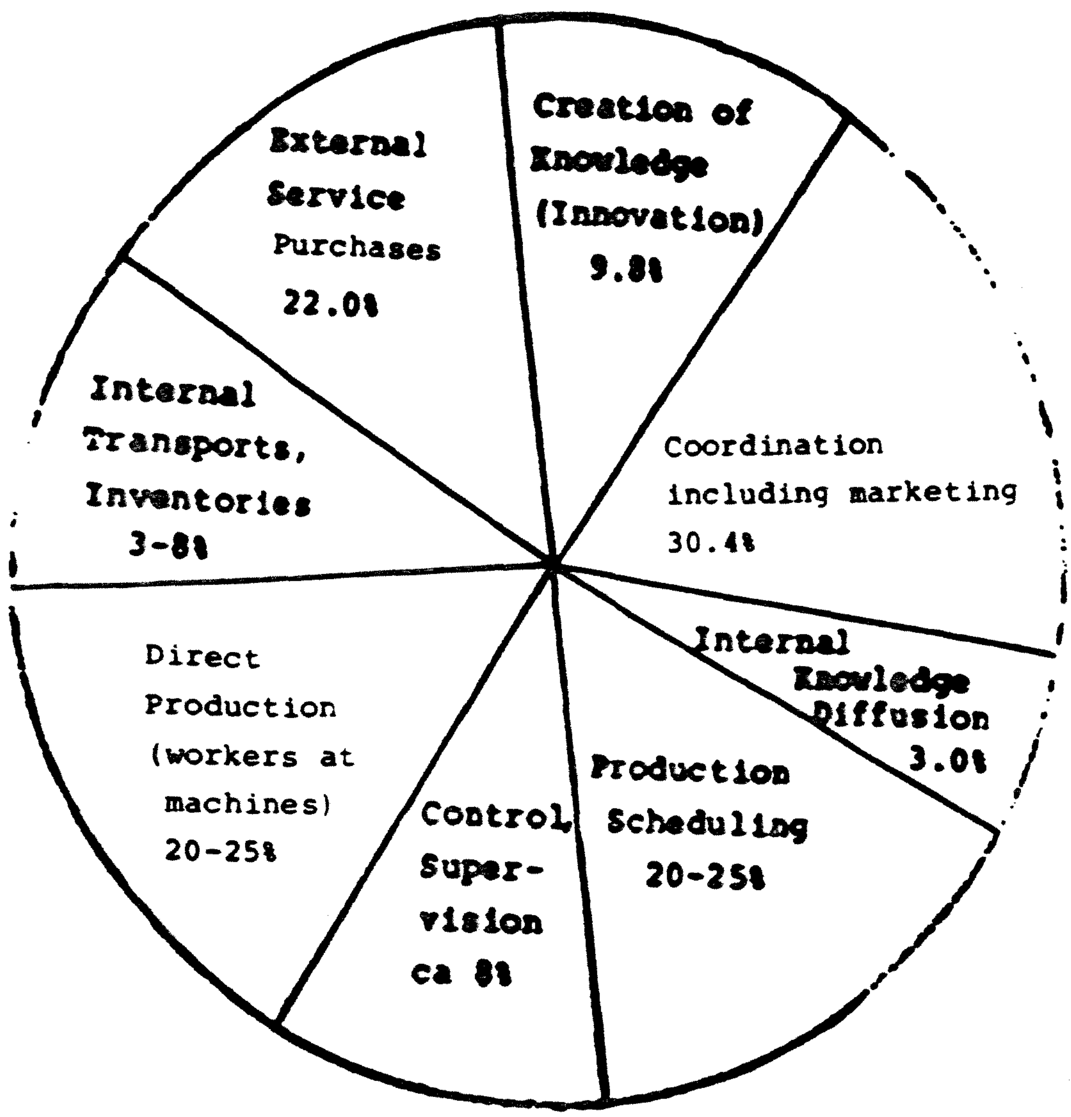
The static antitrust position would be to prevent large scale operators to become monopolists. Increased competition by larger number of firms would increase efficiency and lower prices, through reducing short–term slack in the economy. This might, however, reduce profits to the extent that innovative activity ceases.

To prevent that market have to be organized such that short–term efficiency and incentives are balanced to generate the desired sustainable rate of growth. We currently do not have a theory in which this balancing occurs endogenously and in which policy parameters are explicit. I have just illustrated, however, that my micro–to–macro model allows this balancing to be achieved through experiment–ting with various market regime determining parameters. The empirical evidence is pointing in the direction of innovation being more efficient in a small scale organization than in a large one. New technology, furthermore, is making small scale production profitable where huge scale once dominated (e.g. in steel production). The general tendency (Carlsson 1988) among industrial countries – except Sweden – is a lowering of average firm and establishment size. We find that some large and very successful firms, engaged in volume production, shop around in the market for small innovative firms, that have come up with something new in the product range of the large firm (Eliasson 1986c). The reason is that the large firm is organized for efficient large scale volume production, and an inefficient innovator.

We also find that small units, with high knowledge intensive production, usually engaged in service production tend to separate off from the big firms (Eliasson 1986). This is one reason for the rapid growth of the business service sector. The increase in capital market efficiency, furthermore, has forced divestiture of a number of large and not well managed firms, illustrating the point made earlier, that organizational change really should be treated as endogenous and market determined. None of this, except entry and exit of given units, is explicit in the model. Hence size distributions of firms (in normal experiments) feature remaining firms at each stage. What we can see there (Figures VII and VIII.B) is that concentration tendencies are very slow – due to competition – and really of no consequence in the perspective of a decade or two. The very large firms may even experience distress and shrink in size. The position in the size ranking, however, is by no means stable (Figure VIII.B shows firms ranked as in 1988 for each consecutive year).

Figure 1 **DISTRIBUTION OF LABOR COSTS**

– Large Swedish firms
– Global operations
– Percent

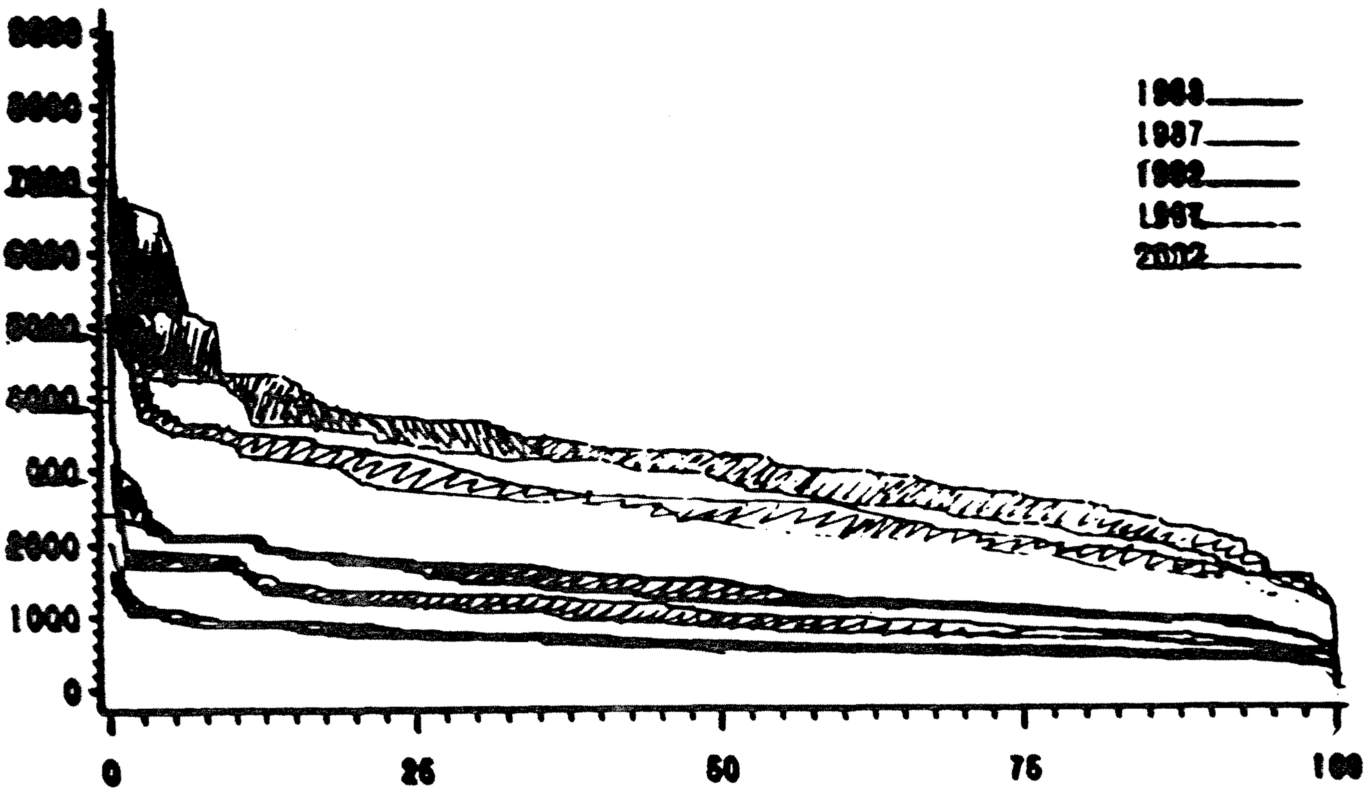


Goods processing: 56.7%
Total: 122%

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

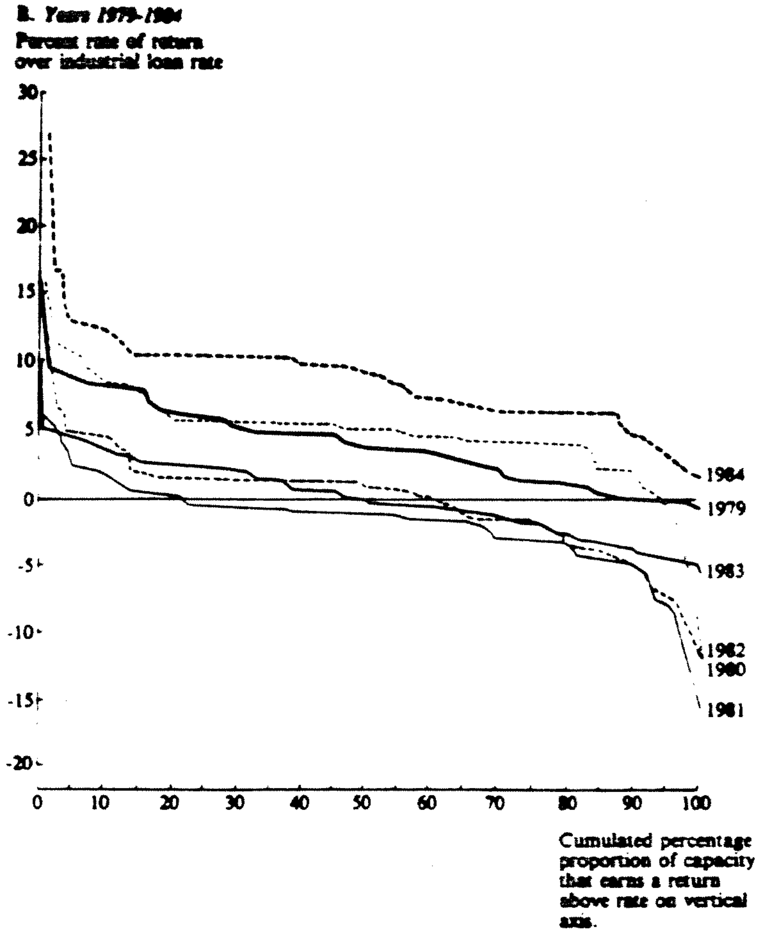
2 A <u>Potential and simulated productivity distributions</u>



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).

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