Introduction

Theory, Measurement and Quality of Prediction

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The objectives and benefits of social research always have to be judged in relation to some current or perceived future decision problem of society. It is not always obvious what is important, and to decide on this question is in principle not the task of the researcher himself. He only represents professional and technical skills.

The experience from social research, however, as well as from most other lines of research, is that the first and most important task is to identify the nature of the problem. What are the goals? What are we interested in? Hence, it is very difficult to remove subjective elements from the work of individual researchers. Constant confrontation of theories and hypotheses with empirical measurement and the involvement of many persons' judgements are the best guarantees of quality, reliability and relevance of scientific progress. Theories that do not naturally expose themselves to the risk of being rejected by observation or that do not incorporate a proper measurement technique tend to evade this time-honored criterion of scientific procedure.

One question that may be asked is to what extent economic theory has gone too far in disregarding the measurement problem. We do not believe that the theoretician and the empiricist can live meaningful separate lives in the social sciences. A minimum requirement of any economic theory is a specification of how to measure variables. This is why we have made techniques of measurement a theme for this summary overview of IUI research. In economics, as in all other sciences, techniques of measurement mark the outer boundaries for theoretical progress. Good theory is something very practical and is best formulated as a method of synthetizing scattered pieces of empirical evidence on the functioning of economic reality. Our techniques of observation, measurement and systematization define our theory and what we can profess to *know*. It should all take place under the same hat. We like to think of this as the philosophy that guides IUI research.

Large scale models

Large scale modelling is a somewhat controversial methodological area in economics. It has been argued that available econometric techniques do not

allow the estimation of relevant and stable economic structures *or* that measurements (data) of sufficient quality are not available to match such models and the questions that are raised. On this one can only say that our knowledge is never better than our theory and our ability to measure. Economics is more retarded as a science than necessary when it comes to establishing a fruitful symbiosis between theory and measurement. We are so far not very skilled in efficiently organizing the vast amounts of data, that are being accumulated, and this can only be blamed on lack of relevant theory. For the analysis of relevant macroeconomic questions this means large scale models or combinations of models concerned with entire economic systems. It is normally impossible to assess the macroeconomic implication of the bits and pieces of sectoral or micro information available. A scientific method for applying analytical results from traditional partial reasoning to total economic systems behavior simply does not exist. The only answer to these problems is a large scale model combined with a good measurement system. This is the reason why the Institute is currently developing two such models.

The first model (p. 40) is of a traditional Leontief–Keynesian medium term variety, based on a fairly detailed sectoral classification and an input-output representation of the production system. A provisional version was built for the earlier long-term survey and is currently being further developed and updated[1]. Work on industrial investments and capacity growth (p. 66), foreign trade (p. 81) and inflation (p. 86) is under way and the results will be put to use in the long-term survey of the Institute (see below).

There are two basic difficulties with this kind of model. One is that the structure of the model is such that short-term cyclical behavior cannot be dealt with at all. The other difficulty is that the rigidity of the coefficient structure of a model of this type makes it unable to capture one of the most important aspects of medium-term growth, namely structural change within the economy. This aspect has gained special importance in the midst of the current "world economic crisis". Price and income determination are difficult to handle jointly, especially when movements are strong and sudden, since market processes are not explicit.

Some of these problems may perhaps be solved in a new type of *micro-market-based simulation model*[2] that is currently being developed at the Institute. In this model cyclical and structural changes are combined explicitly.

[1] See *IUI:s långtidsbedömning 1976. Bilagor* (Supplements to the IUI Medium Term Forecasting Model 1976). IUI. Stockholm 1977.

[2] An early version is presented in Eliasson, G. (ed.), *A Micro-to-Macro Model of the Swedish Economy*. IUI. Stockholm 1978.

Individual firms appear in the model as financial planning and production systems. They compete with one another in markets for labor, products and financial resources. The outcomes of these markets add up to total national accounts levels (see p. 69). Some unique features of this model are the disequilibrium representation of the market process and the complete feedback between market pricing, profit generation, investment and the supply decisions of individual firms. Economic growth is thus made endogenous under an upper technology constraint. The model is now complete as a theoretical system. A consistent micro (firm) data base is currently being accumulated for the model.

To economize on resources, several data bases are being standardized and coordinated both for the two models and for other projects in which large data bases are needed. In joining up micro and macro data bases a new technique of creating synthetic entities to fill in missing information is being developed.

Past failures in large scale modelling can perhaps be traced to excessive ambitions to build "all purpose" models with extreme predictive detail and impossible data requirements. It seems, however, that the most appropriate field of application of such models is to use them to organize and understand large amounts of information and complex systems properties better. Effective tools to coordinate thinking about complex matters and to make scattered evidence yield a better overview of a whole economy are clearly needed.

A detailed forecast is of very limited use until placed in a proper total economic setting. Many business firms projecting their own future from their own limited experience have suffered severely during the last few years. The advantage of large scale modelling is not a matter of numerical precision but of numerical systems consistency.

A projection of future economic growth, furthermore, is much more a matter of understanding the process than of producing correct numbers. This simply repeats our theme that high quality measurement and high quality thinking come together as a condition for understanding. This is synonymous with good theory or modelling. As long as we are concerned with entire economic systems and their problems, there are no substitutes for large scale models.

The next Long-Term Survey – a structural forecast

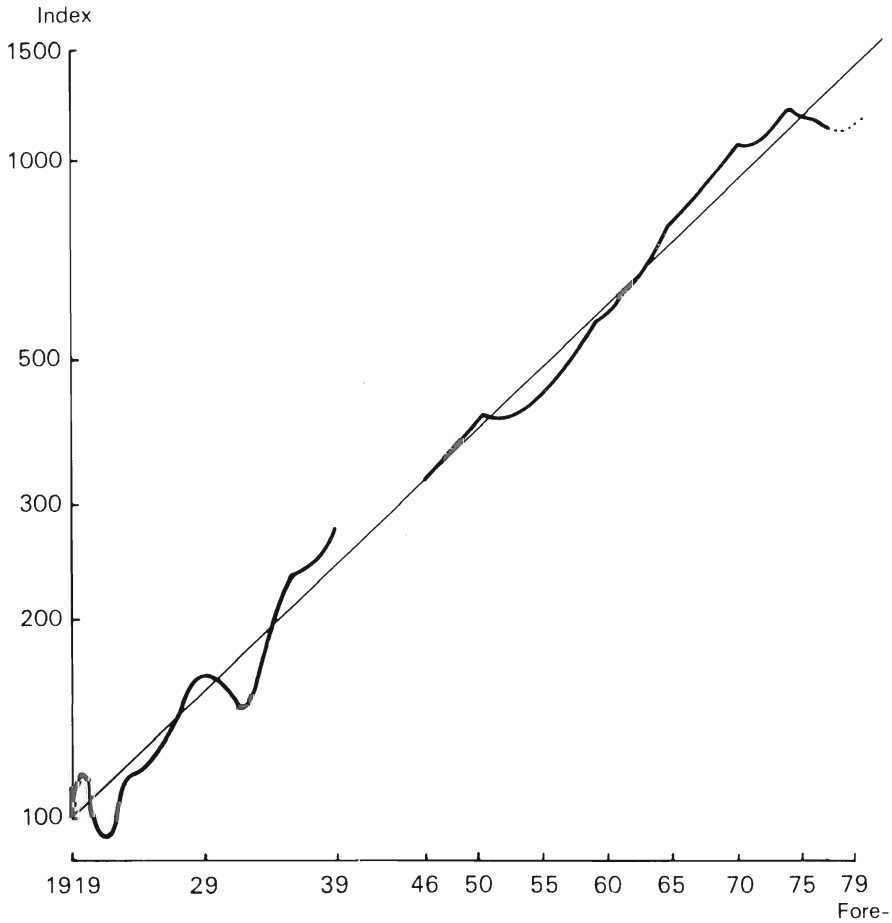
Identification of relevant problems is central in our work on the next IUI long-term assessment of the Swedish economy. Work on this assessment is a way of coordinating IUI expertise within the framework of a long-term

structural forecast and of presenting it in a form that makes it useful for decision making at the economic policy as well as the business firm level.

The dramatic economic events of the last few years in combination with high rates of inflation seem to have refuted much conventionally accepted knowledge. In this sense recent economic experience has been beneficial to economics, although certainly not to the Swedish economy!

The most important long-term question is whether the recession starting in 1975 (see Figure 1) is a temporary, albeit deep, cyclical aberration, as in the 30's, or whether it marks the beginning of a permanently slower growth path for Swedish industry. The second possibility raises the question of whether Swedish economic development will deviate downwards from the rest of the

Figure 1. *Swedish manufacturing production 1919–1979*
Index 1919 = 100. Logarithmic scale



Sources: IUI and Swedish Central Bureau of Statistics.

world in the future, in contrast with the substantially above average performance of the Swedish economy over the past 100 years. (See Figure 1). Such pessimistic views have been voiced recently by Swedish as well as outside observers.

The question implies the need to understand world economic developments in general and the relative competitive position of Sweden in particular. The pessimistic view of a relatively slower Swedish growth rate reflects a belief that international competition has made a large portion of Swedish industry economically obsolete. Before one accepts such a view, given 100 years of past excellence in economic performance, it is necessary to identify the new and unique factors now at work on the Swedish economy to result in such a structural break with the past (see below). This requires a long historical perspective, in order not to get confused by the recent disorderly economic development.

The difficulties involved in understanding the current disequilibrium situation also emphasize the fact that prediction involves the following three basic steps:

– *First,* a *description* of the current economic situation. The quality of the data base is very important here. National accounts data become available only after considerable delay. Therefore, we will not know exactly where we are when the forecast period begins. This will probably be a more serious problem this time than earlier.

– *Second,* an assessment of the *direction and momentum* of the most important exogenous growth factors. These estimates unavoidably rest on the experience and intuition of those responsible for the forecast. Economic policy variables belong to this group of exogenous factors.

– *Third,* a numerical system (a model or *theory*) to coordinate all the known pieces of the national economic machinery with assumptions in a logically and quantitatively consistent manner.

As a prelude to forecasting work, the Institute has directed considerable research effort towards arranging a data base to ascertain the position of the Swedish economy at the micro as well as macro levels. Further development and updating of the macro-economic medium-term model for sector forecasting is part of this preparatory work.

Research has been concentrated around three important questions:

– In what way is the current position of the Swedish economy influenced by economic events in the rest of the world? International economic interdependence in the form of trade, foreign investments and capital movements will be central in both the historical analysis and in the forecast.

– What is the role of technical change in the growth process?

– How do prices, income formation and growth interact in market based economies of the Swedish type, and to what extent do disturbances in the market process hamper growth? What are the short- and long-term impacts of exogenous inflation shocks of the kind we have experienced recently?

The events of the past few years suggest that the scientific understanding available for influencing economic development has been grossly overstated by the economics profession. The governments of most industrial countries are equipped with a large arsenal of economic policy instruments that can be applied to affect various and often detailed targets. But there exists little knowledge on the quantitative effects of these instruments when used in isolation or in various combinations. Economic policy making can easily be harmful if the necessary professional knowledge is missing.

a) International economic interdependence

Some results from a recently started study on Swedish foreign trade suggest that Swedish exports can be divided into *Nordic, European and non-European* components (see p. 81). The Nordic countries buy a larger share of investment and consumer goods from Sweden than do the other countries. Processed raw materials (pulp, paper and steel) dominate our exports to other European countries, and more highly manufactured engineering products dominate Swedish exports to non-European countries.

Market shares have been lost predominantly in raw material exports and also partly in consumer goods exports to North America. The slowdown in engineering exports during the last few years is mainly explained as a demand or cyclical phenomenon. A recently published IUI study (p. 77), however, also suggests that structural changes must be involved to some extent. U.S. subsidiaries in Sweden that have always had high export shares compared to European subsidiaries, have reduced their investments in Sweden during the 70's. Their investments were predominantly in skilled worker intensive industries. European subsidiaries in Sweden have invested predominantly to bypass trade barriers. For these companies no such investment reduction has been observed. Several IUI studies have found that Swedish industry has benefited from a competitive advantage in skilled worker intensive industries (pp. 77 and 79), at least through the 60's. This, of course, is synonymous with saying that the pricing of labor was then such that relatively more value was produced by a skilled worker per wage unit than by other labor. During the 60's, Swedish engineering products gained market shares in world trade. At the same time, relatively unsophisticated, capital intensive, raw material or intermediate goods production with no skill attributes became less competitive. This is coupled with the observation (p. 79) that exports, on one hand,

are positively correlated with foreign investments and that, on the other hand, firms producing R&D intensive products have a relatively high propensity to locate in Sweden and export from here and a relatively low propensity to locate abroad.

These are all indications of how the competitive position of Swedish industry has shifted during the postwar period. Several IUI studies conclude that the economic viability of unsophisticated, unskilled, or non-human capital intensive production on the basis of our raw material resources has been seriously eroded by foreign competition. It may be that a more than 100 year period in which Sweden's import capacity, growth and internationally high living standard to a large extent were based on raw material "land rents" is coming to an end. It may even be that new automated production processes that are fast becoming available globally will soon have eroded Sweden's comparative advantage in the form of a large proportion of skilled workers in the labor force. Rapid growth in more advanced industrial production is necessary to offset the relative decline in these lines of business in order to prevent a prolonged period of stagnation. To what extent are the economic and social preconditions for such a structural transition present?

Competitiveness between countries and between firms in domestic markets is most naturally formulated in profitability terms. We are concerned with the ability of firms at large to maintain a sufficiently high return on investments to generate a sustained long term economic growth rate comparable with or higher than those in other countries. The Swedish economy has been relatively successful in this regard for the past 100 years. The question is whether or not the good performance of the Swedish economy has been based on an abundant raw material endowment that can no longer perform the same welfare service as before due to a permanent relative change in the world market price structure. After all, it is our international purchasing power that is the supreme indicator of our competitive position. This is something different from the normal cyclical imbalance between prices and factor costs that will automatically correct itself with time. Are we concerned with the possibility of a permanent change, suggesting that we have been too slow to foresee and adjust our structure in advance to an increasingly sophisticated world around us? This brings up the question of how technically sophisticated the total Swedish production system is.

b) Technical change

The relative technical position of Swedish industry is currently being investigated in a broadly defined research project carried out jointly between

the IUI and the Royal Swedish Academy of Engineering Sciences (IVA) (p. 48). The ambition is to improve our measurements of the contribution of technical change to economic growth from the macro end and then to probe deeper at the micro level to identify the major components of that change. The second phase requires technical background knowledge. The project is therefore an example of a case in which an interdisciplinary approach is the only meaningful way to further understanding.

We have already found that productivity has increased more rapidly on the production frontier than for average plants in several sectors. These include particle board, fibre board and dairy production (p. 59) as well as hydroelectric power generation (p. 56). Preliminary simulation experiments on the Institute's micro-to-macro model suggest that this cannot be a general phenomenon in Swedish industry (p. 68), or else our macro statistics are all wrong. The experiments, however, show the imperiled growth position of an economy in which new techniques are not brought in sufficiently fast by new investment. Slow growth means difficulty in modernizing through new investment combined with scrapping. The studied sectors are all characterized by a relatively slow growth in demand.

Earlier IUI research has found the fastest labor productivity growth rates in subindustries subjected to tough competition and profit distress. Rapid productivity improvements can often be engineered up to a limit through fast scrapping of inefficient plants and through investments aimed primarily at reducing the manning of existing machines. In the past few decades, the rate of growth of productivity has been faster than that of production. At the same time the life of production equipment in industry has been reduced, the ratio of incremental capacity to investment in new vintages has fallen, and the share of industrial investments used for capacity expansion has diminished. Innovative activities, the development of new products, etc., on the other hand, are long-term and risky investment activities requiring sufficient profitability and an endurable financial position.

An important problem for the IUI long-term inquiry is to assess to what extent the long-term growth potential has been diminished because of reduced innovative activities in the short term having to do with the currently distressed profitability situation.

Two recently concluded studies (p. 52) suggest that the combination of capital, labor, raw material and energy inputs is strongly dependent upon the relative price structure at the time of investment. Technical change together with relative price change gradually affect the structure and composition of output in an industry. Different sectors are similarly guided as to relative growth rates by the relative development of final product prices. A relative price increase often means improved profitability, more investment and a

higher growth rate. Thus, the industrial structure slowly changes. The results may be different, however, if relative prices change strongly and suddenly, as during recent years. Capital equipment may be made economically obsolete overnight, while industries that have benefited from the new price development cannot adjust fast enough. The economy loses growth momentum in the short term. We have managed to simulate the pattern of such short- and long-term growth effects in one of our large scale models (p. 68).

c) The efficiency of a market based economy

Technical change is often thought of as primarily linked with

1) *the production process within a firm.* It is easy to understand that it is difficult to catch all aspects of the piecewise upgrading of a production system in a general theory. The complexity of the matter is made even more pronounced when we include also

2) *product innovation and change,* and add that 1) and 2) often go hand in hand. We are not satisfied with the macro production function approach that treats technical change as an autonomous time-dependent factor that explains practically all growth. We would like to know what the major components at the micro level are. These are aspects of technical change that the IUI-IVA joint project is concerned with (p. 48).

To understand technical change at the macro level, however, an even broader concept of technical change is clearly warranted. It should include

3) the *management technique* of entire business systems since this has a bearing on the process of technical change at the micro level. In a fast changing world economy firms may easily find themselves technically superior in the wrong lines of business. It is clear that management techniques differ between North American and European firms even though science is not yet capable of assessing the macroeconomic impact of these different techniques. Such difficulties become even more acute when it comes to

4) the *management of the entire national economy.* The effect of macro economic management of the entire economy shows up directly in what we call technical change at the aggregate level, namely the residual factor in production function analysis. By paying too much attention to the techniques of production that our analytical tools tend to emphasize, we may miss essential factors in the growth machinery of a sophisticated industrial economy.

The *market based economic system* is probably one of the greatest

technological achievements of mankind. It has evolved by trial and erro without any prior design, and it apparently still evades a proper understand ing. It is based on delegation of decision making through markets and is par of a social value system that accepts change in response to price signals. As such it is very akin to the individualist credo and the democratic process in a pluralistic society. Some waste and some mistakes are parts of its proper functioning by allowing superior techniques to become operational by trial and error. The market based economic systems of the western industrialized economies have contributed to remarkably fast and steady growth over the past century, and the Swedish economy has been one of the supreme performers (cf Figure 1 for Sweden). The market system has also demonstrated a remarkable robustness in weathering the economic shock waves of the last few years including (one is sorry to say) those caused by economic policy mistakes of the various nations. We have studied this aspect of macroeconomic behavior in one of our models where market processes figure explicitly at the micro level. We have found that sudden inflation shocks tend to disturb the market signalling system of an economy and are normally followed by a period of relative stagnation due to a combination of unwarranted optimism, mistaken investment decisions and subsequent over-caution. There is furthermore an apparent trade-off between short-term allocative efficiency in response to changing price signals on the one hand, and stability and robustness of the entire economic system on the other.

It is also interesting to note from such simulation experiments that an economy can easily fail to capture the economic benefits of fast productivity improvements if these are not brought in in sufficient volume through new investment and/or if they are not allocated properly by the market and/or if they are not fully utilized due to irregular performance of the entire economy.

d) Economic policy

Macroeconomic policy making based on misunderstanding of the working of the economy can easily become a harmful activity for the nation. Policy making is a particularly difficult factor in the context of a long-term survey of an economy, since policy making responds to economic development. During the last few years policy makers in Sweden as well as elsewhere have clearly changed their ambitions as a consequence of economic developments.

One question that has been raised frequently is whether policy making should aim ambitiously at controlling a number of goal variables or limit itself to attending to the proper functioning of the market system. It would, for

instance, be a paradoxical outcome if the ambitious welfare state not only managed to reduce its economic growth rate but also reversed the income equalization effects in the longer term, because of negative growth effects of policy making. The potential danger of such perverse long-term effects of regulating the economy on the basis of insufficient information should be a prime concern of research in connection with the long-term survey. We are particularly interested in the possible destabilizing effects of the Swedish tax and subsidizing system. There is, however, no satisfactory scientific basis for conclusive answers to questions of this nature for the time being. Their potential importance and impending policy actions, nevertheless, make it impossible to avoid addressing these delicate issues in the long-term survey.

Recent experience with macroeconomic "fine-tuning" of the economy has brought the paradigm of the invisible hand back into vogue. It seems necessary to approach economic policy making in Sweden and in other countries not only as a vehicle for deliberate and directed change but also as a possible source of major economic disturbance.

A key word behind the growth curve exhibited in Figure 1 is gradual change in many dimensions. Structural change in manufacturing industry accounted for around 30 per cent of growth in the sector during the postwar period according to an IUI study. The ability of the economy to absorb change of various kinds, especially in a slow growth context will have to be a central theme for the long-term inquiry.

The negative side effects of change especially affect the labor market. The last few years have witnessed a series of legislative measures aimed not only at reducing mobility in the labor market (p. 82), but also subsidizing labor in and *owners* of distressed industries. The growth effects of such interference with the market economy have to be discussed as well, even though here also the scientific basis for understanding is scant and definitely not sufficient for informed policy action.

The models that we use to help our thinking are far from perfect tools. We need several and we need experience to work with them and good intuition to come up with informed policy recommendations.

The Institute has developed a large scale simulation model for the Swedish income tax system. The model is partially integrated with the macro model. A recent run on the tax model concerns a household with two children and two grownups working full time, and each obtaining an income increase of 10 per cent (before tax) for 1977. Their disposable income in the range between 40 and 120 000 Swedish kronor ($ 8 to 25 thousands) rose by almost the same percentage, regardless of income bracket, because of various kinds of transfer payments, etc. This *after* tax increase amounted to more than the *before* tax

increase, 11 per cent, and this in turn depended on a deliberate policy which was to maintain domestic demand and production despite the international recession. In this regard Swedish economic policy deviated substantially from that in most other West European countries, which is reflected in large balance of payment deficits. Despite this, real economic growth turned out nil or slightly negative because of a higher inflation rate than in other countries in 1977. The Government's economic policy itself is regarded by many as the cause of this high inflation rate, the lack of growth in 1977 and the large external deficits. There are, however, different views about this. In 1978 policy making has been quite restrictive to make permanent the so far beneficial results of the devaluations in 1977 and to pave the way for an orderly, non-inflationary and sustained upswing.