THE INDUSTRIAL INSTITUTE FOR ECONOMIC AND SOCIAL RESEARCH STOCKHOLM

MEASUREMENT AND ECONOMIC THEORY

IUI RESEARCH PROGRAM

1978/1979

The Industrial Institute for Economic and Social Research

is an independent non-profit research institution, founded in 1939 by the Swedish Employers' Confederation and the Federation of Swedish Industries.

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To carry out research into economic and social conditions of importance for industrial development in Sweden.

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Measurement and Economic Theory

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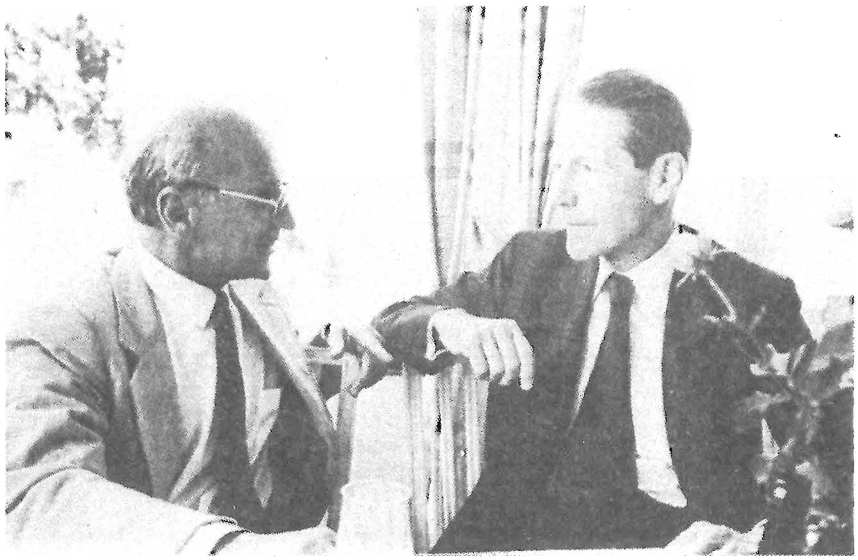

In the spring of 1977, professor Milton Friedman visited the Institute. He is seen here with Mr Erland Waldenström, Chairman of the Institute's Board of Directors.

In the fall of 1977, IUI together with IBM Sweden arranged the first international conference on micro-based macro models. Prof. Robert Clower, UCLA, chaired the session when Prof. Barbara Bergmann presented the University of Maryland model (p. 91).

Gunnar Eliasson, director of the Institute, presents the IUI micro-based macro model at a seminar arranged by the IIASA at Schloss Laxenburg outside Vienna in 1977 (p. 68).

In the summer of 1977, the Institute arranged a small international seminar on Technology and Industrial Structure in the Growth Process. Among the participants were Ishaq Nadiri (New York University), Rolf Färe (University of California at Berkeley), Ragnar Bentzel (Uppsala University) and IUI research staff in the field (p. 91).

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Introduction

Theory, Measurement and Quality of Prediction

by *Gunnar Eliasson*

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

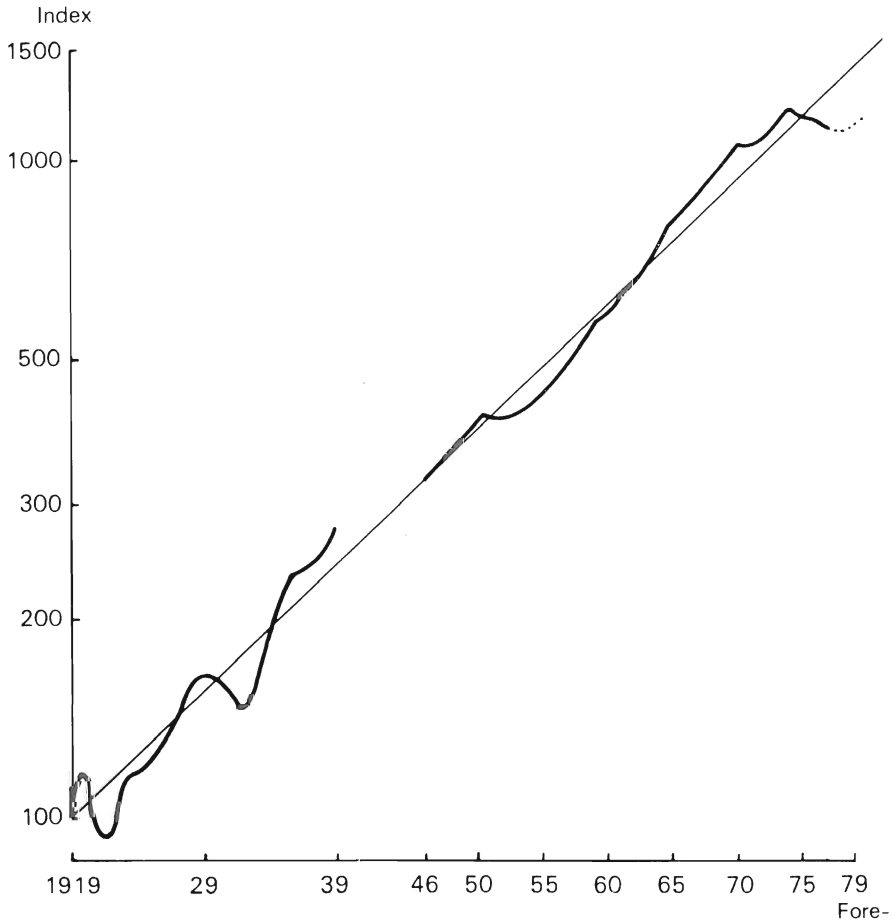
Identification of relevant problems is central in our work on the next IUI long-term assessment of the Swedish economy. Work on this assessment is a way of coordinating IUI expertise within the framework of a long-term

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.

Articles

Perspectives on Tax Developments in Sweden 1950–1977

by *Göran Normann* and *Jan Södersten*

In Sweden the total tax yields, as a percentage of GNP, increased from 21 per cent to 50 per cent during the period 1950 to 1976. As indicated in Table 1, this drastic increase was accompanied by substantial changes in the tax structure.

Of this increase of taxes in relation to GNP by 29 percentage points, higher payroll taxes (including contributions to the supplementary pensions scheme and other social insurance payments) accounted for approximately 14 percentage points, personal income tax for about 12 percentage points and the broad based general sales tax and the VAT (value-added tax) for about 6 percentage points. The greater part of the increase in the personal income tax yield is attributable to increased local government taxes. The share of corporate income tax in GNP has declined during the last few years, causing its share in total tax yield to fall from almost 15 per cent in 1950 to below 4 per cent in 1976.

It is obvious that an increase of the tax burden, as sharp as that experienced

Table 1. *The Swedish tax system 1950 and 1976*

	Tax yield			
	1950		1976[a]	
	As percentage of total tax revenue	As percentage of GNP at market prices	As percentage of total tax revenue	As percentage of GNP at market prices
Personal income tax	47.2	9.9	43.7	21.9
Central Government	22.9	4.8	17.3	8.7
Local Government	24.3	5.1	26.4	13.2
Payroll taxes, including employers' contributions	2.1	0.4	28.2	14.1
Corporate income tax	14.6	3.0	3.7	1.8
Other direct taxes	4.1	0.9	1.2	0.6
General sales tax/VAT	–	–	12.6	6.3
Other indirect taxes	32.0	6.7	10.6	5.3
Total	100.0	20.9	100.0	50.0

[a] Preliminary data.

in Sweden during the last couple of decades, implies a strain on the tax system and the fiscal mechanisms. It is also clear that an active central government tax policy lies behind such changes in the tax system. This is reflected, for example, in the fact that the automatic increase in tax liability resulting from the highly progressive central government income tax has forced frequent modifications of the tax system. The structural changes in the system reflect shifts of fiscal policy goals. The decreased importance in public sector tax revenues accruing from the corporate income tax is, partly, a result of shifts in the ambitions of fiscal policy from the 1950's to the 60's and 70's.

The direction of tax policy

During periods of surplus demand in the 1950's the stabilization policy was mainly directed at containing private investment. Some of the instruments used for this purpose were the investment tax, a successive phasing out of the free use of the depreciation allowance for machines and inventories, a stiffening of the rules of stock valuation and successive increases of the corporate income tax rates.

Towards the end of the 1950's this type of fiscal policy was abandoned as economic growth became a more central economic objective. Through the establishment of a revised system of investment funds at the end of the decade and the introduction of a general sales tax in 1960 the burden of the stabilization mechanism was shifted from corporate investment to private consumption. With the emergence of balance of payments deficits from the mid 1960's expansion of industrial investment became a more clearly desired result of policy making. One notes a more frequent use of the investment funds, a liberalization of the use of depreciation allowances and the abolition of the investment tax component of commodity taxation as the general sales tax was replaced by a value-added tax in 1969.

In the policital debate of the latter half of the 1960's interest in economic growth gave way to concerns about the income distribution. An example of the heightened ambitions in this field was the increase in the redistributive effect of the individual income tax after the mid 1960's.

Tax policy of the 1970's

The tax reform of 1970 involving a shift from joint, to individual taxation of spouses was regarded as most fundamental and has proved to be of significance for labor supply development during the 1970's. Increased progressivity was combined with the abolishment of the deduction allowed for local government income tax. The latter meant that an increase in local government income tax no longer automatically implied a lowering of the

central government tax liability. This meant that increasing local taxes would absorb a very large part of any increment in income. These effects of the 1970 tax change were, as it happened, accentuated even further by the high rates of inflation experienced in the next few years.

Problems with the Swedish tax system also became acute in the early 70's. Among the solutions suggested were (of course) lowered progressivity or indexation of tax scales. The Social Democratic government, however, opted for *ad hoc* annual adjustments, thus solving, temporarily, the trade-off problem as well as being able to allow a policy aimed at redistributing incomes. These actions were often negotiated in direct relation to the central wage agreements, which added a further dimension to the Swedish tax scene. In effect, such a tax-wage agreement comprises two elements: first, a lowering of the income tax rates as compared to the original system and secondly, a shift towards a larger share of payroll taxes and employers' contributions in the system. The first element provided a solution to the trade-off problem. The second element provided a means of "moving taxation closer to production", to use a phrase coined in the beginning of the 70's. The central idea was to tax incomes to an increasing extent before they were paid out to individuals.

A general business or production tax

The advantages of an increased amount of taxation directly on production rather than on individuals are considered to be partly of a tax administrative and partly of a distribution policy nature. The latter effect is explained by the fact that e. g. payroll taxes reduce the importance of personal deductions compared to a conventional personal income tax. An evaluation of the redistributive effects of increased payroll taxes must, however, also take into account the fact that these taxes are assessed only on so-called wage incomes. It is nowadays a well established belief that, in the long run, payroll taxes generate a regressive effect on distribution, i. e. they act to the disadvantage of the low income earner. It has, therefore, been argued that some kind of production tax should be introduced with a wider base than only income from labor, or that the payroll taxes should be complemented by taxes on other factors of production in order to achieve general taxation of the factors of production.

In a recent IUI publication dealing with corporate and indirect taxation these possibilities have been discussed.[1] In the first part of the book different

[1] G. Normann and J. Södersten, *Skattepolitisk resursstyrning och inkomstutjämning. En analys av företagsbeskattning och indirekt beskattning* (The Use of Tax Policy in Resource Allocation and Income Redistribution – An Analysis of Corporate Taxes and Indirect Taxation). IUI 1978.

types of gross income or gross expenditure taxes have been studied as well as taxes on specific factors of production.[1] The study analyzes a number of *different types* of taxes, on both companies and households, which are compared on the basis of their effects on resource allocation and the distribution of income. We will discuss these effects in the form of traditional differential analysis. This means that the effects of different tax packages with the same impact on for instance total demand or employment, are compared. With this restriction interest is concentrated on the effects from substituting one tax for another – as a rule a proportionate income tax.

Payroll taxes versus VAT

The VAT and the payroll taxes are, without doubt, the most important taxes in the field of gross taxation and taxation of factors of production. A comparison of the effects of these taxes on a macro level indicates that they show important similarities, particularly in a long-term perspective. Both taxes are imposed on firms, but the burden is shifted. The present VAT can be characterized as a proportional tax on consumption, while the payroll tax can be viewed as a proportional tax on wage income supplemented by a tax on entrepreneurial income. Both taxes have, therefore, in the long run, a regressive effect on income distribution. The effects on labor supply and savings appear to be similar.

The dynamic shifting process, however, is probably not the same for the two tax types. The VAT is expected to be shifted forward to prices quickly and, therefore, has limited effects on the allocation of resources in the economy. As far as payroll taxes are concerned, the shifting mechanism has been debated more extensively. By connecting increases in the payroll taxes to central collective bargaining, as has been done several times during recent years in Sweden, an immediate backward shifting of the tax is believed to take place. If this is correct the payroll taxes do not generate any marked effect on the allocation of resources in either the short or the long run.

The critics of this view question, however, whether it is possible to reach an immediate shift of tax burden through institutional arrangements. They also point to the fact that several increases of the VAT during the last few years have occurred without any direct connection with wage negotiations. Therefore, it has been claimed that the increased payroll taxes of the 1970's and earlier have had a detrimental effect on profits and, thereby, on employment and the balance of payments.

[1] To the category gross taxes – which are characterized by the fact that deductions are very limited when the tax base is determined – belong different types of VAT, which are extensively dealt with in the book. Among the taxes on factors of productions payroll taxes, taxes on raw materials, energy and investments are analyzed.

The regressive nature of the VAT and the payroll taxes combined with the tax policy developments during the last few years have brought forth extensive criticism of these taxes in their present form. As regards payroll taxes it has been suggested that so-called non-labor incomes should also be made liable to corresponding taxation. Among the various suggestions that have been made regarding the VAT is one that investments should also be included in the tax base.

Alternate versions of the VAT

A VAT which, beside consumption goods, also includes total gross investments has a base which is equal to the Gross National Product (GNP) if we neglect the public sector. Such a VAT is often called a GNP-VAT. If one allows deductions for depreciation from the tax base of this version of the VAT one ends up with another version called the NNP-VAT or the I-VAT. In this case the taxable base covers the Net National Product or the whole National Income, which is the same thing. This means that, besides wages, also profits, interest, rents, royalties, etc., would be covered by the tax. Both the GNP-VAT and the I-VAT can be characterized as production taxes or general taxes on factors of production and would, therefore, meet the demand for symmetry in the taxation of different components of the National Income. This has been a central issue for many of the criticisms of the present system.

The reformed VAT would, probably, not have the same regressive effect on distribution as does the present system. A tax on investments could, at least in the short run, be expected to be progressive and, thus, counteract the regressivity of the taxation of consumption. The long-term effect on income, distribution, however, is more uncertain. If a shift of the burden of the investment tax were to occur, it would be reasonable to believe that this would be a slow and time consuming process. The progressive effect in the short run would, therefore, persist during a considerable time period. The analysis also indicates that value-added taxes that include gross or net investments in the tax base can have considerable effects on the distribution of resources in the economy, and would, *inter alia,* have a dampening effect on the incentive to invest. In these respects the effects of the GNP-VAT would appear to be more marked than the I-VAT. A comparative analysis of these two versions of the VAT indicates that principal arguments can be put forward against the GNP-VAT in comparison to the I-VAT. Thus, in favor of the I-VAT one can mention criteria such as effectiveness and just coverage of the tax base. On the other hand, one can mention administrative factors in favor of the GNP-VAT.

The effects of the corporate income tax

As already mentioned, the shifts in fiscal policy – from containing investments during the 1950's to stimulating industrial capital formation during the 1960's and 1970's – have to a large extent taken place through the taxation of net corporate profits. The use of corporate taxation as a tool in economic policy focuses attention on a number of questions, not very extensively treated in the literature, about the effects of this tax. Among these are the importance of corporate income taxes for stabilization policy as well as the more long-term effects on the allocation of resources and distribution of income. The second part of the recent IUI book[1] focuses on the long-run aspects, i. e. the effects on income distribution, allocation of resources and growth.

Redistributive effects

A central question that arises when studying the long-run effects on income distribution of corporate taxation concerns factors that determine the rate of return, net of taxes, that the owners of capital would claim. In a small economy with extensive possibilities for investment abroad, there are indications that the required rate of return is determined internationally and is, therefore, largely independent of variations in domestic corporate taxation. From this point of view one reaches, with established economic theory, the paradoxical conclusion that increases in corporate income taxation can easily influence income distribution to the disadvantage of wage earners, i.e., have a regressive effect. Assuming that the discussion deals with a small country, the owners of capital can ensure their rate of return by changing the relationship between investment at home and abroad. Thereby, wage incomes can be affected by slower growth in labor productivity in a long-term perspective.

It is a complicated task to quantify the consequences of this theoretical conclusion. The adjustment process of the economy, given a change in the taxation of corporate profits, may be very slow. During a transition period of perhaps several decades, increases in corporate taxation may have a progressive influence on the distribution of income. To what extent this effect eventually reverses itself through a negative influence in investment and growth is, however, outside the reach of current theory.

[1] See p. 23, footnote 1.

The changing role of the corporate tax

The effective corporate tax rate for Swedish industry has been reduced by half since the beginning of the 1950's. The effective tax rate indicates the tax take in relation to actual profits, i.e., profits gross of accelerated depreciation. The decrease of the effective burden has, however, been unevenly distributed in practice. Companies with a fast and steady growth record combined with high profitability have had the greatest opportunities to take advantage of a tax-free consolidation of profits. Stagnating companies with low profitability that have reported profits only to be able to pay dividends have, on the other hand, experienced a very high tax burden.

It is essential to question to what extent the selectivity of the corporate tax has benefited total growth of the economy. One can argue that the taxation of profits has reinforced the wage policy of the Swedish trade union movement. Through the process of collective bargaining, the trade unions have forced more rapid wage cost increases in industries with low pay than in those with high pay. Therefore, companies and industries with low profitability are exposed to wage demands beyond the reach of the "normal" rate of return, while the successful wage leading firms of the economy have been sheltered from the same negative effects.

With this wage policy approach the rate of structural change in the economy has been speeded up. Weak companies have been eliminated while, at the same time, moderate wage demands on the very profitable companies have created better possibilities for expansion as compared with a wage policy directed at obtaining maximum wages in relation to profits. The very existence of an expansive and profitable "margin" within the corporate sector, which has been able to absorb the people who lost their jobs when less profitable companies were closed down, has been an important prerequisite for this kind of wage policy and for the acceptance of structural change by the trade unions. From this point of view, corporate taxation can be said to have a rational structure through the emphasis put on growing, successful companies.

Concluding remarks

The analysis of corporate and indirect taxation which has been presented in the new IUI publication takes place against the background of the development of tax policy in Sweden, and deals with several of the problems and suggestions that have been debated during the last few decades.

In spite of the fact that the corporate tax, since 1950, has come to play a less significant role for public sector revenues, one can argue that it is still an

important tax. Through, for instance, the sharp differentiation between different groups of companies one should take into account systematic effects on the allocation of real resources in the economy. The study has also shown that the conventional opinion about progressive effects on income distribution, can to a large extent, be disputed in the long-run perspective.

The expansive elements in the tax system since 1950 have been the personal income tax, the general sales tax (VAT) and payroll taxes. These taxes have increased significantly. It is, therefore, natural that they have been widely criticized and that suggestions for new types of taxes have been presented. Extensive attention has been devoted to alternate forms of taxation. One should keep in mind, however, that much of the criticism aimed at the expansive elements of the tax system, could as well have been directed against the rapid and accelerating growth of the public sector.

Mobility of Labor and Wage Determination

by *Siv Gustafsson* and *Bertil Holmlund*

The Swedish labor market in the late 1970's displays characteristics which are different in many ways from those of the labor market in the 1960's. The structure of unemployment, mobility of labor, employment policy of the firms and labor force participation of women are some aspects that have changed between the two periods.

A more realistic view of the labor market has developed during the past ten years. This increased realism is reflected in the greater attention that is now paid to the gross flows that affect observed changes in stocks, such as the number of unemployed or the number of vacancies. In view of this, the unemployment rate is no longer a self-evident indicator of welfare. Variations in unemployment may be caused by a variety of changes in gross flows with very different welfare implications, such as an increased labor force participation of married women, more lay-offs or decreased propensity to accept job offers due to better unemployment insurance.

Swedish labor market statistics have mainly been constructed to show changes in stocks of, for example, employment, unemployment and labor force participation. On the other hand, these statistics provide little information about how the flow into unemployment is divided among lay-offs, new entrants in the labor force and quits. Information is also scarce about whether, and to what extent, periods of unemployment come to an end either because people get jobs or because they leave the labor force.

It is, however, possible to get a rough picture of the changing patterns of gross flows in the labor market by studying available statistics. A short survey of a few typical features of the change will be presented below. This is followed by an explanation of the development which is viewed as the adjustment of individuals and firms to changed conditions for labor market search and recruitment policy.

Finally, some results will be presented from two current research projects in the field of labor economics at the IUI.

The statistical picture

Table 2 illustrates some important changes that have taken place on the labor market during the past ten years. The duration of unemployment has increased at the same time as the number of spells has decreased. The frequency of transfers between states of employment and unemployment is closely connected with the separate flows that make up job mobility, i.e. quits,

lay-offs and new hires. These flows have decreased significantly since the middle of the 1960's. Data are given in Table 2 for the flows of blue collar workers in manufacturing industry. Table 2 also shows that during the past few years the lay-off rate has been exceptionally low even when compared to earlier recessions.

Another important change in the labor market is the large increase in the labor force participation rate of women. The number of women in the labor market increased by 300 000 between 1970 and 1977. This means that the labor force participation rate of women increased from 53 to 61 per cent. We do not know exactly what changes in the gross flows are behind this increase of the number of women in the labor market although there is an indication that the average time spent on the labor market has increased. In 1969, 64 per cent of the women who once entered the labor force spent the full year in the labor market. The corresponding figure for 1974 is 72 per cent.

Tendencies towards long-run employment contracts

The above statistical picture may be interpreted as showing the development of more long-run contracts on the labor market. A fruitful point of departure for interpreting the development described above may be the rapid structural change in Swedish industry which took place during the sixties.

During the period 1957–63, industry investments expanded very rapidly. This modernization of the stock of capital was further accentuated by the extensive destruction of capital equipment due to obsolescense. The number of firm closures was unusually high during the recession of 1967–68, which was characterized not only by a unique productivity increase but also by labor dishoarding to a much larger extent than had been observed during earlier recessions after the Second World War. These rapid structural changes may

Table 2. *Data on unemployment and mobility of manufacturing workers, 1965–1976*

	Duration of unemployment (weeks)	Inflow of unemployment (thousands)	Quits	Lay-offs	New hirings
			Percentage of the total number of industrial workers		
1965	5	400	44	3.3	51
1968	9	488	26	4.0	34
1970	7	428	35	2.9	40
1972	15	374	22	3.5	29
1974	10	425	29	1.9	35
1976	12	280	23	1.4	22

have been a governing factor in shaping the development that followed with respect to the individuals, the labor market behavior of firms and the labor market policies of the Swedish government.

Increases in the frequency of lay-offs result in both a higher inflow into unemployment and increasing duration of unemployment. The latter effect is explained by the fact that people whose unemployment is caused by lay-offs tend to experience longer periods of unemployment than other categories of unemployed persons. This observation is probably explained by the fact that deaths of firms hit everybody alike with no exclusion of persons of greater age, small attractiveness on the labor market and a small propensity to migrate. The rapid structural change during the recession of 1967–68 was one of the reasons why the duration of periods of unemployment increased, especially for men. During the boom years of 1969–70 the rate of unemployment as well as the duration of unemployment were higher than during the earlier boom of 1964–65, in spite of the fact that demand pressure on the labor market was higher in the latter period.

The large number of people laid off during that period and the increase in the duration of unemployment changed the labor market outlook for individuals. It is reasonable to expect that the incentives for job search are affected by the expected length of the search period and the dispersion of the wage distribution. Shorter search periods and a wider wage dispersion would normally strengthen incentives for job search. For employed persons, longer periods of unemployment imply both a smaller propensity to search and a smaller propensity to choose unemployment in order to pursue full time job search. The consequences are a smaller inflow into unemployment and fewer quits. The Swedish Confederation of Trade Unions (LO) has strived, in its wage policy, for smaller wage differentials and this, in combination with the high marginal tax rates of the Swedish income tax system, has probably contributed to a decreased propensity to look for new jobs.

Lower rates of quits, furthermore, lead to a smaller number of new vacancies and this, in turn, affects search incentives, quit rates and the duration of unemployment, thus further strengthening the initial effects.

The rapid modernization of the capital stock of the manufacturing industry, which took place during the sixties, might also have introduced new technology with increasing demands for investments in the *quality of labor*. To ensure returns on investments made in job training programs firms have introduced incentives to reduce quit rates by people having received training paid for by firms. One way of achieving this would be the explicit or implicit offer of long-run contracts, for example, in the form of job rationing that excludes already employed persons from competing for jobs. Another way would be to tie the risk for lay-offs to the number of years of employment, by

seniority rules.

Rules governing the order in which people are going to be laid-off may also be seen as an instrument for reducing transaction costs associated with decreases in employment. Both employers and unions probably prefer a system where a clear set of rules makes labor dismissals automatic and impersonal. An increase in the costs of training newly hired employees means a lower propensity for lay-offs during periods of slack in demand and higher propensity for labor hoarding.

New features of Swedish employment policy

The developments in the labor market during the second half of the 1960's seem to have had important effects on employment policy during the 1970's. Swedish labor market policy earlier emphasized policy measures fostering mobility and structural change during most of the post World War II period. Priority was given to job security in the entire labor market rather than job security in a particular firm. During the 1970's the tolerance of the push mechanisms seems to have diminished gradually and emphasis is now more on employment maintenance than on employment creation. In 1971, special laws were passed requiring up to six months' advance notice of lay-offs of older employees. From the middle of 1974 the introduction of new legislation concerning labor relations might have caused structural breaks in labor market behavior. These so called "Åman laws" were intended to protect employees with job seniority. The employer's free right to dismiss was replaced by legislation which demanded objective cause for dismissal; "shortage of work" was considered to be one such objective cause. Firms were required to give employed workers up to six months' advance notice before lay-offs. In addition, rules of rotation were introduced providing special protection for workers with long-term employment with an employer.

The Åman laws probably have reduced labor mobility in several ways. In the first place, rising lay-off difficulties will increase the firms' incentives for adopting employment policies which will smooth over a business cycle, thus discouraging lay-offs. Secondly, the recruitment behavior of firms is likely to have been affected since the laws make it very costly to use dismissals as a measure for correcting past recruitment decisions based on erroneous information. Available job seekers will be inspected more carefully in order to assess their productivity. The result is likely to be longer vacancy durations, i.e., falling recruitment probabilities given that search is undertaken.

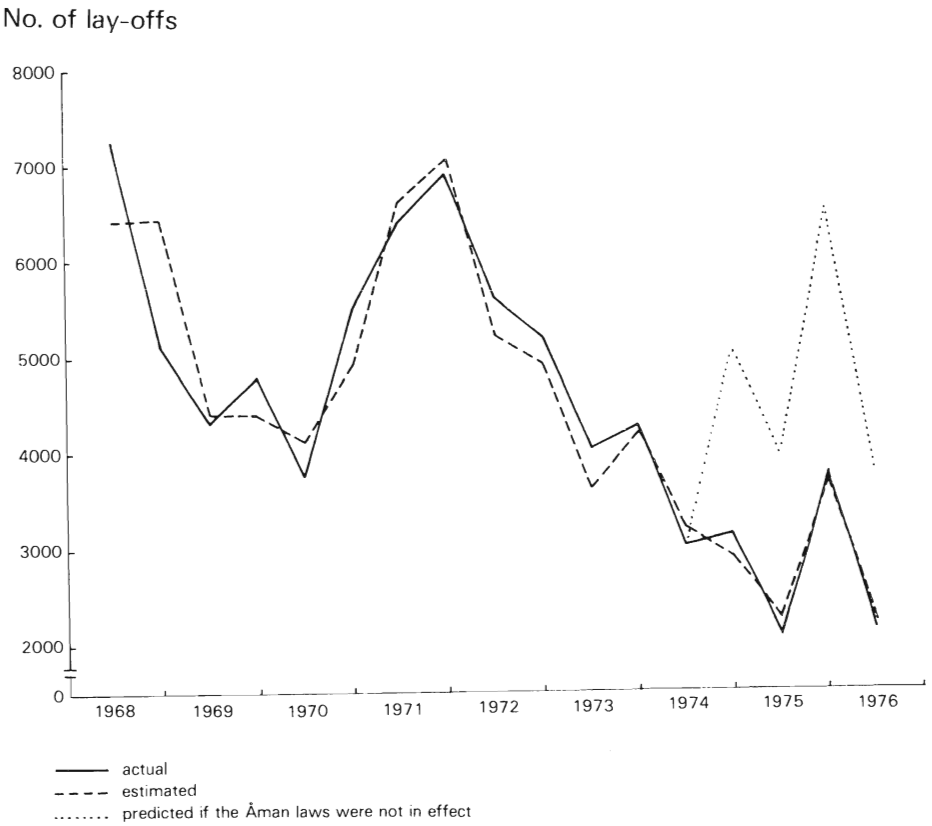
Figure 2 shows the number of manufacturing workers laid off during the period 1968–76. The dotted curve starting from the second half of 1974 shows the development according to econometric estimations assuming the absence of the job security laws. It is seen from the figure that the number of lay-offs would have been much higher during 1975 and 1976 had the Åman laws not existed.

The hypothesis of rising recruitment thresholds owing to lay-off restrictions has been tested by applying the model

$$\left(\frac{H}{VAC}\right)_{it} = \alpha_{1i}\left(\frac{V}{U}\right)_t^{\alpha_{2i}} e^{\alpha_{3i}D},$$

where H_{it} = the number of new recruitments, calculated as the number of filled vacancies at the Employment Service (occupation i and month t),
VAC_{it} = the number of listed vacancies,

Figure 2. *Lay-offs of manufacturing workers by half-year averages of quarterly data, 1968–1976*



V_t/U_t = the total number of unfilled vacancies divided by the total number of unemployed,
D = a dummy variable, which takes the value 1 from July 1974.

The results are set out in Table 3. The dummy coefficient gives the relative change in the placement frequency due to the new legislation. The coefficients generally have the expected signs and are significant in four regressions, implying rising duration of vacancies. An estimated function is shown in Figure 3. These higher recruitment thresholds are also likely to have some effect on the duration and incidence of unemployment.

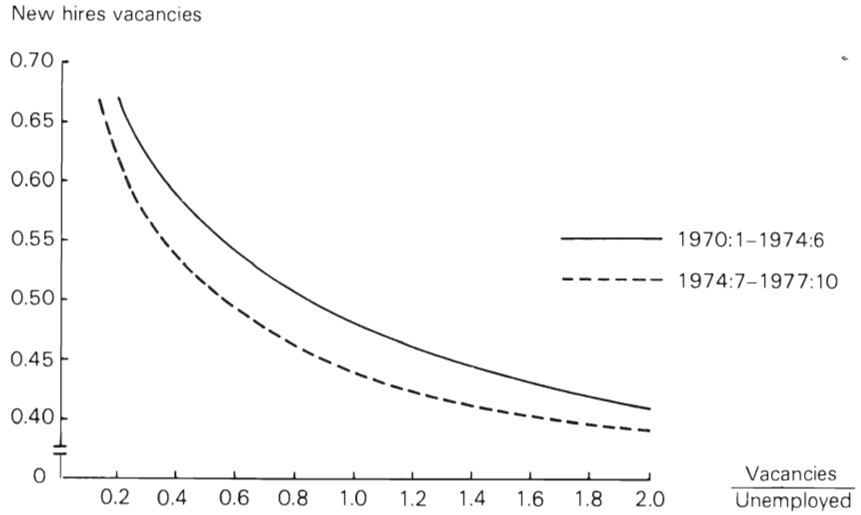
Labor force participation and earnings

A tendency towards longer periods of unemployment also affects the decisions of individuals concerning labor force participation. Women have traditionally made up a marginal group of workers in the labor market because of interrupted or segmented labor force participation owing to child care and domestic work. Increases in the expected duration of job search imply higher risk of labor force interruptions and stronger incentives to remain in the labor force. In addition to this, in 1971, Sweden passed a law of

Table 3. *Placement frequences and the labor market situation – monthly data, 1970:1–1977:10.* t-ratios in parentheses

Occupation	Coefficient for		R^2	DW
	V/U	D^2		
Work in technology, public health & sick care, educational services, legal, social science and artistic work	–0.046 (–4.166)	–0.009 (–0.884)	0.81	1.66
Administration	0.009 (0.118)	0.044 (0.653)	0.01	1.96
Accounting and general office work	–0.102 (–8.566)	–0.014 (–1.250)	0.79	1.71
Commercial work	–0.057 (–3.166)	–0.062 (–3.742)	0.70	1.84
Agricultural, forestry and fishery work	–0.235 (–7.229)	–0.033 (–1.121)	0.75	1.80
Mining and quarrying	–0.196 (–2.676)	–0.066 (–0.987)	0.40	2.09
Transport and communication	–0.198 (–7.007)	–0.067 (–2.557)	0.80	2.04
Manufacturing	–0.214 (–7.853)	–0.078 (3.085)	0.86	2.41
Services	–0.079 (–6.114)	–0.083 (–7.001)	0.80	1.52

Figure 3. *Relation between new hiring per vacancy and the labor market situation in manufacturing industry 1970–1977*



individual taxation of income for husband and wife. In combination with the highly progressive income tax in Sweden, this has meant that the earnings of women are a greater addition to family disposable income than before, and this has encouraged the labor force participation of women.

An increased stability in the female labor force participation will have effects on female earnings if labor force interruptions affect future earnings. Tendencies towards fewer interruptions may then narrow the wage differentials based on sex. If continuous labor force participation is a prerequisite for success on the job, interruptions may be one of the explanatory factors for the average pay differentials between men and women.

Labor force interruptions may affect the productivity of labor in three ways. First, they imply that job skills are not maintained, since labor force interruptions may mean that the individual forgets the job skills once learned. Second, the organization and methods of work change continuously and job skills may have become obsolete when the individual tries to return to the labor market. Third, a person who is not working cannot invest in further job skills by on-the-job-training. A person who has experienced long labor force interruptions probably has a smaller earnings potential owing to smaller production potential during his or her life time than a person who has not experienced such labor force interruptions. Effects of labor force interruptions are probably smaller for short interruptions than for long ones.

Labor force interruptions may be expected to affect earnings capacity

regardless of sex and regardless of the reasons for the interruption (except if the reason is studied). Labor force interruptions are fairly unusual for men whereas women often choose to stay at home for child and home care instead of continuing to work in the labor force.

The hypothesis that labor force interruptions affect future earnings has been tested by econometric estimations on a set of data which is a one in ten sample of white collar workers in the private sector in 1974. The number of individuals is 32 000. The hypothesis tested is that the monthly salary of 1974 depends on how the individual has allocated his time between years of studying, years of labor market work and years spent neither studying nor working on the labor market.

The hypothesis has been tested by applying the model:

$$\mathrm{Ln}\, Y_i = ß_0 + ß_1 S + ß_2 (NX) + ß_3 (PX) + ß_4 (PX)^2 + \epsilon_i,$$

where
Y_i = monthly salary in 1974 for individual i
S = number of years of schooling
NX = years of nonexperience during the period 1960–74
PX = potential experience measured as actual age minus age at graduation.

The expectations are that
$ß_1 > 0, ß_2 < 0, ß_3 > 0, ß_4 < 0.$

The model was applied on 12 subsamples defined by education and sex. The $ß_1, ß_3$ and $ß_4$ coefficients were found to have the expected signs and to be statistically significant. Most of the $ß_2$ coefficients were negative and significant.

The $ß_2$ coefficient may be interpreted as the effect of nonexperience years on current salary. The antilogs of these coefficients expressed as percentages are given in Tables 4 and 5.

Older men with compulsory schooling who had experienced one year of labor force interruption during the 15 year period earned, on the average, 1.8 per cent less than did men of the same educational background and age but with no interruption. The effect refers to after tax real salary.

It also turned out (see Table 4) that the effect on earnings of labor force interruption is about 2 per cent per year of interruption independent of both sex and education. This effect refers to people who had finished school at least 15 years before 1974.

For younger employees (with less than 15 years' experience after finishing school) the effects of labor force interruption were found to be different between men and women (see Table 5). The young women had a smaller salary in 1974 as a result of labor force interruptions, whereas this was not found to be true for young men. One interpretation of this finding is that labor

Table 4. *Effects of labor force interruptions on future salaries of older employees*

Education	Effect of interruption (in per cent per year)		Average interruption during 1960–1974 (in number of years)	
	Men	Women	Men	Women
Compulsory school	−1.8	−2.0	0.3	1.9
Secondary school	−1.7	−2.4	0.4	2.2
University	−2.3	−1.0[a]	0.4	1.7

[a] The regression coefficient is not statistically significant.

Table 5. *Effects of labor force interruptions on future salaries of younger employees*

Education	Effect of interruptions (in per cent per year)		Average interruption during 1960–1974 (in number of years)	
	Men	Women	Men	Women
Compulsory school	0.0[a]	−0.4	2.4	1.9
Secondary school	0.5[a]	−1.3	1.2	0.8
University	0.8[a]	−2.2	0.3	0.3

[a] The regression coefficient is not statistically significant.

force interruptions have long-run effects for young women but not for young men. Another interpretation is that different causes of interruption have different effects on earnings.

For young men with compulsory or secondary schooling military service is a major reason for labor force interruptions. Effects of labor force interruptions are zero for young men with compulsory schooling. This may be interpreted to mean that men invest as much in their earnings capacity when in the military service as they do when in the labor force.

For men with secondary or academic training the effect of nonexperience years is positive but not statistically significant. If the effect really is positive it would imply that these men had a higher earnings capacity as a result of the interruption than they would have had if there had been no interruption. The most likely interpretation of this result is that men have used their years of interruption for education of some kind which has not been registered in the educational variable of this study.

Sorting mechanisms in the labor market

Our results suggest that female employees have labor force interruptions of similar magnitude as male employees, when interruptions are recorded per year. Differences in labor force interruptions do not explain more than a minor part of the salary differentials between the sexes. How can we then explain salary differentials between men and women of the same age, with the same education and who, furthermore, have been on the labor market the same number of years? Is part of the explanation that employers expect a typical labor force participation pattern of women? These expectations should then include higher absenteeism, higher propensity to take part-time work and a lower propensity to accept overtime work. Some of these expectations might not be confirmed if we had properly standardized data. Difficulties in assessing the real productivity potential of the individual at the point of hiring and potential promotion always make it profitable to economize the information gathering. Is this a reason for using sex as a sorting criterion and what is the effect of this sorting criterion if it is incorrect?

Some probable disadvantages of the Åman laws are a parallel case in point. If standard recruitment practices are sharpened persons with limited labor force experience, of higher age and with different sorts of handicaps or social problems are likely to experience increased difficulties in getting job offers. In this and other senses the welfare implications of the Åman laws may turn out to have both a desirable and a non-desirable side.

Research projects

Long Term Projections

Research during 1978 has very much been oriented towards central issues in the next long term survey. This project coordinates and synthetizes results from several studies concerning problems that are relevant for the next five to ten years. The survey itself and the macro econometric model designed for this purpose are described below. Two other IUI large scale models, the corresponding data bases, the large technology project, and other IUI projects will also serve as analytical tools and important inputs in the long term outlook as described below.

The Next Long–Term Survey

This is a team project, part of which has already been presented in the introduction (p. 11). Besides the two modelling projects (pp. 40 and 68), special studies are under way on:

- Foreign trade and the international competitive environment (p. 81)
- Inflation and growth (pp. 68 and 86)
- The public sector in the total economy (p. 65)
- Technology and growth (p. 48)
- Labor market mobility (p. 82).

All these separate inquiries are essential for a proper understanding of the future prospects of the Swedish economy. The models are designed to coordinate the information available with various assumptions to facilitate quantitative projections for the entire economy. We are aware that much essential knowledge for an informed view about the future is missing or cannot be quantitatively entered into the projections. Assumptions and reasoning will have to substitute for knowledge in our macro view. The risk of being wrong on major points is there as always. We believe, however, that we are now able to identify more exactly than earlier where emphasis in inquiries should be placed and where important information is simply not available.

Economic theory is predominantly static in nature, a property that by assumption is embedded in most empirical results that are available for us to draw on. The restrictive nature of such background knowledge is all too

obvious when one has to deal with the current economic situation.

The long time survey will use 1977 as base year for the statistical series. We believe that a high quality initial period description is unusually necessary this time but also that a long historical perspective is needed to obtain a proper understanding of the current disequilibrium situation.

For measurement of the initial position of the economy, the planning survey of the Federation of Swedish Industries will be particularly useful. Projections will be numerical through 1985. The dynamics of the terminal situation in 1985, however, will have to be explicit. Should we aim to be on a fairly stable steady growth rate of some kind by then, or should immediate problems (and they are many) be awarded high priority? How close to such a steady rate would be compatible with a reasonable policy ambition on the part of the Swedish Government? If we cannot tell, how does either alternative affect development during the preceding years? Earlier long-term surveys have dealt with the scenario problem as a choice among a menu of steady state projections. Such an approach is hardly relevant this time.

The relationship problem between inflation and growth as the economy moves out of the deep recession of 1976–78 can be dealt with to some extent quantitatively by two models developed at the institute. Once the general growth paths of the economy are mapped out under two or more alternatives the macro input-output model (p. 68) will be used to hold together all sector forecasts. The fact that three nationwide models with different orientations and based on different philosophies will be combined with some peripheral models linked up to the macro sector model (foreign trade, industry financing and investment and local community public consumption) will make this long term investigation interesting from a methodological point of view. In a way it presents a method to deal with global problems in a systematic manner without resource to a single all purpose, and possibly misleading, analytical tool.

Responsible: *Gunnar Eliasson.*

The IUI Medium-Term Forecasting Model for the Swedish Economy

A macro model developed at the Institute was used for consistency evaluation for the medium-term projection of 1976. Further improvements of the model and a continuous updating of the data base are in progress and a

medium-term forecast for the whole economy is planned to be completed early in 1979.

The 1976 version of the model has been presented in detail in an anthology of papers. [1] Figure 4 gives a compact description of the model. The balance equation represents a 23 sector model where X (gross output), PI (private investment), etc., are column vectors. The model can be characterized as a Keynes-Leontief model, i.e., an input-output model with built-in multiplier mechanisms. The arrows emerging from the sector products indicate the order in which the multiplier effects work themselves through the model. As can be seen, no arrows lead into the central and local government block, thus indicating that they are exogenous. The same goes for PI (private investment), DS (inventory change) and EX (exports). Since the system described by Figure 4 involves a number of nonlinear relationships, the gross production levels have to be calculated with a nonlinear minimization program. Since the previous year's production influences both imports and private consumption, a solution has to be found for every year in the forecasting period. This makes the model dynamic but only in a technical sense, since the influence of the lagged values does not produce a business cycle.

A brief description of each block in Figure 4 will be given below, and along with this some planned improvements of the model will be indicated.

Foreign trade relations

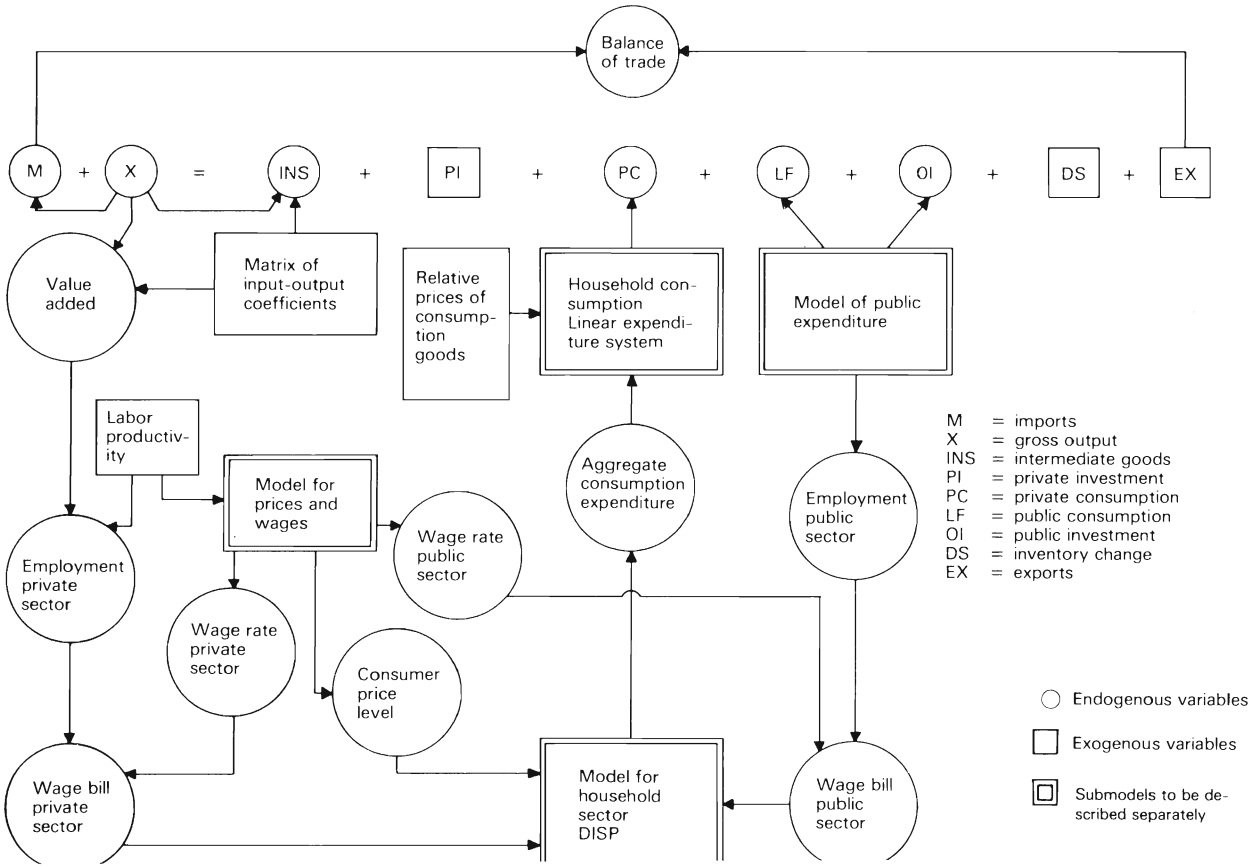
Exports by sector appeared in the 1976 version as exogenous variables. This time, import functions have been estimated for each production sector, using the principle that imports are dependent on gross production. When appropriate, however, other variables enter, e.g., private consumtion. One of the main concerns is to analyze the dependence of imports and exports on the relation between domestic and foreign prices.

Intermediate deliveries

Flows of intermediate goods between the 23 producing sectors are represented by a 23x23 input-output matrix. A projection for each input-output coefficient has been made with respect to observed historical trends and expert evaluations.

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

Figure 4. *Main structure of the IUI macro model 1976*



Public expenditure model

The public sector is divided into two parts, one for central government and the other for local government. The two parts are in turn subdivided into seven and six sectors, respectively. Public consumption is exogenously determined in the following way. First, a minimum target has been determined based on the assumption that today's level of public services in all sectors is maintained. An increase in public consumption above this target and its distribution on sectors was exogenously "decided". The public sector thus enters the model as an exogenous block. It is used as a target variable (the minimum demand for public consumption) as well as a policy instrument (the distribution of the extra increases in public consumption).[1]

Attempts are being made to reformulate the treatment of the local government sector. The new approach (se p. 65) will make the level and distribution of local government expenditure endogenous in the model system.

Price and wage formation

The modelling of prices consists of two elements dealing with relative prices and the general price level, respectively. Relative price formation is treated by a standard input-output costing model.

The level of wages and prices was determined in the 1976 version by the so-called Scandinavian model of inflation. In this approach domestic prices in the so-called "non-sheltered sectors" are primarily determined by international prices. Pricing, in sectors sheltered from foreign competition, is basically of the mark-up type. Wage change in the non-sheltered part of the economy is determined as the international price change plus the exogenous productivity change. This wage change spreads rapidly through the labor market, and differences in productivity trends between sectors of the economy will affect the general price level in a significant way.

Recent behavior of the economy indicates that this model is too simple and we are currently experimenting with alternative approaches to the treatment of the inflationary process.

[1] Studies of the differential effects of public and private consumption can be made, since the two types enter by way of separated blocks. Moreover, the disaggregated structure of the public sector allows us to analyze the impacts of different public spending patterns. (See L. Dahlberg and U. Jakobsson, *On the Effects of Different Patterns of Public Consumption Expenditures,* published in The Review of Income and Wealth 1977:4. Also published in the IUI booklet series No. 87, 1978).

The household sector

The submodel for the household sector, called DISP, establishes the link between factor income and disposable income (see Figure 5). This link is strongly affected by fiscal policies, both taxes and transfers.

One characteristic feature of this submodel is that the system of rules and parameters is explicit. Also, the distribution of income before taxes and transfers between different categories of income earners are handled explicitly. The model thus generates the development of disposable income under different hypotheses concerning the future development of income before tax for different types of households.

The DISP-model draws heavily on the highly disaggregated TAX-model developed earlier at the Institute (see p. 61). This model, covering personal income and payroll taxes, is used to estimate the aggregate tax function. This means that the automatic properties of the progressive tax system are incorporated in the Keynesian multiplier. Changes in the parameters of the tax system are simulated by shift parameters in the aggregate tax function.

The disaggregated treatment of the household sector should, to some extent, facilitate the analysis of discriminatory effects of fiscal policy measures in the macro model.

Private consumption

A linear expenditure system with habit formation,[1] estimated for 10 homogeneous groups of goods, has been used. The consumption of domestic goods is then distributed among the 23 production sectors by means of a transformation matrix.

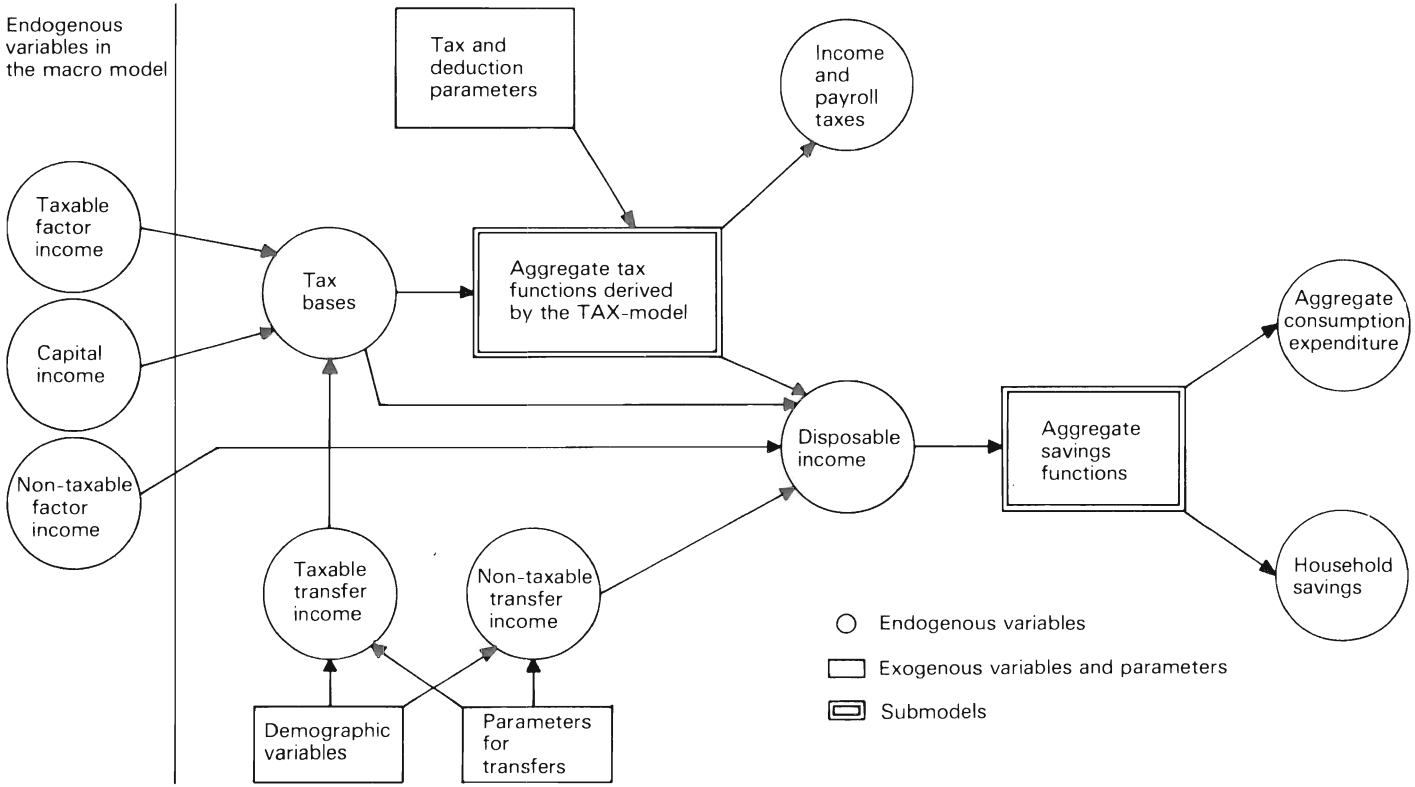
Production functions and investment demand

While in the 1976 version of the model productivity and investment were exogenously determined, attempts are now being made to treat these variables endogenously for manufacturing industry. The idea is to derive the capital/labor ratio from cost minimizing behavior on the part of firms given the long run production function and the factor price ratio. The stock of capital is then determined by expected demand and a profit indicator.

Cooperating in the project: *Bo Axell, Eva Christina Horwitz, Leif Jansson, Tomas Nordström, Göran Normann,* and others.

[1] Based on work done earlier at the Institute by C.J. Dahlman and A. Klevmarken in *Den privata konsumtionen 1931–1975* (Private Consumption in Sweden 1931–1975). IUI. Stockholm 1971.

Figure 5. *The DISP-model*



Energy Crises and Economic Development

This project is a joint effort primarily by the Institute and The Stockholm School of Economics.

The objective is to study how a future energy crisis – defined, e.g., as a drastic change in the relative price of energy or as a long-term rationing in the international energy markets – might affect the structural development of the Swedish economy, how the domestic economy may adjust and how this adjustment may be conditioned by the energy politics of today.

The main part of the study builds on simulations with a model of Swedish long-term structural development that can be characterized as an extended version of the Johansen Multi-sectoral-growth-model with particular specification in regard to energy inputs. Linked with this overall model are linear activity submodels computing the cost minimizing method of domestically producing various forms of energy and of producing heat for domestic houses. Micro and macro data as well as ex-post experience and planning surveys are employed in estimating the relations used.

It is hoped that the results of this study will contribute both to improved prediction of future energy demand and to increased knowledge in regard to the possibilities of affecting future economic vulnerability by current tax and investment policies in the energy field.

The project was started during 1978 but the main parts of the work are scheduled for 1979.

Cooperating within the Institute: *Bo Carlsson, Gunnar Eliasson* and *Leif Jansson.*

Project leader: *Bengt-Christer Ysander.*

Studies of the Retail Sector

(Joint Project)

In 1977 a joint project with the Handelns Utredningsinstitut, now the Handelns Forskningsinstitut (HFI), was initiated. It falls within the scope of the medium-term forecasting project. The project will be directed towards improving the treatment of the retail sector in the Institute's econometric models. The input/output tables which are now based on purchasing prices do not treat the retail sector separately; instead, retail and transportation services enter in the form of distribution margins for each commodity. This

gives rise to certain methodological and computational problems which will be dealt with in this study. Other issues that will be dealt with are the long-run effects of structural changes on retail margins and the relationship between changes in the price of distribution services and prices of factors of production and productivity.

Folke Larsson and *Per Nellevad* (HFI).

Productivity, Technology and Resource Use

The Institute's activities in this area can be roughly divided into three main groups. One of these consists of studies of the impact of technology and technical change on economic growth and international competitiveness; another main group, oriented heavily towards methodology, is energy studies; while the third group includes studies of production functions, technical change and industrial structure. Several other projects, particularly those concerned with economic growth and competitiveness, are linked directly to other projects within the Institute.

In July 1977, the Institute arranged an international seminar entitled *Production, Technology and Industrial Structure* where several papers from the Institute's current research projects were presented. Ishaq Nadiri (National Bureau of Economic Research and New York University), Jim Albrecht (Columbia University) and Rolf Färe (University of California at Berkeley) participated from the United States. A conference volume, *The Importance of Technology and the Permanence of Structure in Industrial Growth,* edited by B. Carlsson, G. Eliasson and I. Nadiri, was published in early fall, 1978.

As far as technology studies are concerned, a joint research project with the Royal Swedish Academy of Engineering Sciences (IVA) was started in the fall of 1977 under the heading "Sweden's Technical Industrial Competence and Long-Term Competitiveness". This project constitutes a major expansion of an already existing project as well as an integration of several current projects within the Institute: "The Development of Swedish Industry during the Postwar Period" (p. 49), "Economic Growth in Sweden" (p. 51) and "The Chemical Industry" (p. 52).

In the energy field, two reports were published during 1977: *Relativprisutvecklingen på energi och dess betydelse för energiåtgång, branschstruktur och teknologival* (Relative Energy Prices and Their Impact on Energy Use,

Industrial Structure and Choice of Technology: An International Comparison) by Bo Carlsson (p. 52), and *Substitutionsmöjligheter mellan energi och andra produktionsfaktorer* (Possibilities of Substitution between Energy and Other Factors of Production) by Lennart Hjalmarsson (p. 52). Both of these studies, commissioned by the Swedish Energy Commission, deal with the long-term sensitivity of the industrial structure to changes in energy prices.

Bo Carlsson is directing research in this area.

Sweden's Technical Industrial Competence and Future Competitiveness

In the spring of 1977, the Institute initiated a study of the international competiveness of leading Swedish export firms, particularly in the engineering industry, focusing mainly on the dependence of competitiveness on the technical know-how of firms. During the summer and fall of 1977, plans were drawn up within the Royal Swedish Academy of Engineering Sciences (IVA) for a similar but broader study, and, therefore, it seemed natural to merge the two projects into a larger joint study. IVA is in charge of the project which is financed by the Department of Industry, but the IUI is responsible for certain major parts.

The background of the project is the difficult position in which Swedish industry finds itself today. The purpose of the study is

- to describe Sweden's technical industrial competence in international and historical perspective;
- to identify the factors which have generated Swedish industrial growth, particularly the role of technical change;
- to discuss how the Swedish economy can adjust to the new circumstances.

The work of the IUI will be directed primarily at the following problems:

a) The nature and origin of the present crisis, especially with a view towards distinguishing between short-term and long-term elements. In order to gain perspective on the present situation, comparisons will be made with similar situations in the past.

b) The factors which have generated Sweden's industrial growth, how they have changed over time and in relation to other countries, as well as the role of technical change. This analysis will be carried out at the macro (industry) level. Special emphasis will be given to structural change in Swedish industry

during the postwar period. *Märtha Josefsson* is responsible for this part of the study.

c) The *content* of technical change (the so-called residual) at the micro level, i.e., the productivity change in firms and parts of firms all the way down to the product level – the impact of new plant and machinery, phasing out of old units and the adoption of new technology, new organization, etc. For obvious reasons a large part of this work will have to be carried out in close collaboration with firms via interviews. *Anders Grufman* is responsible for this part of the project.

d) The technical position of Swedish industry in relation to major foreign competitors at various times during the postwar period, as well as the role of genuinely Swedish contributions to technical and technological change in various industries. These and other issues will be investigated through a questionnaire to prominent engineers with an overview over large areas of technical competence. *Bo Carlsson* is responsible for this part of the study.

e) The present situation from the point of view of leading firms in several industrial sectors. How do they evaluate their current competitive strength, to what extent do they change their overall business strategies in the face of the present difficulties, etc.? These and many other questions will be investigated through interviews with the top management in about a dozen large firms. The interviews will be carried out in cooperation with another committee within the joint project with IVA. *Bo Carlsson* is responsible for the IUI part in the interviews.

f) In connection with this a financial analysis will be made of both the firms being interviewed and a large number of other firms with the purpose of identifying differences in financial patterns in firms with different rates of growth and the role of finance in firm growth. *Johan Örtengren* is responsible for this analysis (p. 73).

Project leader: *Bo Carlsson*

The Development of Swedish Industry during the Postwar Period

During the last few years a comprehensive study of different aspects of Swedish industrial development during the postwar period has been carried out at the IUI. This work can be seen partly as a step in the Institute's research

concerning growth and structural changes in Swedish industry, partly as a follow-up and widening of Erik Dahmén's thesis, *Svensk industriell företagarverksamhet* (Swedish Industrial Entrepreneurship). As a base for the study other projects within the IUI and some special research projects have been utilized. In this predominantly historical study the focus has been on the interaction between technical development, financing and economic development. The emphasis is on entrepreneurship, its prerequisites and meaning.

The approach of the study broadly coincides with that of the IUI study in cooperation with the Royal Swedish Academy of Engineering Sciences (IVA). It is, therefore, natural that these two projects are linked together. A large portion of the historical material, which has already been collected, will therefore be analyzed within the framework of the cooperative program with IVA.

A conspicuous characteristic of postwar industrial development is that a large number of interesting changes have occurred, particularly towards the middle of the 1960's. Industrial employment in Sweden has stagnated and then tended to decrease while, on the other hand, employment has increased rapidly in Swedish-owned companies abroad. The investment activity has been concentrated to a larger extent on machinery rather than construction. The profitability and solidity have, on the average, decreased at the same time as the differences between industries and companies have changed considerably. The structural changes have been large and mergers and closures have increased whereas the establishment of new companies has been less noticeable. An important undertaking in the study is to analyze and explain these changes.

An important expression of entrepreneurship constitutes new and better products and, therefore, particular attention has also been paid in the study to the effect that postwar innovations and inventions have had on industrial development. Using a narrow definition one finds that, in 1974, new products accounted for just over 30 per cent of the value of industrial production. If it were possible to include the larger and more significant improvements that have taken place in the quality and functioning of existing goods, the share would probably be significantly higher. The study also deals with the causal mechanisms that lie behind new products, and other effects they may have the form of, for example, characteristic chain reactions and development blocks. While earlier studies have mainly been interested in the role played by newer and better products in changing methods of production, this project emphasizes their effect on productivity.

Erik Dahmén

Economic Growth in Sweden

One large research project at the IUI deals with economic growth in Sweden over the last 100 years. Large sections of this study dealing with production and productivity, foreign trade, capital formation, labor supply and economic policy, covering a period from about 1870, have already been published. A comprehensive analysis of this material is under way and, *inter alia,* a simple annual model has been designed for analyzing economic development in Sweden during the period 1870 to 1975.[1]

The model focuses on the importance of investment and technical development in economic growth. The analysis shows, among other things, that technical development has progressed at a faster rate during the postwar period than ever before, and this has caused a very sharp decrease in the life span of capital during the last few years. See Table 6. This, in turn, has meant that old capital has been replaced at a higher rate and that the differences in productivity between old and new plants have diminished. At the same time, as indicated in Table 6, the capital stock has increased in relation to the volume of production. In total, this means that the growth potential of Swedish industry will weaken unless the volume of investment increases substantially. These results will be used and analyzed in the joint IUI/IVA study.

Table 6. *Estimated output/capital ratio and number of vintages in the Swedish economy (excluding public administration), 1890–1975*

	1890	1910	1930	1950	1955	1960	1965	1970	1975
Output/capital ratio	0.43	0.43	0.43	0.34	0.30	0.30	0.30	0.30	0.26
Number of vintages	63	63	63	49	40	40	40	40	30

Ragnar Bentzel

[1] This part of the study is published in the conference volume from the IUI seminar on *Production, Technology and Industrial Structure,* July 18–19, 1977. (The Importance of Technology and the Permanence of Structure in Industrial Growth. *IUI Conference Reports* 1978:2).

The Chemical Industry

The chemical industry has for many years been one of the fastest growing branches of Swedish industry. A study of the development of this industry during the post-war period, and the present and future competitive conditions relating to it, are therefore of great interest. What are the basic technical and economic conditions that have generated the expansion in this industry and in what way have these changed over time? This question is closely connected to one of the main problems dealt with in the joint IUI/IVA study mentioned above, and it is therefore natural that there should be close ties between these two projects.

Tomas Pousette

Energy Prices, Industrial Structure and Choice of Technology

During 1977, two studies for the subcommittee on policy instruments of the Swedish Energy Commission were carried out within the Institute, namely *Relativprisutvecklingen på energi och dess betydelse för energiåtgång, bransch-struktur och teknologival: En internationell jämförelse* (Relative Energy Prices and Their Impact on Energy Consumption, Industrial Structure and Choice of Technology) by Bo Carlsson[1] and *Substitutionsmöjligheter mellan energi och andra produktionsfaktorer* (Possibilities of Substitution between Energy and Other Factors of Production) by Lennart Hjalmarsson[2].

The main purpose of the first study is to analyze international differences in energy prices and how long-term differences in relative price structures are reflected in resource allocation, particularly in manufacturing industry.

The economic and industrial structure of a country is determined by a number of factors which are reflected in relative prices. Among these factors are natural resources, the quantity and quality of labor, historical traditions, etc. Long-term changes in the resource endowment which are reflected in relative prices, influence the long-run composition of industrial production.

[1] Published both as appendix 12 to *Styrmedel för en framtida energihushållning* (Policy Instruments for Future Energy Economy), Appendix volume 2 to the main report of the Subcommittee on policy instruments, Ds I 1977:17, and as item no. 83 in the Institute's reprint series.

[2] Published both as appendix 13 to *Styrmedel för en framtida energihushållning* (Policy Instruments for Future Energy Economy), and as item no. 84 in the Institute's reprint series.

In order to understand the economic development in a country it is necessary, therefore, to take a very long time perspective. For example, it often takes a couple of decades for new technologies to come forth and still a few decades for them to replace older technologies in production (cf. for instance p. 57). Changes in energy consumption at a particular point in time can thus be the result of changes which occurred several decades earlier.

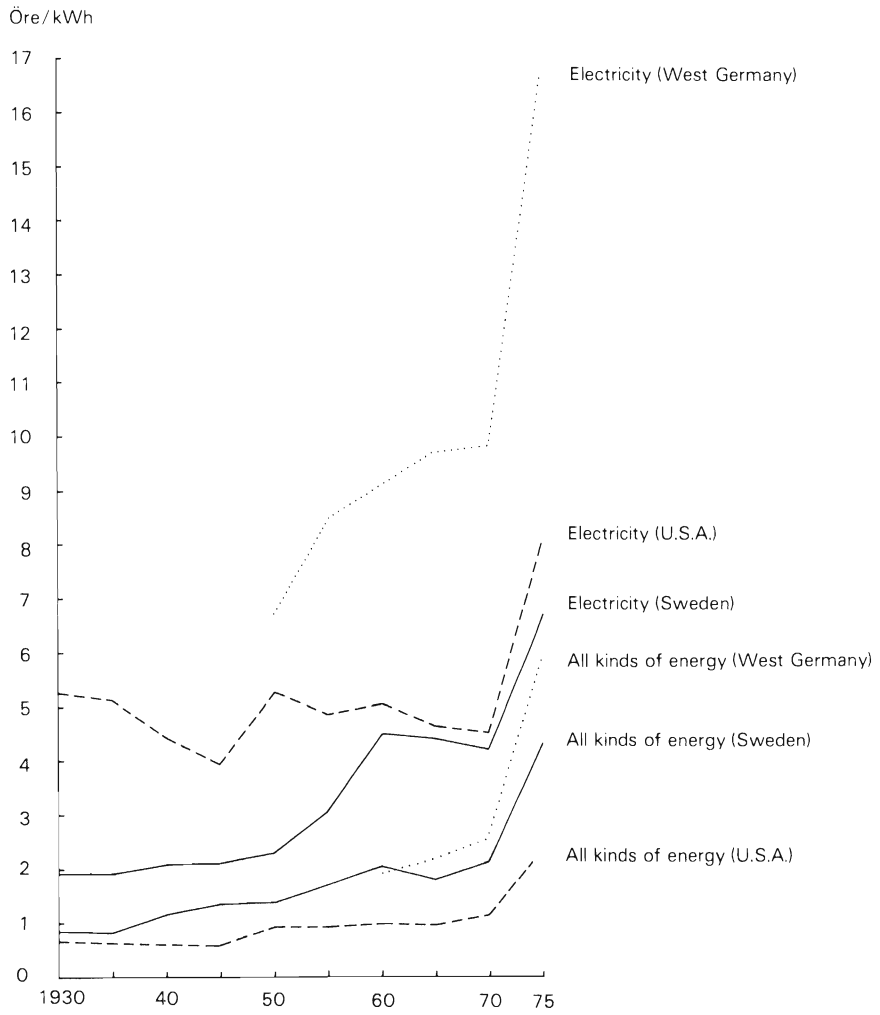
The first part of the study is devoted to a study of the development of energy prices in relation to the prices of other goods and services in Sweden, the United States, West Germany and Great Britain during most of the 20th century. In general, the energy price index for manufacturing which has been constructed for the various countries turns out to have increased at the same rate as the wholesale price index from 1950 until the so-called oil crisis 1973–74, when it increased more rapidly. Thus, the investigation does not support the proposition that energy prices have fallen substantially in relation to other prices during the last few decades. However, energy prices do show a sharply falling trend in comparison with wages.

Some of the results of the price comparison are shown in Figure 6. On average, energy prices have been substantially lower in the United States than in Western Europe, and still are. In 1965, the average price of energy in the manufacturing industry was about 20 per cent lower in the U.S. than in Sweden. On the other hand, Swedish electricity prices have been lowest among all the countries studied. This is true especially for the 1960's, when the Swedish system of electricity production was based entirely on hydro power. This has certainly been a contributing factor to the relatively high electricity consumption per unit of output of the Swedish manufacturing industry.

In another section of the study, the differences in industrial energy consumption between Sweden, the United States and West Germany are analyzed. These differences can be explained at three levels: 1) For a given *product* the production process may have varying energy intensity. 2) For a given *industry* the product *assortment* may be different. 3) For the manufacturing industry as a whole the composition of output by industry may vary.

The results show, firstly, that the production processes are less energy intensive in Sweden than in the United States where energy prices are lower. Secondly, it is found that energy consumption per unit of output tends to be lower in Sweden for any given industry. However, the data do not permit one to determine whether this is due to differences in product assortment or the choice of technology. But as far as electricity is concerned, Swedish consumption per unit of output is substantially higher than the American consumption. This seems to be due to strong Swedish specialization on

Figure 6. *Energy prices in the manufacturing industry in Sweden, West Germany and the United States, 1930–1975.*



Note: All prices converted to Swedish currency using average official exchange rates for each year.

certain very electricity intensive processes. And the Swedish composition of output by industry is considerably more energy intensive than the American pattern. This is explained by the fact that Sweden has other comparative advantages which counteract the influence of energy prices on the composition of output. Similar comparisons are made with West Germany in the study.

A question which is important for the interpretation of the results is in what *time perspective* possibilities of changing production technology exist. The international comparison shows the differences in energy consumption at a given point in time. These differences, in turn, reflect international differences in long-run factors. "Long-run" here refers to the calculated longevity of the production equipment which varies from industry to industry and from process to process. In the most capital intensive industries it is a matter of several decades, while in the light industries the production equipment may be replaced within ten years. However, it must be pointed out that the most energy intensive industries are also the most capital intensive, where the normal life of the production equipment is extremely long.

In the second study the purpose is to analyze how energy and other factors of production have been combined in producing similar product assortments. Earlier studies have generally been carried out at a very high level of aggregation, e.g., for the manufacturing sector as a whole or for various industrial branches. This report includes both a survey of some earlier studies and an analysis of new, detailed data for Swedish blast furnaces, dairies and grain mills, as well as particle board, fiber board and cement plants. The study examines firms' choice of technique in existing plants, how this choice has changed over time and the reasons for the changes. The results indicate a relatively large dispersion of energy use per unit of output among plants in each industry.

Factor substitution in the short run refers to substitution which is possible without changing the capital stock in the form of buildings and machinery. Long-run substitution is made possible through gradual change of the capital stock through new investments.

The results indicate that historically and for the manufacturing sector as a whole there have been substantial possibilities of substitution not only between energy and capital and between energy and labor, but also between energy and raw materials. Therefore, relative prices of various factors of production seem to have been decisive for the firms' choice of technology and thus also input coefficients for various factors of production. In addition, the results indicate that energy is the most price sensitive factor of production in the long run.

The possibilities of reducing energy consumption in a crisis by reducing the

utilization of capacity within an industry, with the smallest possible effects on employment, have also been studied, based on data for the industries mentioned above. The results indicate that it is easier to maintain employment during an oil crisis than during an electricity shortage, *ceteris paribus,* for a given reduction in capacity utilization.

Bo Carlsson and *Lennart Hjalmarsson*

Technical Change and Productivity in the Energy Conversion Sector

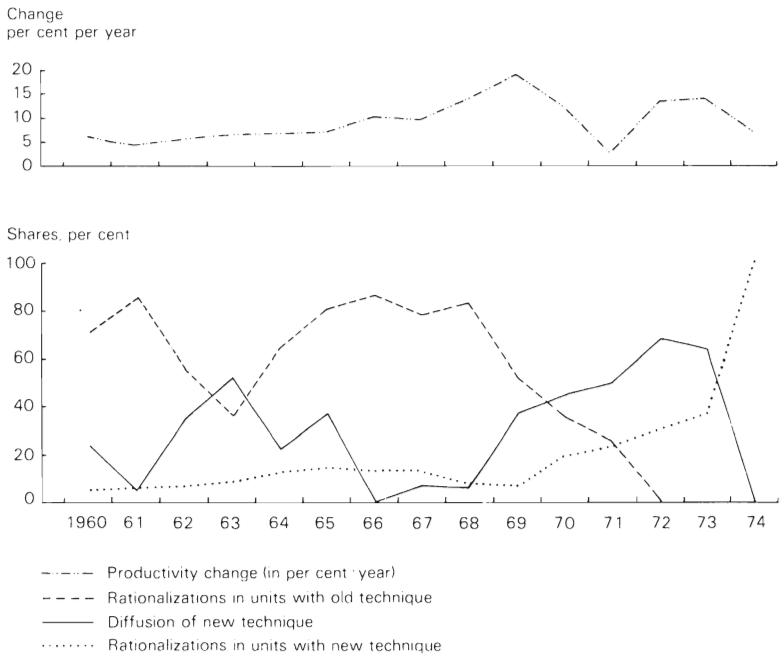
A number of studies have been made dealing with how technical change has influenced energy consumption in Sweden and other countries. However, there seems to have been no previous study focusing on technical and structural change in the energy producing or converting sector. The value added of the energy conversion sector (i.e. where primary energy, such as crude oil or hydro power, is converted into secondary energy, such as fuel oil and electricity) comprised 4 per cent of GNP in 1975 or 25 per cent more than the combined value added of the Swedish iron and steel and metal working sectors. From a production point of view the energy conversion sector therefore is a large sector, but its share of total employment is only 0.7 per cent, due to its high capital intensity. The sector converted a total of 233 TWh in 1975 (1 TWh = 10^9 kWh).

The conversion sector includes electricity and heat, oil refineries, and the gas and coke sectors. Over the period 1950–74 total productivity (i.e. output in relation to capital and labor inputs combined) in the energy conversion sector shows the same pattern of development as in the rest of Swedish industry, i.e. a relatively slow growth during the 1950's, a rapid growth during the 1960's and a stagnating growth during the 1970's. Behind this aggregated development there are, however, large differences among the included sectors. The electricity and heat sectors, e.g., are distinguished by a rapid growth in production but modest total productivity growth. The gas and coke sector, an industry that has been stagnating and shrinking for many years, shows a very rapid total productivity increase. This holds especially for the period 1960–73, when an entirely new gas production technique was introduced. This new technique is above all labor saving. A characteristic of the diffusion of the new technique is that the smallest plants with the lowest labor productivity were first to introduce the new technique, whereas the best of the old plants were the last to introduce it. The large dispersion in labor productivity in the gas

and coke sector which prevailed when the new technique first was introduced appears to have given the best old plants (which were also the largest) breathing space to perform labor-saving measures which to a large extent seem to have prolonged the diffusion process. These measures undertaken in the larger old gas and coke plants at first contributed more to sector productivity increases than did the introduction of new techniques in the smaller plants. It was only when the largest plants which represent 75 per cent of production in the sector went over to the new technique that the diffusion effect was larger than the effect of labor-saving in the older plants (the rationalization effects). This is shown in Figure 7, where the curves indicate the share of each year's change in labor productivity which depends upon a) the introduction of new technique (diffusion effect), b) labor saving in already installed units with the new technique and c) labor saving in the old part of the gas sector (the rationalization effect).

During the period 1962–73 the diffusion effect contributed 32 per cent of the sectoral productivity increase, rationalizations in already installed plants with new technique contributed 28 per cent, and rationalizations in the old

Figure 7. *Productivity change in the gas sector 1960–1974 subdivided into the contribution from rationalizations in units with old technique, diffusion of new technique and rationalizations in units with new technique.*



part of the gas och coke sector contributed 40 per cent.

The field that is studied the most thoroughly is technical change in the electricity sector. The analysis is at first performed at the aggregated electricity sector level. Thereafter a subdivision into smaller sectors is performed. Technical change in the hydro-power sector is subject to special interest, partly because the hydro-power sector is a large subsector, and partly because available data have permitted analysis of a very long period, namely the period 1900–1975. Moreover, the homogeneity of the hydro-power sector both concerning the product and the production factors has made possible the analysis of the effect of separate innovations for the capital saving technical change during the last 20 years. This analysis has been made partly with the help of engineering production functions for generators and hydro turbines.

Anders Grufman

Production Function Theory

Basic studies in production function theory establish and analyze links between inputs and outputs of goods and services. An important component in this research is to translate mathematical properties of different models into economically relevant terms like the influence of prices on the choice of production level, technique, etc. A frequent problem in empirical studies is to choose a model that is general enough not to create a bias in the empirical findings, but still manageable to operate. Many general and flexible production functions have been proposed during the last few years to test properties on the underlying economic system directly on observations. If these direct analyses of data turn out to be operational, the possibilities to build better analytical tools will have improved. It is possible, for instance, to test whether the basic assumption that any increase of input will always give an increase of output is supported by the data.

This project is a type of basic research for other projects within the Institute. Studies of this kind aim at a better description of the technology factor in industry.

Leif Jansson

Industrial Structure, Technical Progress and Efficiency[1]

The purpose of this project is to analyze different aspects of the structural and technical development in Swedish industry. The empirical analysis is based upon data for industries, such as milk processing, cement, blast furnaces, particle board, etc. all producing homogeneous products. In some cases the studies were based on a complete set of cross section–time series data, covering a period of 10 years, relating to 28 individual plants, all producing pasteurized milk. A great deal of effort has been put into writing computer programs for analyzing different aspects of the industrial structure. Plotting programs for representing the empirical results have also been constructed. The project can be divided into five different parts as follows:

1. A description of the industrial structure and structural change is presented by means of computer plotted Salter diagrams and input coeffients–capacity diagrams.

2. Technical progress is estimated on the basis of frontier and average production functions. A homothetic production function allowing a neutrally variable elasticity of scale has been utilized.

3. An estimation of efficiency is carried out on the basis of frontier production functions. Farrell's measures of productive efficiency have been generalized to nonhomogeneous production functions. Different measures of technical efficiency and scale efficiency including some new ones are defined

[1] The results are presented in the following papers:
"Technical Progress, Best-Practice Production Functions and Average Production Functions in the Swedish Dairy Industry." Paper presented at The Econometric Society European Meeting, Helsinki, August 23–27, 1976.

"Structural Change and Economic Efficiency of Swedish Dairy Plants." Paper presented at The European Meeting on Antitrust and Economic Efficiency, Bruxelles, September 2–4, 1976.

"Technical Progress and Structural Efficiency of Swedish Dairy Plants." Paper presented at The International Colloquium on Capital in the Production Function at Paris X-Nanterre, November 18–20, 1976. Also in *Capital in the Production Function.* Institut de Recherches en Economic de la Production, Paris X-Nanterre. *Forthcoming.*

"Production Functions in Swedish Particle Board Industry." Paper presented at The International Colloquium on Capital in the Production Function at Paris X-Nanterre, November 18–20, 1976. Also in *Capital in the Production Function.* Institut de Recherches en Economic de la Production, Paris X-Nanterre. *Forthcoming.*

"Frontier Production Functions and Technical Progress: A Study of General Milk Processing in Swedish Dairy Plants." IUI Working paper 1977:16. Forthcoming in *Econometrica.*

"Generalized Farrell Measures of Efficiency: An Application to Milk Processing in Swedish Dairy Plants." IUI Working paper 1978:18.

and calculated. Several of these measures have been applied to the Swedish milk processing industry.

4. The distance between best-practice production functions and average *performance* and the distance between best-practice and average-practice *production functions* have also been studied.

5. The short-run macro (sector) production function (introduced by L. Johansen) is estimated by means of computer plottings of pairwise substitution regions with corresponding isoquants. Moreover, the development of the elasticity of scale throughout the substitution region and the development of the elasticity of substitution along the isoquants are also estimated.

The driving force behind technical progress, allowing variable returns to scale, turned out to be a fairly rapid shift in the returns to scale function. The upward shift of the production frontier tended to be nonneutral, increasing the kernel elasticity of labor while somewhat decreasing the kernel elasticity of capital.

To characterize technical change, Salter's measures of bias and technical advance were utilized and interpreted within the framework of Farrell's concepts of efficiency. The splitting up of the generalized Salter measure showed that it was the rapid increase in optimal scale that resulted in the significant reductions of 9–13 per cent per year in average costs at optimal scale. Optimal adjustment to the capital saving bias resulted in quite insignificant cost reductions.

Industrial structure and structural change were examined by studying both the shape of the efficiency distributions for the individual units and their changes through time. The aggregate performance of the sector was studied by the development of the different measures of structural efficiency.

Lennart Hjalmarsson and *Finn Førsund*

Taxes and Public Economics

Household Income Taxes and Transfers

The Swedish personal income tax system has been extensively studied at the IUI, where a simulation model called TAX has been developed for this purpose. With this model it is possible to analyze the development of personal income taxation from the beginning of the 1950's for different types of households. By changing the tax rates and deductions allowed it is also possible to compare different tax systems. Since the model incorporates income distribution among households, it permits the study of the effects of different tax systems on income redistribution and the income tax yield. The latest version of the model also incorporates payroll taxes and some untaxed transfers to the household sector, thus establishing a link between the households' gross income (including payroll taxes) and disposable income. TAX is also a central component of the more aggregated model of the household sector (DISP), which is part of the Institute's medium-term macro model (see p. 44).

A central theme of the Swedish income tax debate in recent years has been the automatic increase in the progressivity of the tax system caused by a combination of high rates of inflation and fixed income brackets.

In the absence of a simultaneous change in the tax structure, inflation will greatly limit the increase in a household's net after tax income resulting from a given increase in taxable income.

Similar effects are created by some untaxed allowances, especially housing allowances. For low income households with children changes in transfer payments can be of major importance in compensating for the strong marginal effects with unchanged tax and transfer rules.

In Table 7, the changes in disposable income between 1976 and 1977, for a household with two children, have been split up into three components. The first shows the change in the household's disposable income with unchanged tax structure and transfer rules. The second and third express the effects of changes in tax structure and transfer rules, respectively, that actually took place. The total of these three components gives the actual change in disposable income.

The table shows that the percentage increase of disposable income was approximately the same at all income levels studied in 1976 and 1977 for the household type studied. The changes in the personal income tax system favored medium and high income households, while low income households

Table 7. *The change in disposable income and its composition from 1976 to 1977 for different income levels, assuming a wage increase of 10 per cent*

Wage 1976 (in thousands of Swedish kronor)	Change in disposable income, per cent			
	Under fixed tax and transfer rules	Effects of changes in		
		tax rates	transfer rules	Total
40	4.3	0.9	5.5	10.7
60	4.9	2.6	4.4	11.9
80	6.0	4.5	0.5	11.0
100	6.4	5.1	0.4	11.9
120	5.5	5.1	0.4	11.0

Comments: The household consists of two full-time working adults and two children of pre-school age. The total wage income is distributed between the parents in the proportion 40/60. The public daycare fee which is progressive is deducted from the disposable income. Possible welfare assistance at the lower income levels is not taken into account. Disposable income = wage – tax – daycare fee + child allowance + housing allowance. The wage increase is the official average estimate. The current exchange rate is 0.217 US $ per Skr.

were compensated primarily by increased housing allowances. Since consumer prices increased by 11.5 per cent real disposable income remained practically unchanged between 1976 and 1977.

Tomas Nordström and *Göran Normann*

Taxation of Factors of Production

The study of the economic effect of taxing labor, capital, energy and raw materials was undertaken in a project which was completed in 1977. Within the framework of a problem oriented overall view of the Swedish tax system and its development, the relationship between these taxes on factors of production and other selective or general taxes, for example, different types of value-added taxes, general sales taxes and personal income taxes, are discussed.

The study was undertaken on the request of the Government's Commission on Corporate Taxation. The report on the findings, written by Göran Normann and entitled, *"Bruttobeskattning och skatter på produktionsfaktorer"* (The Taxation of Gross Income and Factors of Production), has been published both in the Reports of the Swedish Public Sector Committees, 1977:87 (Annex Corporate Taxation), and in the IUI's own publication series together with a study of the taxation of corporate profits (see immediately

below.) The recent IUI publication, *Skattepolitisk resursstyrning och inkomstutjämning. En analys av företagsbeskattning och indirekt beskattning* (Income Distribution, Resource Allocation and Tax Policy. An Analysis of Business Taxation and Indirect Taxation), is discussed more extensively in the article, "Perspectives on Tax Developments in Sweden, 1950–1977" (p. 21 in this Annual Report.

Taxation of Corporate Profits

A study on the influence of taxes on net profits of companies was also undertaken at the request of the Government's Commission on Corporate Taxation. The study has been confined to the long run aspects of the corporate tax, for example, its effects on the distribution of resources and income. The research project, carried out by Jan Södersten, was completed in 1977 and the results were published in the Reports of the Swedish Public Sector Committees, 1977:87, as well as in the IUI's own publication series (see above). A more detailed description of the results appears in the article "Perspectives on Tax Developments in Sweden, 1950–1977" (p. 21) in this Annual Report.

Capital Gains Taxation

The discussion about capital gains taxation has centered around the wish to construct a consistent system implying equal treatment of capital gains on property and shares. This study deals mainly with the behavior of firms. The influence on the firm's behavior of the capital gains tax is not independent of its other tax payments. We have, therefore, worked out a dynamic steady-state model for a firm that maximizes the wealth of its owners. Using this model which incorporates the capital gains tax, the profits tax and the personal income tax, we examine the effects that these taxes have on the investment and financing policy decisions of the firm.

Compared to earlier models this one is more in conformity with business reality in so far as account is taken of a simple form of uncertainty. Assuming short-run random fluctuations in the gross earnings of the firm, and risk averting lenders and stockholders, it can be shown that the cost of capital for the firm rises owing to either increased borrowing or increased retention with ploughed back profits. These financial restraints imply a mutual dependency between the investment and financing decisions within the firm, and this interrelationship is devoted special attention in the study.

Another important phenomenon which will be analyzed is that capital

gains are not taxed until the date of realization according to Swedish tax law. This means a lower effective tax rate than the nominal one due to the fact that the postponement of the tax payments implies that the individuals are given a tax credit. The longer the holding period of the shares and the faster the increase in their value, the smaller is the effective capital gains tax rate. Obviously, there exists an optimal average stock-holding period for the stockholders. Determination of this period and hence the turnover of stocks are also interrelated with the firm's investment and financial behavior. Thus taxes also have real effects through their impact on the optimal holding period.

Göran Eriksson

Profitability, Taxation and Growth

How do corporate income taxes affect industrial development?

This is the central question to which this project addresses itself, i.e., it investigates the way in which corporate income taxation – and thereby, indirectly, the public sector – affects firm behavior, the resource allocation process in the business sector and long-term industrial growth.

The most important reason for starting this fairly ambitious project in the spring of 1978 was that, as of today, there appears to be only limited understanding of many of the effects of the corporate income tax system.

Fortunately, in the micro-to-macro simulation model of the Institute (p. 69) we possess an analytical tool that should prove helpful in dealing with some of the problems related to this topic. The connection between taxes and growth appears to be a typical micro-to-macro phenomenon, while conventional macro based econometric techniques suffer from obvious limitations in their application to the problem at hand. It is also a typical dynamic process where static theory yields only unsatisfactory results.

One important advantage in using this simulation model is that micro entities (firms) do not to the same extent as macro entities, conceal the complex process of events within and between the relevant decision units.

The following are some issues that, hopefully, will be clarified:

- In what way have past and present Swedish fiscal depreciation rules affected firms' preferences for ploughing back internally generated funds into investments?

- How has the efficiency of investment activity, as a whole, been influenced?
- Would the overall economic growth rates have changed if the same amount of funds had been distributed differently over markets and firms?

Other related projects are those of Erik Dahmén (p. 49), Jan Södersten (p. 72) and Johan Örtengren (p. 73).

Thomas Lindberg

Local Public Consumption and Economic Development

The study of public consumption has been of long-standing interest at the Institute. One major result in this area was the book published in 1962 by Erik Höök, surveying the development of public expenditures during the period 1913–58. Although limited to local expenditures – by far the most expansive part of the government budget during the postwar years – the present project can be viewed as a continuation and follow-up of Höök's study.

The descriptive phase of the work involves surveying the postwar developments of various local public expenditures and mapping the major organizational and economic reforms that were introduced in local governments during this period.

The analytical part of the work is centered around the construction of a model aimed at explaining the development of different local expenditures and their financing in terms of demographic changes in household structure and regional distribution, developments in household income and interest and changes in state support of local government.

We hope that this model, by being linked with the Instute's long-term model for the total economy, will also facilitate a closer study of the interrelation between local public expenditures and developments in other sectors of the economy.

Linked to this project are also special studies of the pricing of public services and of household preferences in regard to local public services.

Cooperating in the project: *Richard Murray, Tomas Nordström,* and others.

Project leader: *Bengt-Christer Ysander*

Profitability, Financing and Capital Market Analyses

Industrial Development and the Long-Term Supply of Capital

This study, undertaken at the request of the Ministry for Economic Affairs, was completed and published in January 1978 as a supplement to the reports of the Government Capital Market Committee entitled *Industrins tillväxt och långsiktiga finansiering* (Industrial Growth and Long-Term Finance).

The development of savings, investment and external financing of the industrial sector has been surveyed from the middle of the 1960's to 1975, and projections have been made for the internal and external financing of industry as well as for the development of the capital structure covering the period 1975 to 1980. The size of external financing indicates what the requirements will be in capital markets in the future. The financial calculations have been based on the two main alternatives used in the 1976 IUI Medium-Term Forecast. Through revisions and comments, due consideration has been given to the new trends that have emerged in recent years. A question of vital importance has been whether the real growth calculations, on the one hand, and the profitability assumptions together with the financial consequences, on the other, are compatible and feasible. The two alternative developments can be seen as representing two different political biases, where the expansion is either directed to the public sector or to the private sector.

Considering the problems Swedish industry faces today with a substantial deficit in the balance of payments, the public sector alternative will be less interesting. To reach the external balance and desired long-term growth in combination, industrial investments would have to reach the level suggested in the private sector alternative. It is assumed that firms will increase investment to that level if profitability improves and the degree of self-financing increases. If, as present conditions suggest, the required high level of profitability cannot be reached, then neither can the investment target.

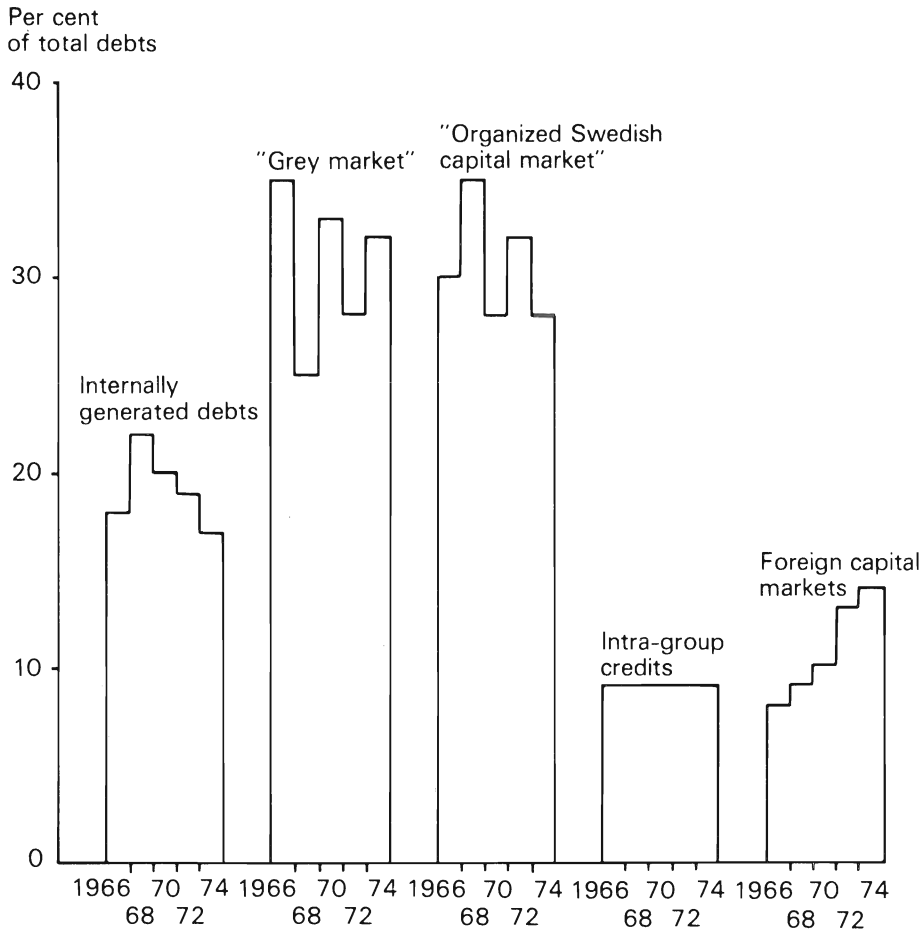
An interesting feature of the financial pattern in industry is that one-third of the funds raised come from the so-called "Grey Market", which together with the internally generated part constitutes more than 50 per cent of all debts. These are available to firms almost automatically, and hardly any negotiations are required. Access to international money markets, which

have increased in importance, and the above-mentioned "automatic" credits together imply that an intervening authority really has not placed or been able to place a financial restriction on firms. This point is illustrated in figure 8. The development in the "Grey Market" appears to be almost perfectly negatively correlated with that in the "Organized Swedish Capital Market". The possibilities of affecting investment behavior via credit policy are obviously limited.

In the part of the study which deals with the supply of risky funds the way in which households determine their portfolios is discussed in terms of the rate of return and risk involved in common shareholding vis-a-vis bank deposits.

Concerning new investments, it is evident that households have preferred

Figure 8. *Debt-structure in Swedish industry, 1966–1974*



placing their assets in banks to holding shares, something that might seem irrational in an inflationary economy. The decreased holding of shares could be interpreted as indicating that the rate of return does not compensate for the higher risk involved in shareholding. However, since the return on shares has been subject to a drastic decrease from the beginning of the 1960's, without any corresponding decrease in either the rate of return on substitutes or the risk, this form of holding assets has become less attractive and households have turned to other forms of investment.

Bo Lindörn, Lars Wohlin and *Thomas Lindberg*

Profitability, Growth and Inflation – a Micro-to-Macro Modelling Project

This project can be divided into three parts:

1) a study of the methodology underlying micro-to-macro large scale simulation modelling on the one hand; and

2) the two empirical applications for which the technique was originally conceived on the other hand, namely, the study of the micro market-based transmission of inflation throughout the economy and its effects on activity levels and growth; and

3) the study of the relationships between profitability, investment och growth.

The modelling project has been a joint research venture between IUI, IBM Sweden and the University of Uppsala during the past 2 1/2 years. It has been monitored by regular research seminars at the IBM Research Centers in Pisa (Italy) and Peterlee (England) and at the IUI. The modelling phase of the project was concluded during 1978, and work on the model has now been taken over by the Institute. Parts of the application studies have been finished or are under way.

The project aims at concluding these parts and then organizing micro firm-based research (p. 11) at the Institute around the model project. The idea is, on the one hand, to establish a framework for generalizing micro results to the macro level and on the other to set up a systematic measurement system within which one can organize micro data base work. Beyond an attempt to develop a direct total model interface with individual firms, further model

development will be halted at least temporarily to allow estimation and data base work to catch up.

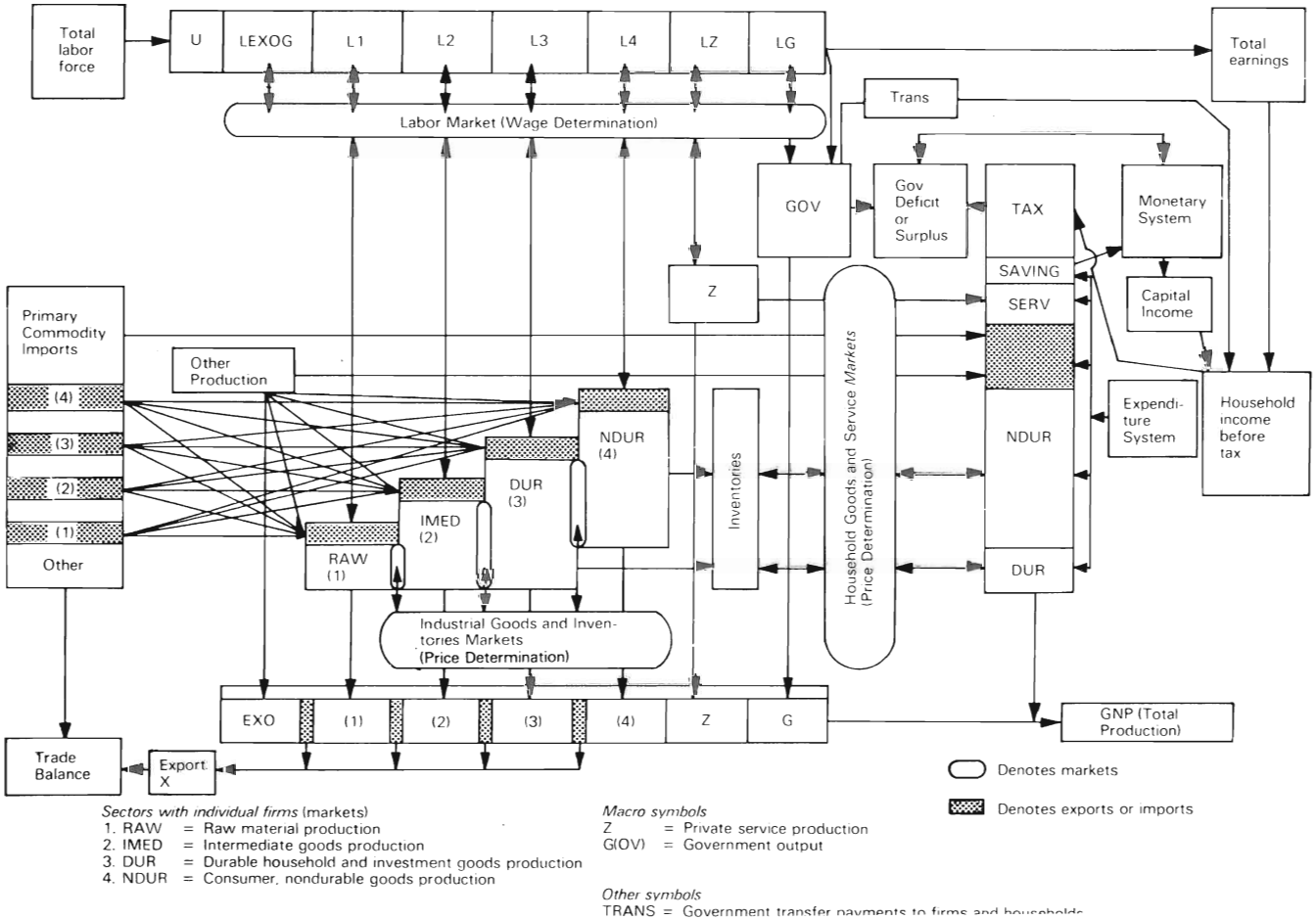
The Swedish Micro-to-Macro Model

The model is based on (1) a variable number of individual firm, production planning and investment financing models, that are (2) integrated (and aggregated) through explicitly modelled labor, product and credit markets, all being (3) constrained within a macro model of the rest of the economy. The most important exogenous variables besides Government policy parameters are foreign prices (one index for each market), and the rate of technical change (embodied in new investment) and total labor supply. The model is a disequilibrium one in the sense that markets are not fully cleared and stocks are not kept at desired levels. Rather, markets adjust towards the equilibrium in discrete steps. The model has a very elaborately developed short-term and long-term supply side embodied in the individual firm planning process. There is a feedback, from the price and quantity outcomes in markets through profit determination and cash flows via rate of return and borrowing considerations to the investment decision in individual firms that brings in new techniques of production. There is another complete integration between a monetary sector and the real system. This makes the model truly dynamic in the sense that growth is endogenously determined subject to a technology constraint. The micro model is combined with traditional Leontief input-output and Keynesian aggregate demand systems that are very similar to those used in the Institute's macro model (see p. 40).[1] Thus, price determination and income generation are combined in a theoretical (albeit numerical) model. The overall macro structure of the model system (excluding the monetary side) is shown in Figure 9.

The model project requires substantial data base work at the micro level. The regular planning survey of the Federation of Swedish Industries has been designed according to the format of the model, and the model is currently loaded with data from the 30 to 40 largest Swedish companies. The idea is to design a measurement system around decision units and to use the high quality data that exist at the firm level. Such data are seldom used efficiently, especially in support of macro analysis, and this is the primary purpose of the

[1] A complete discription of the model as it stood in Autumn 1977 is found in Eliasson, G. (ed.), *A Micro-to-Macro Model of the Swedish Economy,* IUI Conference Reports 1978:1. Also see Eliasson, Competition and Market Processes in a Simulation Model of the Swedish Economy, *AER* 1977:1 and (same author) *Relative Price Change and Industrial Structure* and Albrecht, J., *Production Frontiers of Individual Firms in Swedish Manufacturing 1975 and 1976,* both in Carlsson-Eliasson-Nadiri (eds.), *The Importance of Technology and the Permanence of Structure in Industrial Growth,* IUI Conference Reports 1978:2.

Figure 9. *Macro delivery and income determination structure of Swedish model*



model project. Direct observation of the units of measurement allows the use of very simple and efficient estimation techniques at the micro level. Some of this has been done and much is under way, but much more data work has, yet, to be undertaken before the model has a sufficient empirical footing.

Applications

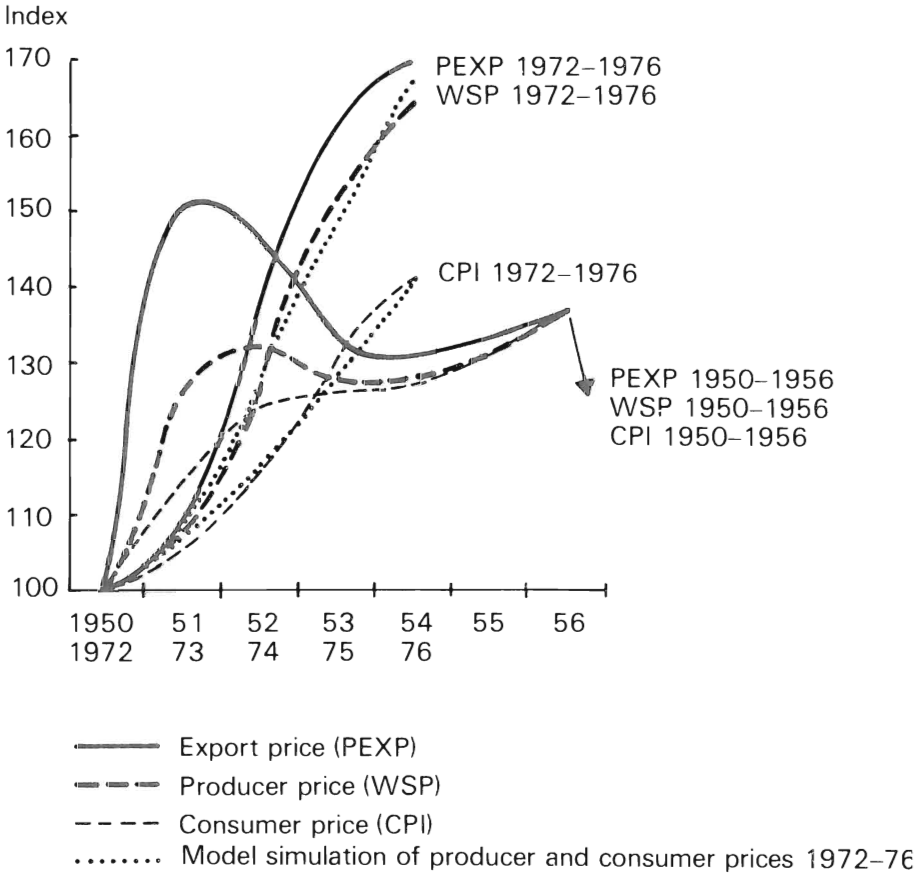
Until recently, most analytical work on the model has been concerned with sensitivity analysis aimed at ascertaining the properties of the entire economic system. Even though positive experiences for the economy generate normal short-term or medium-term effects, as in conventional macro models, reversals take place sooner or later. We have consistently found that if shocks, positive or negative, are large and sudden enough, they disturb the market signalling system and lead to erroneous decisions which cause lasting damage in the form of lost growth. This has helped to clarify the restrictive nature of traditional equilibrium assumptions.

Part of the reason for these growth effects is the long transmission times of price disturbances that upset the relative price structure and make it difficult for individual firms to interpret price and wage signals in the markets. A brief period with high prices and profits easily changes into wage drift and a cost crisis that takes years to correct itself if the initial disturbance was strong enough, and firms grow cautious and investments are hurt. As illustrated in Figure 10 the model has exhibited good performance in tracking price transmission through the economy and also longer term growth rates.

Some of the less palatable conclusions that have emerged from model analysis can be traced to the initial positioning of the economy, emphasizing the importance of high quality measurement for a proper understanding of economic phenomena. Further applied work consists in ascertaining the empirical basis for the behavior of the entire system, especially at the micro and market levels. Much empirical analysis of the life histories of individual firms remains, and some of this work will take place in the context of a separate study on the macro effects of corporate income taxation (p. 63). An estimation project on the positioning and shifting of individual firm production frontiers is being planned, partly to make the model empirically useful as an instrument to analyze the efficiency and stability properties of the Swedish economy.

Gunnar Eliasson (project leader), *Gösta Olavi, Thomas Lindberg, Louise Ahlström* and *Jim Albrecht*

Figure 10. *Domestic price transmission, 1950–1956 and 1972–1976*
1950–55 Korean cycle
1972–76 "Oil crisis" cycle
Index 1950 and 1972 = 100



Inflation and Capital Growth

In the beginning of 1978, a research project was started at the Institute dealing with the theoretical and empirical consequences of inflation on the value and growth prospects of the firm.

The study is concentrated to three aspects of particular importance. The common view that the rate of inflation is underestimated in loan agreements will be investigated. A second and closely related problem has to do with the effects of inflation on external financing patterns. As a third aspect, the workings of the tax system in an inflationary process will be studied.

The first part of the study, now about to be completed, has dealt with the distortionary effects of inflation via the tax system on the firm's cost of capital. Existing literature on capital cost often either completely overlooks the effects of inflation by assuming constant prices of investment goods, or just touches upon the analysis of inflation in connection with other problems.

By constructing a model of neoclassical firm behavior, the *nominal* cost of capital is derived from the rates of return on financial markets, i.e., the credit market and the stock market, taking into account profit taxation and shareholders' taxation of dividends and capital gains. Making simple assumptions as to how market rates are changed by inflation, the impact of inflation on *real* capital cost is then analyzed. By this procedure several counteracting tendencies are taken into account, e.g. the current practice of basing depreciation allowances on historical costs, of allowing the firm to deduct the nominal cost of debt, of taxing shareholders' nominal rates of return on alternative financial investments and of taxing nominal capital gains on corporate stock. The net result of these opposing tendencies turns out to be inconclusive.

Jan Södersten

Industry Finance during the Postwar Period

After World War I Swedish industry adapted to peace time conditions in a severe crisis – in Sweden more severe than the great depression of 1929–32. The industry emerged from this crisis financially weak and heavily dependent on the merchant banks. Therefore, financial consolidation was a characteristic feature of industrial development during the interwar period. It started on a moderate scale in the twenties but was in full swing during the thirties, and even World War II and the first peace years meant no disruption of this process.

As a result of this long favorable financial development, Swedish industry was well consolidated around 1950. Due to liberal rules for the depreciation of assets and writeoff of stocks, "hidden reserves" were of great importance in this consolidation. For instance, in 1954 inventory reserves amounted to some 70 per cent of their value. This process of consolidation culminated, however, during the 1950's and was reversed during the following decade. After the exceptional profits of the Korea boom, rates of return and the ratio between internally generated funds and investments remained high and

remarkably stable for Swedish industry as a whole. Debt-equity ratios were also low but tended to rise as industrial investment accelerated towards the end of the 1950's.

The financial picture was altered when the industrial transformation process gained momentum around 1960. A rapid increase in production and productivity contrasted, however, with a decline in profitability and a rise in the debt-equity ratio. The relatively stable pattern of the 1950's was replaced by cyclically falling rates of return on total capital until 1973–74. A drastic rise in the debt-equity ratio resulted via increased leverage in a more favorable development of the rates of return on equity. The same applies to company savings primarily due to lower effective corporate tax rates (cf. p. 27). Another prominent feature of postwar industrial finance has been a rapid increase in the ratio between financial and material assets.

This aggregated picture forms the background to this project in which the postwar development of industrial finance is studied. In order to reach a deeper understanding of the issues involved, the study is based on data being collected on financial funds and flows in individual firms. The focus is on the role played by industrial finance in the industrial transformation process as reflected in the expansion and contraction of industries and firms, entry and exit of firms, mergers, etc. The study is closely connected with the research done by professor Erik Dahmén at the Institute and the ongoing joint project with the Royal Swedish Academy of Engineering Sciences (p. 48).

Johan Örtengren

The Growth of Large Firms and its Determinants

Existing theory has not paid much attention to how individual firms change their output over time. Nor does it explain to what extent the growth of the industry is accounted for by existing firms and how much is contributed by new entrants to the industry. This study deals mainly with the former gap in our knowledge. Its purpose is to describe and explain the growth of output of the largest firms in about 30 manufacturing industries in Sweden, covering the period 1954–68. Data on firm size are available for all large firms and most smaller firms in the plastic materials industry and in the engineering industries for the years 1954–58, 1964 and 1968. The rate of growth of each of the largest firms in these industries has been calculated for these three periods. The variance in growth rates in each period as well as the co-variance

between periods have been calculated.

The study seeks to determine whether the variance in growth between industries can be explained by a) the degree of concentration in the industry, b) the rate of industry growth, c) the technological characteristics of the industry, d) product characteristics and e) cartelization. A similar analysis has been carried out to explain the variance in the growth rate of small firms in the same industries, and the results for large and small firms have been compared. One purpose of this analysis is to test the hypothesis that a high degree of concentration facilitates the division of markets between the largest firms.

John Hause

Private Consumption Studies

Demand for Consumer Goods

The study of the ability of various types of demand models to explain and predict the demand for food products, which was undertaken during 1976, has been supplemented by a similar study concerning all consumer goods. The results show, as before, that it is difficult to differentiate between the ability of different theories to explain actual developments. It is, however, possible to reach some conclusions. Models based on the theory of choice prove to be better than simpler models. The model that was used previously in the IUI projection of consumption and in the medium-term surveys – the so-called linear expenditure model with habit formation – proves to give a relatively good approximation of the observed development of consumption as well as good predictions. The estimations of income and price elasticities depend to a great extent on the type of model that is used, as well as the grouping of consumer goods. In a situation where the development of incomes and prices can be expected to deviate from that observed so far, the type of model used and the grouping of goods is of particular significance.

One difficulty encountered in studies dealing with private consumption is that of distinguishing between changes in demand and changes in supply. For example, for many years during the postwar period the construction of private housing in Sweden was controlled, thus resulting in excess demand. This

affected not only the demand for housing but can also have been expected to affect other groups of goods. Therefore, to be able to correctly estimate demand, it is necessary to take into account the special situation on the housing market.

Anders Klevmarken

Demand for Printed Matter

The Institute's study of the printing industry was initiated by a government commission examining the printing industry. Its primary task was to analyze the situation for the employees within the industry against the background of an expected rapid technical transformation in the industry. *Inter alia* the Commission was to predict the industry's demand for labor.

The development of employment within the industry is determined by the development of demand for the industry's products and of labor productivity within the industry. The IUI had earlier conducted an analysis of the demand for printed matter, and this study has now been updated on the request of Statens Industriverk (National Industrial Board).

Deliveries from the printing industry do not always change at the same rate as final sales of printed matter. During the first half of the 1970's sales from the publishing houses seem to have increased substantially more rapidly than their purchases from the printing industry in Sweden and abroad. As can be seen in Table 8 the volume of sales to final consumers increased by 6.3 per cent per annum between 1970 and 1974. At the same time purchases by the publishing houses from the printing industry decreased by 5.6 per cent per annum. Data about sales from publishing houses and about purchases by publishing houses from the printing industry have been obtained through adaption of data about sales from publishing houses and industry and foreign trade statistics, respectively. Of course, errors in some of the sources may partly explain the great difference observed. Other possible explanations are that the publishing houses decreased their inventories and the share of scrapped volumes.

The table also illustrates how deliveries from the printing industry may increase more rapidly than final purchases of books. Thus, an increment of consumer purchases of 2.0 per cent per annum between 1974 and 1985 corresponds to an increment of the publishers' purchases from Swedish and foreign printers of 3.2 per cent per annum.

The publishers' purchases from *Swedish* printers, however, do not

Table 8. *Registered or predicted purchases of books in Sweden 1970, 1974, 1980 and 1985 at retail level and at manufacturing production level*
Millions of Swedish kronor in 1974 prices

	Retail level (1)	Manufacturing production level (2)	(2)/(1)
Purchases			
1970	665	188	0.2827
1974	848	149	0.1757
Change 1970–74, per cent per year	+6.3	–5.6	
Purchases 1980			
upper prediction	955	191	0.2000
lower prediction	944	189	0.2000
Change 1974–80, per cent per year			
upper prediction	+2.0	+4.2	
lower prediction	+1.8	+4.0	
Purchases 1985			
upper prediction	1 054	211	0.2000
lower prediction	984	197	0.2000
Change 1974–85 per cent per year			
upper prediction	+2.0	+3.2	
lower prediction	+1.4	+2.6	

necessarily have to increase at this rate. There are tendencies that printing services are bought abroad to an increasing extent, according to evidence traced from the foreign trade statistics for recent years.

Bertil Lindström

Foreign Trade, the International Division of Labor and the Internationalization of National Firms

Foreign Direct Investment in Sweden

Foreign Direct Investment in Sweden by Hans-Fredrik Samuelsson, which was published in book form in 1977, analyzes the determinants of production by foreign-owned companies in Sweden. In cross-sectional analysis covering some 120 manufacturing industries in Sweden, Samuelsson shows that

foreign-owned companies had a larger share of output in industries characterized by, most importantly, high technical personnel intensity and high advertizing intensity and, to a lesser extent, by high physical capital intensity. This finding suggests that in establishing manufacturing abroad multinational firms exploit their own internal competitive advantage, and that this advantage is based on different forms of know-how.

Multinational firms of different nationalities do not have a competitive advantage in the same activities, however. U.S. owned manufacturing firms in Sweden account for relatively large shares of output in industries which are simultaneously characterized by high technical personnel intensity, high physical capital intensity and high export shares. Western European firms, on the other hand, have relatively large shares in industries characterized by, primarily, high advertising intensity. Since advertising intensity is especially high in consumer goods industries, these differences show U.S. owned firms as concentrated in producer goods industries, while European owned firms, to a relatively larger extent, are found in consumer goods industries.

Furthermore, there is a significant negative relationship between the share that U.S. owned firms hold in an industry and the share that European owned firms hold in the same industry, as well as between both of these and the relative share of Swedish multinationals in the industry. This divergent specialization pattern shows that the competitive advantage of multinational firms varies with their national origin.

Production in Sweden substitutes for exports to Sweden in industries in which Sweden may be expected to have a (national) comparative advantage, i.e., in industries characterized by a relatively high-skilled labor intensity and also a relatively high capital intensity. Tariffs and transportation costs also have the expected effect on the choice between exports and foreign production. Again, there is a difference between U.S. owned and European owned firms. Production in Sweden by the former seems primarily motivated by Sweden's comparative advantage in skilled labor intensive production, while production by the latter seems primarily motivated by distance related factors, such as, tariffs and market considerations. This difference is consistent with the earlier one of producer and consumer goods industries. It is reflected in the difference in export shares between the two groups of firms. The average export share was 63 % for U.S. owned firms and 23 % for European owned firms.

Swedish Manufacturing Investment Abroad

The main purpose of this study is to analyze the determinants of the relative volume of exports and foreign production and of the choice between these sources of supply in serving foreign markets. The empirical analysis is based on cross-sectional data collected at the Institute, covering practically all Swedish manufacturing firms with foreign affiliates abroad for the years 1965, 1970 and 1974.

Differences between firms in size both at home and abroad depend on differences in competitive power. A competitive advantage which is specific to a particular firm – a unique product or unique competence – explains the differential size and growth of firms in the same industry. To the extent that growth costs or financial constraints limit the maximum profitable rate of growth in any period, size differences between firms also depend on the age of the firm.

Given the competitive power of firms, the choice between domestic and foreign sales and production depends on the relative profitability of these alternatives. The firm's propensity to sell abroad is probably higher, the larger the firm is relative to the domestic market. The choice between domestic and foreign production depends on factors affecting location such as, the cost of factors of production in different countries and the importance of scale economies, on whether production is resource or market oriented, and on transportation costs and other barriers to trade.

The influence of the above mentioned factors on the foreign sales and production of Swedish firms has been tested by means of regression analysis. The results, in brief, are the following.

The competitive advantage of Swedish manufacturing firms producing abroad is related to a high skill intensity in production as well as a relatively large research and development (R&D) effort. However, a high R&D intensity, which is assumed to reflect an innovative advantage, is more important in explaining the foreign involvement of relatively recent investors (post-1960 investors) and, then, especially their export performance. It does not explain the foreign activities of the older and much larger foreign investors. A plausible explanation for this result is that actual manufacturing is rather more integrated with the firm's R&D activities at home in the initial stages of product or process development, so that foreign markets are more readily served via exports. Foreign production becomes a profitable option, only after the products or processes have become relatively standardized.

The size of the firm in the home market and the extent to which it has diversified into other product markets are negatively related to the propensity to sell in foreign markets. That is, domestic growth and product diversifica-

tion are, as expected, alternatives to growth in foreign markets.

The size of foreign markets strongly affects the distribution of both exports and foreign production by country. Per capita income abroad and the foreign wage level relative to the Swedish wage level have a positive effect on the propensity to produce in a particular country. This suggests that wage differences between countries are more than compensated for by other characteristics of high income (high wage) countries. Presumably, one such factor is a higher productivity of labor. Hence, Swedish firms have a high propensity to produce in countries where the skill level and productivity of labor are similar to those in Sweden.

The choice between exports and foreign production depends, among other things, on the firm's capital intensity and on the importance of scale economies in production. Thus, firms characterized by a low capital intensity and a small average plant size produce relatively more abroad. In addition, the length of time that the firm has been producing abroad, or in a particular country, has an important bearing on the relative volume of foreign production, reflecting the fact that it takes time to build up foreign manufacturing operations.

Birgitta Swedenborg

Foreign Investments and International Capital Flows

The growing internationalization of Swedish industry makes it increasingly misleading to restrict an analysis of the behavior and growth of firms to a region or a country. Instead of only studying that part of a firm which is located in Sweden, one ought to consider the whole firm, regardless of the location of its parts, as the relevant economic and financial unit.

This study concentrates on the financial aspects of foreign investments. It is based mainly on the large empirical material regarding foreign direct investment by Swedish manufacturing firms, which the Institute has collected previously (see p. 77). The purpose is to map the interdependence between the Swedish and foreign activities of firms. An important task is to determine how profitability requirements vary between host countries. A further task is to find out to what extent the financial structure differs between investments in Sweden and in other countries, and to show how such differences influence the total financial situation of firms with respect to risk evaluation, solvency, etc.

In a more macro-oriented part of the study we will look at the international capital flows which are associated with the international activities of Swedish firms and try to determine their impact on the Swedish balance of payments.

Gunnar Eliasson and *Thomas Lindberg*

The Competitive Position of Swedish Industry and the Long-Term Balance of Trade

This study focuses on the connection between growth of Swedish exports and the development of demand in the markets for Swedish goods. Long-term patterns of trade and changes in the trade structure will be of primary interest. The relation between the growth of exports and the overall changes in demand in the OECD-countries will be examined as a basis for the forecasting work to be done in the context of the long-term survey of the Swedish economy. Factors of particular importance in the initial stages of this study are the analysis of Swedish market shares and the development of Swedish export and import prices relative to prices in the other OECD countries. The project is consequently closely connected to the study on inflation as well as the long-term survey.

The structure of Swedish exports differs quite significantly between markets. For the purposes of the long-term survey exports will be analyzed according to final use categories, i.e., raw materials and intermediate goods, investment goods and consumer goods. On the basis of this division of commodities the pattern of exports to different markets may be easily distinguished. Exports to other Nordic countries are basically made up of investment goods and consumer goods, whereas exports to Western Europe are heavily geared towards raw materials and intermediate goods which account for over 60 per cent of exports to these markets. The U.S., Canada and other overseas countries import mainly investment goods from Sweden.

An initial study of the relations between demand in foreign countries and changes in Swedish exports has been completed. A very simple model has been used in which growth in industrial production, investments and private consumption in a particular country are regarded as explanatory variables for

Swedish exports to that particular market.

In another study, about to be completed, trade statistics have been analyzed in great detail for the purpose of calculating market shares and the growth of exports to Sweden's traditional trading countries.

A detailed breakdown of the Swedish market shares of the OECD-countries' total imports shows that a gradual decline has taken place in total market shares for Swedish exports over the period 1963–76, although the pace of the decline has been somewhat more rapid during the latest recession. This can be attributed to a decline in exports, mainly to West European markets and particularly the EEC countries, of both raw materials and investment goods, including passenger cars. Sweden's shares of total imports to the other Nordic countries showed a strong increase in the 60's but have since declined rapidly, thereby reinforcing the downward trend in total market shares.

Eva Christina Horwitz

Labor Market and Wage Formation

Labor Turnover

The past ten years' growing literature on the economics of information and job search has generated a lot of new implications concerning the functioning of labor markets, thereby throwing new light on important policy questions, such as unemployment and inflation. With the exception of numerous efforts to test the natural rate hypothesis there seem, however, to have been fairly few attempts to investigate the empirical relevance of various job search models.

The purpose of this study is to analyze the determinants of quits, new hires and layoffs in Swedish industry. A search theory approach is used as the framework for the econometric specifications. Among questions to be elucidated could be mentioned: What are the relationships between wage inflation and labor turnover? Does the firm's wage offer affect its new hire rate and its quit rate? How is the firm's wage choice related to its recruitment plans? How does a higher accession rate affect quit rates in the firm?

The empirical analysis is based on aggregate time-series as well as pooled time-series and cross-section observations from about 3 000 industrial establishments.

Bertil Holmlund

Labor Force Interruptions and Male-Female Earnings Differentials in Sweden

One of the main shortcomings in the early literature on earnings differentials between men and women was that the data did not contain information on labor force interruptions. Once data on these interruptions became available it was natural to estimate the rate of depreciation of human capital due to this factor.

In the pathbreaking study by Mincer and Polachek[1] the conclusion was that periods of domestic work had significant negative effects on earnings of white women between 30 and 44 years of age. Since the women, on average, had spent half of their adult life in domestic work, labor force interruptions could explain a substantial share of the sex differential in current earnings.

In a study presented in the IUI working paper series entitled "Rates of Depreciation of Human Capital due to Nonuse," I set out to see if the same conclusions would hold for Sweden. The sample used consists of male and female white collar workers in the private sector. Retrospective information on labor force participation is available for 15 years.

I found that it is crucial to the interpretation of the coefficients of labor force interruptions to distinguish between the cases where years of potential experience enter the regression and those cases where years of actual experience enter the regression. The coefficient for years of labor force interruption can be interpreted as a rate of depreciation only in the first case. In the second case the coefficient includes investment forgone and depreciation.

The results show that young white collar workers in private industry do not experience net depreciation of human capital as a result of labor force interruptions.

This means that upon return to the labor market they receive lower salaries than they would have had the next year, had they had a continuous labor force commitment but not low enough to imply net depreciation. When comparing individuals of the same age rather than comparing individuals of the same number of years of experience negative effects of labor force interruptions were found. For employees whose potential experience was at least 15 years it was found that an interruption during any of these years decreased actual earnings by 2 per cent per year of duration of the interruption.

Both men and women suffer from labor force interruptions and the

[1] J. Mincer and S. Polacheck, "Family Investments in Human Capital Earnings of Women", *Journal of Political Economy*, Vol. 82, No. 2, March/April 1974, pp. S76–S108.

magnitude of this decrease in current earnings due to labor force withdrawals was about the same for men and women. This result is new since American studies have not included data on work histories of men. For the younger employees, the effects for men differ from those for women. Young men do not suffer because of interruptions whereas young women do.

The Swedish sample is a random sample comprising every tenth private sector white collar worker in 1974. In contrast to the American sample, Swedish data show that women on the average had been absent from the labor market two years out of ten. Entering the mean values of variables into the regression in order to calculate the effects of labor force interruptions on male-female earnings differentials gives the result that interruptions do not give a large contribution to the explanation of salary differentials based on sex (see Table 9). Comparing men and women who had worked all 15 years still left a differential of 22.6 per cent after standardizing for age and education.

Table 9. *Salary differentials between male and female white collar workers in Swedish industry in 1974*
Per cent of male salaries

	Not standardized	Standardized by age and education	
		not by years of experience	also by years of experience
Worked all 15 years	31.5	22.6	22.6
Worked less than 15 years	37.5	19.7	17.7
Young employees according to education			
compulsory school	23.6	16.6	15.0
secondary school	25.1	11.8	11.0
university	29.7	21.8	21.9
Older employees according to education			
compulsory school	25.0	24.8	22.3
secondary school	29.3	29.3	26.2
university	39.4	44.8	44.0

Siv Gustafsson

Other Research Projects

Entry in Swedish Manufacturing Industry 1954–1970

The purpose of this project is to study the extent, character and determinants of entry, exit and growth of firms in Swedish manufacturing industry during the postwar period. The project covers three industries, plastics, primary metals and engineering, which account for almost 50 per cent of industrial employment in Sweden. For purposes of cross section analyses these industries are split up into 40 subindustries.

The study is based on information for about 6 000 establishments obtained from the register of establishments at the Swedish Central Bureau of Statistics as well as a large amount of supplementary data collected through direct contacts with a great number of industrial enterprises, from directories and from other data sources.

The study is divided into a descriptive and an analytical part. The principal descriptive findings of the investigation have been presented earlier in two publications.[1] The purpose of the second part of the study is to analyze the determinants of new firm entry and diversification. The core of the theoretical analysis is a model that considers how changes in the industry growth rate affect supply changes of three categories of firms: entering, exiting and permanent firms. The long-run average cost curves of all firms are assumed to be perfectly elastic after a certain minimum efficient size. From the adjustment cost theories is borrowed the assumption about increasing convex costs of expansion for a firm as its growth rate increases. By making some additional assumptions about the supply of new entrepreneurs to the industry and the exit of firms from the industry it is possible to determine within the model both the entry rate and the growth rate of permanent firms. A central implication of the model is that the entry rate is an increasing convex function of the equilibrium market growth rate.

The model also explains how the entry rate is influenced by specific industry characteristics such as economies of scale and other entry barriers, technological change, monopolistic behavior, etc.

The econometric analysis shows that the rates of both new firm entry and

[1] G. Du Rietz, *Etablering och nedläggning av självständiga företag i metallmanufakturindustrin, 1954–1970* (Entry and Exit of Firms in the Metal Manufacturing Industry, 1954–1970). IUI. Stockholm. 1973 ; G. Du Rietz, *Etablering, nedläggning och industriell tillväxt i Sverige, 1954–1970* (Entry, Exit and Growth of Firms in Swedish Manufacturing Industry during the Postwar Period). IUI. Stockholm. 1975.

diversification are very sensitive to the growth rate of the industry. Both types of entry prove to be positive convex functions of the growth rate, that is, the entry rates accelerate with the growth rate. The results indicate, further, that the minimum optimum size is an important barrier to new firm entry but not to diversification entry. Also, the technical personnel ratio is found to be strongly inversely related to both new firm and diversification entry. A high technical personnel ratio may indicate a complicated production technology that makes entry more difficult. It is also possible that the technical change in industries with a high technical personnel ratio is generated to a large extent in existing firms, thus giving existing firms a lead over newcomers.

In the study, no significant partial effect has been established for any of the variables that have been used to represent technological change. This does not necessarily conflict with Erik Dahmén's earlier finding for the interwar period that a high rate of product innovation in an industry encourages entry. The reason is that a strong expansion is often caused by brisk innovative activity, i.e., our growth rate variable may have captured the effect of innovations on the entry rate. Finally, we found a significant, negative effect of registered mergers upon the new firm entry rate but not on the rate of diversification. 80 per cent of the total variation between 40 industries in new firm entry is explained by the model and almost 60 per cent of the total variation in diversification entry.

Gunnar Du Rietz

Price Controls in Sweden

During and immediately after the Second World War price controls were used in Sweden in an ineffective attempt to bring down the rate of inflation. The result, however, was a loss of faith in the efficiency of price controls in reducing inflation.

Scepticism also characterized the government study on price controls presented in 1955. This study resulted in a new price control law that made it possible to introduce different kinds of price controls in case of war or the threat of war or if, for some other reason, there was a danger of the general price level in the country rising sharply. The law had to be ratified by Parliament.

Price controls were not introduced under this law until August 27, 1970, when controls on certain food stuffs were announced. In October, 1970, a general price freeze was announced and stayed in effect until the end of 1971.

In the spring of 1973, Parliament passed a new law which stated that price controls may be introduced in the event of danger of a serious rise in prices of essential commodities or services – that is, even in the absence of a rise of the general price level. This law further stated that government agencies may negotiate with firms to set prices that may not be altered subsequently without permission from the agency. Under the provision of this law it is also possible to require that advance notice be given of price increases. Price controls have been used fairly extensively under this law.

In early 1977, about 10 per cent of total consumption was subject to some sort of price control. The high present rate of inflation has caused many problems. Some economists believe that the decrease in the growth rate can be explained by the higher rate of inflation which has severely disturbed the information system that works through the price system and thereby decreased the efficiency of the allocation of resources.

The main purpose of this study is to describe and analyze the effects of price controls in Sweden since 1970. The study can be divided into two parts: the effect of price controls on the rate of inflation, and their effect on resource allocation.

In the first part of the study an attempt is made to determine whether the rate of inflation has, in fact, been lower in periods of price controls than would otherwise have been the case and, secondly, whether in the period following controls the rate of inflation has been higher than would otherwise have been expected. To do this we need a model of inflation which allows us to eliminate the influence of other explanatory variables. This work is integrated with the work on the IUI-model (p. 40).

Preliminary results indicate that the general price freeze of 1970–71 did *not* reduce the rate of inflation. After this period of price stop, however, the rate of inflation was significantly higher than the level that can be explained by the model.

Bo Axell

Optimal Pricing of Telecommunications

The Institute has earlier conducted a study on the demand for telephones and telephone services, which was commissioned by the Swedish Telecommunications Administration. That research project has now been followed up by a study on optimal pricing of telecommunications.

The study is mainly theoretical but it contains some simplified numerical examples showing possible procedures rather than exact practical results. The

point of departure for the analysis has been welfare theory. Thus, it is assumed that if the prices are based on marginal costs, the resources of the society will be optimally allocated at a given distribution of income. In the analysis the short-run pricing decisions with a given capacity are separated from the long-run questions that also involve new investments and capacity additions for different types of tele services.

An important question is how optimal prices can be obtained allowing for the negative externalities associated with traffic congestion. These externalities are created when calls from one subscriber affect other subscribers' possibility of making a call. A numerical example shows how congestion fees can be derived from estimates of the costs of lost time for subscribers.

The Telecommunications Administration has to cover its total costs including a specified surplus paid into the Treasury. If average cost is decreasing, marginal cost pricing results in a deficit. An important question is, therefore, how to choose the best combination of prices based on marginal costs given the budget constraint. In the simplest case each price should be set so that its percentage deviation from marginal cost is inversely proportionate to the item's price elasticity of demand. Another essential result is that the resources are more efficiently utilized if the budget constraint is enforced on the Telecommunications Administration as a whole and not on separate branches or products.

For investments, the difference between private and public investment criteria is stressed. The study indicates that the consumer surplus is of great importance for public investment decisions. A numerical example shows that the optimal level of traffic congestion can be obtained in a cost-benefit calculation.

At present the Telecommunications Administration bases its prices on neither marginal costs nor average costs. Instead, the call fees, especially for trunk calls, subsidize the subscription charges as shown in Table 10. The call fees, excluding short-distance calls, are all above average costs, while the subscription charge is only about 40 % of the average cost of subscriptions. The expected cost development, according to the Telecommunications Administration, is likely to prove favorable to trunk calls and to a certain degree to short-distance calls but less so to local calls and subscriptions.

To put forward exact proposals for optimal prices one needs a lot more empirical information than is available at present. This is particularly true for the demand side. The study, therefore, presents an outline of a pricing experiment which would provide more information about the subscribers' reactions to large changes in the general tariff structure.

Table 10. *Average costs and prices for local calls, short-distance calls, trunk calls and subscriptions, 1975/76*
In Swedish kronor per call for subscriptions

	Average cost	Price
Local calls	0.09	0.14
Short-distance calls	0.67	0.14
Trunk calls[a]		
distance zone 1	0.68	0.98
2	0.86	1.82
3	1.11	2.80
4	1.26	3.50
5	1.63[b]	4.20
average	1.00	2.40
Subscriptions	3.48	1.40

[a] Excluding trunk calls in pulse intervals 180 and 90 seconds.
[b] 270–800 kilometers.
Note: The call duration was fixed at 213 seconds for local calls, 307 seconds for short-distance calls and 307 seconds for trunk calls.
Sources: Average costs: The Telecommunications Administration internal statistics. Prices: The Telephone directory, 1977.

Tomas Pousette

Foreign Guests

On the resignation of Dr Marcus Wallenberg as chairman of the Institute's Board of Directors the IUI received a donation from the Marianne and Marcus Wallenberg Foundation set aside to enable the Institute to invite foreign researchers at the IUI.

Within the framework of this program the following persons visited the IUI during 1977 and 1978:

Professor John Hause, University of Minnesota, USA
Professor Harvey Leibenstein, Harvard University, USA
Professor Jim Albrecht, Columbia University, USA
Professor Robert E Lipsey, National Bureau of Economic Research, New York, USA
Dr Cliff Pratten, Cambridge University, England
Professor John Bishop, University of Wisconsin, USA
Professor Martin Feldstein, National Bureau of Economic Research, Cambridge, Mass., USA
Professor Giora Hanoch, Hebrew University of Jerusalem, Israel
Professor Gary Haufbauer, Department of the Treasury, Washington, D.C., USA
Professor Albert G. Hart, Columbia University, USA
Professor Axel Leijonhufvud, University of California at Los Angeles, USA
Professor C.A. Knox Lovell, University of North Carolina at Chapel Hill, USA
Professor Lars Mathiesen, Odense University, Denmark
Professor Charles E.McLure, Jr, National Bureau of Economic Research, Cambridge, Mass., USA
Professor Richard R. Nelson, Yale University, USA
Professor A. William Peterson, Cambridge, England
Professor Steven Rosefield, University of North Carolina, USA
Professor Nathan Rosenberg, Stanford University, USA
Professor Ronald L. Teigen, University of Michigan, USA
Dr Charles Wolf, Rand Corp., Santa Monica, California, USA.

Conferences arranged by the IUI

The Institute sponsored two international seminars during 1977. In July, a seminar was held dealing with the theme Productivity, Technology and Industrial Structure. In September, IUI, together with IBM Sweden, arranged a conference on Micro Simulation Models.

The programs and participants of the seminars are presented below. The Institute intends to publish a collection of the papers presented at each of the conferences.

Production, Technology and Industrial Structure

July 18–19, 1977

Leif Jansson, IUI,
On Ray-Homothetic Production Functions (in collaboration with Rolf Färe, University of California, Berkeley, and Knox Lovell, University of North Carolina).

Ragnar Bentzel, Uppsala University,
A Vintage Model of Swedish Economic Growth from 1870 to 1975.

Anders Grufman, IUI,
Technical Change in the Swedish Hydro Power Sector 1900–1975.

Lennart Hjalmarsson, IUI and the University of Gothenburg,
Technical Progress and Structural Efficiency in Swedish Milk Processing (in collaboration with Finn Førsund, Oslo University).

Ishaq Nadiri, National Bureau of Economic Research and New York University,
A Dynamic Model of Research and Development Expenditure.

Bo Carlsson, IUI,
Choice of Technology in the Cement Industry: A Comparison of the United States and Sweden.

Gunnar Eliasson, IUI,
Relative Price Change and Industrial Structure: Experiments on the Swedish Micro-to-Macro Model.

Rolf Färe, University of California, Berkeley.
The Law of Diminishing Returns in a Dynamic Framework.

Jim Albrecht, Columbia University.
Uses of Capacity Utilization Data in Describing Production Possibilities.

Micro Simulation Seminar organized jointly with IBM Sweden

September 19–20, 1977

Session A

Chairman: Robert Clower, University of California, Los Angeles, USA

Barbara Bergmann, University of Maryland, USA
A Transaction Model of the United States.

Guy Orcutt, Yale University, USA
Microanalytic Models and their Solutions.

Gunnar Eliasson, IUI,
A Micro-Macro Simulation Model of Sweden

Session B

Chairman: Don Nichols, U.S. Department of Labor, USA

Guy Orcutt, Yale University, USA
Hypothesis Formulation, Testing and Estimation.

Barbara Bergmann, University of Maryland, USA
Alternative Methods of Parameter Estimation in Micro Simulation Models.

Gunnar Eliasson, IUI, and Gösta Olavi, IBM Sweden
Stepwise Parameter Estimation of Micro Simulation Models.

Session C

Chairman: Barbara Bergmann, University of Maryland, USA

Don Nichols, U.S. Department of Labor, USA
Simulation of Policies that Affect the Distribution of Income.

Guy Orcutt, Yale University and James Smith, University of Pennsylvania, USA
(together with S. Franklin, Yale University)
Micro Simulation in Exploring Income and Wealth Distribution – A Progress Report.

Gunnar Eliasson, IUI,
How Does Inflation Affect Growth – Experiment on the Swedish Model.

Gösta Olavi, IBM Sweden
Demonstration of the Swedish Model.

Session D

Chairman: Albert Hart, Columbia University, USA

Frederic Pryor, Swarthmore College, USA
Micro Simulation as a Tool in Comparative Economics.

Jim Albrecht, Columbia University, USA
Expectations, Cyclical Fluctuations and Growth Experiments on the Swedish Model.

Session E

Chairman: Guy Orcutt, Yale University, USA

Robert Bennett, University of Maryland, USA
Banks and Financial Intermediaries in the Micro Simulated Transaction Model of the U.S. Economy.

Special Project Reports

Louise Ahlström, IUI,
The Market Oriented Inter-Industry Stock and Flow Data Aggregation Scheme Used in the Swedish Model.

Ralph Brennecke, Wolfgang Goethe Universität, Frankfurt, W. Germany
The Socio-Political Decision and Indicator System in the Federal Republic of Germany: A Review.

Dieter Bungers, Gesellschaft für Mathematik und Datenverarbeitung. Bonn, W. Germany
The Bafplan System – Brief Outline.

Bo Carlsson, IUI, Gösta Olavi, IBM Sweden
Technical Change and Longevity of Capital in the Swedish Model.

Christen Sørensen, Det Ekonomiske Råd, Köpenhamn, Denmark
MICS – A Micro Simulation Model for Households.

Ebbe Yndgaard, Aarhus University, Denmark
Computerisation of Micro Founded Macro Econometric Models.

The Institute's Publications 1970– March 1979

A complete list of the Institute's publications can be obtained by request.

Books

Teknik och industristruktur – 70-talets ekonomiska kris i historisk belysning (Swedish Technology and Industrial Structure – the Crisis of the Seventies in Historical Perspective). Bo Carlsson et al. 1979 (IUI, IVA). 194 pp.

The Importance of Technology and the Permanence of Structure in Industrial Growth. (Eds B Carlsson, G Eliasson, I Nadiri). IUI Conference Reports 1978:2. 237 pp.

A Micro-to-Macro Model of the Swedish Economy (ed G Eliasson). IUI Conference Reports 1978:1. 240 pp.

Teknisk utveckling och produktivitet i energiomvandlingssektorn[1] (Technical Change and Productivity in the Energy Conversion Sector). Anders Grufman. 1978. 186 pp.

Skattepolitisk resursstyrning och inkomstutjämning. En analys av företagsbeskattning och indirekt beskattning (Income Distribution, Resource Allocation and Tax Policy. An Analysis of Business Taxation and Indirect Taxation). Göran Normann – Jan Södersten. 1978. 197 pp.

Utländska direkta investeringar i Sverige[1] (Foreign Direct Investments in Sweden – An Econometric Analysis). Hans-Fredrik Samuelsson. 1977. 202 pp.

Growth and Finance of the Firm. Göran Eriksson. 1978. 176 pp. (Distributed by Almqvist & Wiksell International, Stockholm, and John Wiley & Sons, New York.)

IUI:s långtidsbedömning 1976. Bilagor (Supplements to the IUI Medium Term Projection 1976). 1977. 324 pp.

Svensk verkstadsindustris internationella specialisering[1] (Patterns of Engineering Trade Specialization in Sweden 1960–1970 – with an International Comparison). Lennart Ohlsson. 1976. 388 pp.

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