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MOSES DATABASE

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THE INDUSTRIAL INSTITUTE FOR
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Foreword

The MOSES Micro-to-Macro model project of the Swedish economy began in 1975 as a joint project between the University of Uppsala and the Federation of Swedish Industries on the one hand, and IBM, Sweden, on the other. The model has been used extensively over the years in several empirical studies. Behind this model lies a huge database and estimation work that has, so far, only been documented in a fragmentary fashion. The problem with documenting a model of this kind is that its structure changes constantly. There has, however, been a large demand for information on the basic micro-to-macro database input in the model.

This database book presents the 1982 full-scale initial state database. It documents the micro (firm or division) data sets and how they have been consolidated and aggregated systematically through the dynamic markets of the model, to an economy-wide description consistent with the Swedish national accounts.

The ambition of this book is to document, not only the micro inputs needed to operate the model but also the micro panel data that have so far been used only partially to test model performance over historic periods. There is also a need to present data already collected to be used for estimation and initial state representation in future extensions of the model, notably data on the internal content of production, the so-called "invisible capital" and the skill composition of the labor force. A parallel development of a household database, to make it possible to complement MOSES with a micro household sector, has been presented separately (Eliasson and Klevmarken 1981, Klevmarken 1986). This documentation is also part of a wider effort to reorganize future IUI micro database work on a more unified format.

The advantage of the MOSES Database is that most firm data have been collected from the same unit of observation (a firm or division), a circumstance that minimizes internal consistency problems. The unit of observation accounted for in this book is the financially defined firm or division (of a larger firm). Hence, the equally important documentation of interior firm data, stability of interior firm structures over time and the ongoing recombination and consolidation of internal firm structures to new financial decision units still remains largely unfinished. There is information on the annual planning survey of firms and divisions of large firms (Albrecht's Chapter III), and the modification of national accounts needed to achieve a consistent micro-to-macro database, consolidated over the production, price and financial dimensions at the national accounts level (Nordström's Chapter V). Taymaz' Chapter II explains how the real firm production and investment data are merged with the financial accounts to establish the firm of the MOSES model. Braunerhjelm's Chapter IV presents the new, small firm sample of the planning survey and attempts to broaden the survey to include interior firm characteristics like new types of "soft capital", and to collect data on the financial firm entity and its composite divisions in the same survey. Firm data are exhibited as initial state Salter structures 1982. Braunerhjelm also discusses how the firm data sets, the planning survey and the surveys of Swedish multinational firms may later be carried out on a unified format. Taymaz (Chapter VI) shows how consistent firm accounting histories evolve over time within the consolidated macro model economy. My own Chapter I explains how the model is integrated, on the one hand with the database design and on the other with economic theory. Consistent data integration is the main methodological story of the Swedish micro-to-macro modeling project and the M–M model provides the vehicle for that integration. Chapter I also outlines related databases that are, or will be, part of the MOSES Database.

Dynamic path-dependent models typically exhibit initial state dependency and sometimes phases of erratic behavior. Chapter VII, finally, shows the model's sensitivity to initial state specifications and misspecifications.

MOSES Database concludes the documentation of the current version of the model which also includes *The Firm and Financial Markets in the Swedish Micro-to-Macro Model* (1985), *MOSES Code* (1989), *MOSES Handbook* (1989), and *MOSES on PC* (1991).

Stockholm in March 1992
Gunnar Eliasson

CONTENTS

* Expanded version of paper presented to the IARIW Conference in Lahnstein, West Germany, August 20–25, 1989.

CHAPTER I

The MOSES Model —Database and Applications

Gunnar Eliasson

The true method of discovery is like a flight of an aeroplane. It starts from the ground of particular observation; it makes a flight in the thin air of imaginative generalization; and it again lands for renewed observation rendered acute by rational interpretation.

Alfred North Whitehead

Page

CONTENTS

Tables

Figures

Introduction

Theory should never be separated from measurement, and the limits of measurement carry over to theory and understanding. The quantitative model is the intellectual intermediary that integrates our choice of priors with facts into comprehension.

Good economic measurement is, however, much too serious a matter to be mechanically accounted for. Economics has a long way to go to develop a scientifically based measurement tradition. When it does, it would, I am convinced, despite the principal handicaps of measurement in social sciences, put the bulk of mainstream theory at peril. I personally dislike the academic tradition that has developed an intermediate caste of applied specialists between highbrow pure theorists and lowbrow data gatherers, the former estimating or testing their models from remote ivory towers, without even touching the data, let alone participating in the design of measurements and data collection. I much prefer heroic, but visible priors in model and measurement designs to "econometric results" replete with concealed methodological conveniences. No science can develop good theory without having its influential, innovative theorists being very curious about what goes on in the labs. Hence, the reader will have to put up with a few philosophical, introductory pages on measurement design.

The lead theme of this book is that cross-sectional characteristics matter for macroeconomic behavior. When aggregation through dynamic markets is explicitly modeled, we may not even need macro theory. The problem is, however, that macro representation confronts us at all levels. Even if we do not like macro modeling at the national or sector levels, the firm is a macro entity. Thus, choice of optimal micro unit becomes a critical, analytical concern where theory and database design have to be dealt with simultaneously. The MOSES[1] modeling project, hence, through learning and experience rather than through prior design, has become a much more ambitious research project than originally conceived. What was once the idea to clarify the macroeconomic implications of the all pervasive, boundedly rational behavior of firms, observed in Eliasson (1976a), now also includes the ambi-

[1] for Model Of the Swedish Economic System.

tion to generalize these implications to the conceptual level of what I have called (Eliasson 1987) the *Experimentally Organized Economy* (EOE), and to derive the appropriate measurement system to capture such an economy in *The Knowledge Based Information Economy* (see Table 1A) and to analyze its properties through the micro-to-macro model MOSES. As it happens this modeling has been a very creative experience, generating ideas about the more general conceptual design and how to design and organize the appropriate measurement system. In fact, the research design of Table 1A is a method to systematize standardized case information through prior theory and modeling such that the macroeconomic implications can be derived. The MOSES model includes a very large such sample of cases. The overriding theoretical problem (at level 1 in Table 1A), as I now see it, is to what extent these cases, or a larger sample of cases, aggregated through well researched prior theory of market behavior will tell economically interesting stories about future such cases.

Hence, the first chapter of this Database book on the Swedish Micro-Macro Model (MOSES) includes a brief account of the model (Section 3), the conceptualization of the experimentally organized economic environment in which firms of the model are operating (Section 2) and an overview (Section 4) of the rather wide ranging database work associated over the years with the MOSES project, as an introduction to the subsequent, more specialized chapters. Section 5 explains how the statistical systems are used by the firm itself. The chapter concludes (Section 6) with some applications of the model, designed to illustrate the importance of good economic measurement.

1 The Theory and Measurement Design of the Knowledge-based Information Economy

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

The more elaborate work specialization, the more resources needed to *coordinate* production. Hence, there are explicit transactions costs associated with organizing a specialized economy. Such organization can be achieved through *competition in the market* by what Adam Smith called the invisible hand, and through *management* or *administrative method* in production units ("hierarchies"). The relative efficiency of the two methods determines the size structure of administrative units, or firms in the economy, as suggested by Coase (1937), and hence of the market structure.

Determining the division of labor and thereby the *information technology* to coordinate economic action is also a prime function of markets. It includes the entry and exit of firms, or the recombination of firms, the movement of people with competence between firms and within firms (internal labor markets). The complexities of the sorting and selecting mechanisms of the markets, the *filter* in a large measure characterizes the economic system.

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

The first conclusion coming right out of Adam Smith's original idea is that macroeconomic *growth theory has to be based on a theory of the organization of markets and of hierarchies* to capture what goes on in a growing economy.

The other fundamental understanding, also coming right out of Adam Smith, concerns the limits of productivity advance through increased division of labor or improved work organization, or the openness of the economic "system". While neoclassical theory needs a narrow convex space to achieve the transparency of insight necessary for the existence of approximate, full information equilibrium, this restriction was not considered necessary to impose by Adam Smith, or anybody before Jevons and the marginalists. The openness of the economic system, the size of state space or of the set of business opportunities (E 1990b, 1990c)[2] is fundamental to the state of information of the economy and, hence, of measurement.

The open system of the Swedish micro-to-macro model features an extremely large opportunity set made up of all existing firms and the performance characteristics embodied in their organization, all possible new firms, defined by the algorithms that determine their entry and exit behavior, and a number of exogenous (known) facts. This opportunity set, even though

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[2] I have been involved in this project since its beginning. My name will therefore pop up in more than numerous references. References to Eliasson without coauthor will therefore be to E only and year.

far smaller than the real opportunity set featuring far more unknown detail, is still sufficiently large to prevent the kind of transparency required of neo-classical modeling (see E 1991c). Hence, the Swedish micro-to-macro model features a large number of individual firms that operate according to *the same classical principles* but with different quantitative characteristics, and in different phases, states that in turn derive from their past evolutions. Thus boundedly rational behavior of each individual agent together constitutes the fundamental non-transparency of the opportunity set which in turn forces boundedly rational behavior on each agent.

The unpredictability to each agent of local economic systems behavior precludes the possibility of the economic system of ever reaching a state of full information equilibrium, and hence creates the local unpredictability that was its origin (E 1991c). With such characteristics an economy has to be *experimentally organized* (E 1987). The outcome of individual decisions cannot be assessed until they have been tried in the market (a business experiment), and the outcomes ex post exhibit non-stochastic behavior. The micro-macro model (like the real economy) is bounded, but can, for certain (not unplausible) parameter values, exhibit grossly unstable behavior that would, for the real economy exceed what is normally considered acceptable from a welfare point of view. Macro stabilization would therefore continue to be a policy problem, but the information requirements on the economic adviser/policy maker to improve the situation would be enormous and very different from what they used to be in the Keynesian world (E 1983, 1991c).[3] It is obvious that the preconceptions in this respect that enter the design of your theory strongly influence your understanding of what goes on. Similarly, the way firm decision makers view their environment fundamentally affects the design of their information and decision systems that we use to load the model with data. Good quality measurement and specification of agent characteristics, hence, are necessary for understanding the dynamics of an economy. This is also the raison d'être for the micro-to-macro database design of this book.

This is also the philosophy behind the growth theory embodied in the M–M model economy to be sketched here that, in turn, serves as the design

[3] These phenomena are well known to those familiar with the literature on non-linear systems dynamics [see, e.g., the July 1991 (Vol. 16, No. 1–2) issue of *Journal of Economic Behavior and Organization*].

for the MOSES micro simulation model, and the systematic micro-to-macro database upon which this model operates. The theme of this paper is that *theory, model and measurement cannot be separated.* Thus, I have to devote some space to presenting the micro-to-macro model from the point of view of both theoretical foundation and database design. The M–M model can be seen as a vehicle to systematically integrate theory and measurement. The model can also be regarded as an instrument to systematically generalize from case observations (E 1976a, 1984a, 1990e) to the national level via explicit aggregation through dynamic markets. Since the model as such has been recently documented in several publications (Albrecht et al. 1989, Bergholm 1989, E 1977, 1978a, 1985a, 1986, 1989b, 1991a,b,c) this presentation will be sketchy, and I will concentrate on the definition, place and use of certain critical variables in the model. I conclude with a few applications in Section 6, specially designed to illustrate the Salter (1960) curve initial state representation of the model and the interaction of price and quantity setting behavior of agents in dynamic markets.

This idea is reflected in the organization grid of the model economy that coordinates all economic action. It can be viewed as a complex *structural memory* that embodies the state of organizational technology of the economy, and of all its firms that control the coordination, innovation, selection and learning mechanisms of the economy. This memory is continually updated by the ongoing economic process. It makes the model economy *path dependent.* Simulations on the model, hence, become sensitive to *initial conditions* that keep influencing future model behavior for years. This path dependence, I consider a desired property of the model economy. I believe economies to be strongly path dependent. This is part of their dynamic *evolutionary* characterization, and they should be modeled accordingly (E 1991b,c). The degree of, or absence of path dependence is an empirical question which greatly influences economic systems behavior. To make convenient a priori assumptions in that respect will therefore unavoidably lead to errors of unknown size and direction. The important empirical question is the degree to which the organizational memory that controls the coordination, innovation, filtering and learning mechanisms of an economy has its roots in the past, how it operates, and to what extent it can be decoded, understood and manipulated, or policed.

Path dependence and sensitivity to initial conditions pose special demands on quality of measurement. Empirical studies become sensitive to *errors of measurement in the initial state* description of the economy from which all analysis of a path-dependent system has to begin. This is our key empirical problem, not parameter estimation. This also illustrates—I repeat—the importance for economics to *integrate theory, modeling and measurement* systematically, something the economics profession has painstakingly avoided by prior designs of models that make them invariant to initial state descriptions. In doing this, economics has avoided benefiting efficiently from the learning process that characterizes scientific progress; theory guiding measurement design, improved measurement and testing forcing a redesign of, sometimes, a radical change in theory.

A related and growing problem with economic measurement on the output as well as input sides is the *quality* dimension. The output of an advanced economy, notably what is produced for the open market, is dominated by a quality change component that more or less determines the value of output. Quality is difficult to measure and it is inherently heterogeneous. It matters increasingly for consumer satisfaction and the more so, the more quality on the input side matters. This means that economic measurement increasingly measures less and less well what is becoming more and more important (E 1990a).

There are limits to the extent to which qualities can be captured by more sophisticated correction techniques. The problem is heterogeneity, meaning that there is a variety of applications of each unit of input and a variety of equally satisfying uses on the output side. Hence, there is no unique method of correction. This fundamentally disturbs welfare analysis, but it is also well recognized as a problem in business decision making and solved in this context, as it is always done, through approximations (see E 1976a).

It is now easy to understand that the organizational memory of the economy is complex and for all practical purposes intractable to the individual agent participating in the economic process. A large part of resources used by the agents are devoted to "decoding" this memory to be able to improve their positions. We call this "learning" or intelligence gathering. The ability of decision makers at large to capture the structure and development of the memory in an unbiased way gives the economy its important dynamic properties. We do not assume agents to be capable of learning immediately and fully at no or known costs, as in rational expectations and efficient market theory. We rather study the consequences of costly information biases in the economy. We observe already here that the four types of information processing activities in Table 1B account for the bulk of cost applications in the advanced manufacturing firm (see Figure 2).[4] Hence, the efficiency and reliability of these information processes dominate macroeconomic behavior.

The ambition of the micro-macro economy is not greater detail in output, but to *understand macroeconomic behavior better through systematically using the wealth of internal microdata constantly collected, analyzed and used by decision makers themselves.* "Systematically" here means formulating a relevant theory through which microdata can be explicitly aggregated dynamically through markets to a macro representation of the economy. This means modeling explicitly the innovating, filtering, learning and competition processes of agents, accounting also explicitly for the limits of their view ("insight") into state space or the opportunity set. A statistician might rather say, that the MOSES model simulates the accounts of the national economy from micro firm data through a non-linear, dynamic model.

This, finally, spells out the general problem of measurement in social sciences, the fundamental instability of the *unit of measurement.* You don't find more stability as you look for further detail. The macro aggregates, on the other hand, derive their stability from the law of large numbers, concealing underneath them a wealth of microeconomic variation and mobility that normally cancels out in the aggregate, but that constitutes the dynamics of the ongoing economic processes that one should want to understand. The *optimal observation unit*, hence, is neither the most stable, nor the most detailed. It is *the unit that makes sense as a decision unit*, i.e., the most monolithically controlled decision unit that enjoys maximum autonomy in the various markets in which it operates. Since profits is the ultimate objective of commercial activities, this means that the financial market will become the dominant, controlling market of business behavior. Pricing in the financial markets will exercise a strong leverage on prices in all other markets.

All this means, that however deep into detail you try to bring your measurements, the ambition to measure will always have to stop somewhere by establishing an arbitrary scale or classification scheme. The unit of

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[4] Since the design of the MOSES model unavoidably had to be guided by existing economic theory and measurement, we initially missed the extent of resources used up in information processing as categorized in Table 1B. This was so despite my own prior interview work (E 1976a). I became aware of this embarrassing oversight when collecting data to test the model. We are now modifying the model to accommodate the new information. Its design fortunately makes this easy.

measurement—the firm or division—is the finest and at the same time a reasonably stable unit of account that can be observed. Very few firms attain the age of the world's oldest joint stock company, Stora Kopparberg, that turned 700 years in 1988. It is represented in Figure 1 through its reasonably stable *name* and the associated financial ownership characteristics. Underneath its aggregate "financial surface", however, the internal structure of Stora Kopparberg exhibits the same recurrent instability that kills most firms along the way as autonomous decision units, and steadily creates new entities that in turn, most of them, perish. The firm, in fact, is very much represented by its *internal statistical system* designed to support its autonomous decisions. Since the objective is profits this statistical system has a strong financial bias (E 1976a, Ch. XI). The various categories of work carried out inside the financial boundaries normally blend into one another, but are separated by boundaries that, to the extent possible, correspond to natural dividing lines to support internal profit control. Table 1B represents such a taxonomy that is very general in principle but that will have to be arbitrarily applied.

The reader should observe, however, that we here encounter a fundamental problem of all sciences, the limits of understanding, determined by the limits of measurements. Competitive markets that make up the driving and disciplining mechanisms of the entire economy also require reliable information (or measurement) systems to perform their functions which are the markets themselves. The better the measurement function the less competitive the economy and vice versa. The fundamental uncertainty principle also rules in economics, a fact of life that firms, designing their own internal statistical information systems, have well understood (E 1976b, 1990e; also see Section 5), in fact, much better than the economics profession.

2 The Organization-Based Experimental Growth Model

The Swedish micro-to-macro model—called MOSES—is structured on the design of the knowledge-based information economy of Table 1A. It explicitly integrates theory and measurement. All information activities, except one, internal education, occur explicitly in the model. As described in more detail below and in Chapter V, the individual firms of the MOSES model reside in four manufacturing sectors, or rather markets for manufacturing goods. All individual firms are interacting with other manufacturing firms, with other sectors and with the rest of the world (assumed to be in steady state) through product, labor and financial markets. When seen from above the MOSES model appears as an eleven-sector Leontief–Keynesian sector model with endogenous investment and dynamic demand feedback.

2.1 The Unit of Observation

The idea of the model is to represent the autonomous behavior of agents in markets, through their own statistical (information) systems and the ways they interpret and decide on the basis of these data. It is, hence, desirable to identify agents that are reasonably stable entities. We have chosen *the firm and/or the division* as the smallest, financially defined and most stable decision unit.

Since *internal reorganization is the essence of its productivity advance*, not even a division will exhibit a stable internal structure (E 1985a). The division, and more so the firm, however, represents the consistently most stable measurement unit you can obtain, since it maps reasonably one-to-one into a well-defined group of products, representing a common *product market* know-how, a monolithic set of *financial objectives*, and (hence) also into a reasonably well defined *incentive* and compensation *scheme* (labor market). The classification of this information system of behaving units relates their objectives (the rate of return) directly to the corresponding price (the interest rate) in the capital market (financial objectives). This is also part of the design idea of the micro-to-macro model. The financial units, however, also break up and recombine (mergers, acquisitions etc.), illustrating the arbitrariness of any measurement system you may devise. This recombinatorial technique may also be the most forceful factor behind macroeconomic productivity advance.[5] Again, however (see E 1989c), the financial unit

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[5] Until a dynamic theory of mergers and acquisitions has been formulated, it will, hence, be impossible to properly capture the aggregation process between factor inputs and macro productivity change. At the IUI we have organized our productivity studies on the design of the model. This means that productivity advance, originating in reorganizations within firms, is studied separately from productivity advance, originating in entry and exit of and investment in given firms (see E 1980a,b, 1991a, Carlsson 1989, Hanson 1986, Jagrén 1986). Interior firm productivity ("management") and external ("market allocation") efficiency are so to speak studied separately.

called a division or a firm, the information system which links together financial objectives of the firm with its incentive and production system, is a provisional technique (an "information technique") to install a higher level order on market activities, a higher efficiency, and a higher rate of return through "market coordination" than otherwise feasible.

2.2 A Salter Curve Representation of State Space (the Opportunity Set) and the Updating of Structures

Agents (firms) are operating in a state space or—as I prefer to call it—the opportunity set (E 1987, 1990b), including not only a snapshot representation of today but also all possible future combinations achievable through possible action of all agents from now into the future. This opportunity set is, of course, very large, complex and inherently heterogeneous. It is assumed to be sufficiently large to prevent any agent from having more than a very limited insight (bounded rationality). This opportunity set has a time dimension, and it includes for each agent all possible future behavior, a circumstance that makes the situation of full information infeasible, and bounded rationality[6] and tacit knowledge a necessary characteristic of agent behavior. In fact, it is demonstrated (E 1990b, 1991c) that the boundedly rational behavior of firms observed (in E 1976a) is sufficient to create the market unpredictability associated with a large, and largely (for each agent) non-transparent opportunity set which in turn imposes bounded rationality on agents. This section demonstrates that the observable Salter (1960) curve representation of the Swedish economy of the MOSES model is sufficient to create the conditions of the experimentally organized economy (EOE).

In the MOSES system the opportunity set is defined by all future, feasible Salter curves of variables taken into account by firm decision makers. It is not completely open-ended since there are, at each point in time, upper physical limits to the domain of operation of the economy. As the economy advances, the nature of these physical limits also changes, being determined by the actual path taken by the economy, being restricted by the ability of all agents to peek, at each time, into this opportunity set. In a sense, the opportunity set is updated at each point in time by the actions taken by all agents

[6] Bounded rationality is thereby more broadly defined than in the situation of asymmetric information of modern IO-literature.

on the basis of what they have been able to learn (understand) of the opportunity set. *The specification of the boundedness of an agent's rationality or understanding, hence, includes a specification of the competence of the agent to act successfully in markets.*

One way to illustrate the opportunity set and, hence, the dynamics of the micro-macro model economy is to start with a set of actual and potential Salter (1960) productivity and rate of return distributions of firms (see Figures 3 and 4).

(a) The *place* on the potential Salter distribution of an individual firm indicates its temporary competitive position (ex post).

(b) There is a spectrum of potential, ex ante such Salter distributions, exhibiting the consequences of increased capacity utilization, new entry, exit, innovation and investment.

(c) Each firm, in turn, operates underneath its own "Salter" production frontier (see Figure 2) that exhibits its potential for performance upgrading.

(d) The *shape* of the potential Salter distributions, or rather the performance spread between the best and worst agents, measures potential competition of domestic producers and the degree of competitive exposure of those positioned on the tail end of the distribution.

(e) The actual intensity of competition depends on the pressure brought on each actor by the same action of all actors, as reflected in price and quantity decisions. Rate of return demands imposed by the capital market, the position on the Salter curves and the potential to do something about its own situation determine the competitive action of each individual firm.

(f) The propensity and the potential to do something depend on what the firm knows about its own position relative to other firms. The firm, hence, engages in various kinds of *learning* activities. If it finds that its position is superior to that of other actors it may relax, even though a successful past tends to have generated high internal rate of return standards (E 1976a). If the firm finds itself in a precarious position, it knows both that higher performance is feasible and that it has to do something about its situation.

(g) Performance is upgraded through the investment decision. New, innovative entry, exit forced by competition, and investment (dependent on the expected rate of return) introduce new technology and phase out economically obsolescent technology, thereby upgrading the Salter structures continuously and endogenously.

The main experimental process machinery of the model is concerned with economic learning for coordination (internal and external through markets) and filtering. In the MOSES model ready-made "innovations" are brought into the firms with new investment. The innovative process per se is not modeled. On the other hand, productivity growth through organizational change is explicitly modeled, including the organization of market competition and the development of a "tacit" systems competence embodied in the organization of the entire economic system. The structure of the model represents a competence memory that is constantly updated and also controls all information processing in the model; in its markets and within its firms.

The MOSES model as it is currently implemented empirically presents the firm as a financially defined organization, represented by its financial accounts and its internal, financially based statistical information system (E 1976a, Ch. XI) and placed in the Salter rankings as described above.[7] The whole model can be seen as a dynamically coordinated ***computable disequilibrium adjustment model of economic growth.*** Agents in markets (firms and labor) make quantity decisions on the basis of perceived profit or wage opportunities but adjust prices, price expectations, and quantities as they learn about actual opportunities from participating in the ongoing market process.

Economic growth builds on dynamic coordination of micro (firm)

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[7] In the early days of building the MOSES model we considered representing the MOSES structures analytically. This is perfectly possible to do, but an analytical representation would constrain the dynamics of firm behavior. Above all, it would force us to do equilibrium modeling which I did not want to do then, and does not want to do now. The point is that there is no stable analytical Salter representation in the experimentally organized economy.

behavior which is, in turn, restricted and influenced by the ensuing macro feedback. Micro (firm) behavior is explicit in the form of an *experimental learning process.* Hence, it is *not* optimizing behavior. *Competition* is technologically based (through process efficiency).

2.3 Firm Behavior

The above Salter curve representation of the MOSES model economy exhibits each firm as being constantly threatened from above and below by competitor firms. Its ability to cope with this competitive challenge depends in part on the nature of its intelligence system.

The firm *intelligence system* exhibits bounded rationality and tacit knowledge. Firms are characterized by rent (profit) seeking on a hill climbing (not optimization) mode, guided by perceived profit opportunities. *The landscape of immediate rent opportunities is, however, constantly changing as a consequence of all agent behavior.*

Ex ante plans normally fail to match the constraints imposed by the plans of all other actors, and the characteristics of the environment of opportunities. Individual mistakes are frequent and unpredictability at the micro level the normal situation. The market environment is what I have called experimentally organized (E 1987). Firms, as a consequence, are organized as experimentators and specialists in fast identification and effective correction of errors (E 1990b).

Failure of agent plans shows up in unused capacity, undesired stocks and price adjustment. This explicit plan realization function is *the source of dynamics* in the MOSES economy. Constant failure of ex ante plans to match at the micro level causes a constant ex ante/ex post dichotomy (*the realization process*).

Out of equilibrium there is no way to tell how prices and quantities will move if you only have an equilibrium model. You need a process–representation of economic activity in which *learning behavior and expectations forming, decision making and the realization processes* are explicit in time. The nature of the *plan realization process* determines the state of information in the economy, the potential for learning reliably about its fundamentals and the feasibility of a state of full information. From a database point of view this means that firms at each point in time read off and interpret signals from state space, from their internal accounts and their local environment from which they construe an ex ante *inconsistent* picture of their own place in state space for the next period. In terms of the MOSES firm, it tries to figure out as much as possible about the potential Salter distributions around them from the signals emitted by the model economy, mostly prices. The novel feature of the M–M economy is that each agent faces a locally unpredictable environment that it has to confront, nevertheless, through envisioning a boundedly rational prediction of its behavior. The large number of different such views is sufficient to create unpredictable behavior, and force bounded rationality on agents (E 1991c). This paradoxical situation creates unexpected solutions which relate directly to the firms' information system and economic measurement. A decision to act has to be single valued, at least just then, i.e., the decision model has to have a unique (equilibrium) solution. Failure on the part of the firm organization to come up with such a single-valued solution is disorganizing (E 1990e). Hence, *it is* only *natural to expect agents*, as we have found, *to use equilibrium, albeit different decision models*, *to relate the firm to its environment*, to be capable of operational decision making. It is therefore perfectly rational for agents to look at the world around them through a linear filter. The models, however, differ from agent to agent, and the inconsistent decisions taken on such biased information are sorted out through confrontations in markets. Ex ante, individual equilibrium (decision) models are, therefore, something very different from equilibrium models of the entire economy. Equilibrium modeling of ex post outcomes of the entire economy violates the assumptions of the experimentally organized economy.[8]

All ex ante positions taken are inconsistent when confronted in markets. They create local turbulence all over, and eventually generate a consistent new state that will again be interpreted inconsistently by all actors, and so on. The ex ante/ex post outcomes cannot be assumed to be random.

2.4 How Do MOSES Firms Learn and Exhibit Competence?

The nature of the environment of the firm, and of the realization process in particular, determines how the firm perceives itself in relation to its market

[8] The stochastic, static equilibrium model is a special case that has no raison d'être in this context, except mathematical convenience.

context. Its learning behavior is organized accordingly. It is important to understand what information the firm needs and to what extent its needs coincide with the data requirements of the model.

MOSES firms accumulate and exhibit competence in three principally different ways:

(1) They *learn* dynamically *through reading off market signals* and orient themselves in their market environment. They also have the capacity to modify their learning algorithms, incorporating signaling patterns of the past.

(2) They are subject to *selection through competition* which upgrades the average productive capacity of surviving firms.

(3) They make *internal investment decisions* through which new technology is brought into the firm.

Since MOSES economic development is characterized by endogenous market-induced reorganization of micro structures, the evolving micro state is a *"tacit" memory of competence*, that determines the ability of the firm to exploit the opportunity set and at each point in time bounds the feasibility of future states *(path dependence)*. Unexploited business opportunities are abundantly available to firms willing to engage in risk taking through trial and error (*experimentation*). Hence, price and profit expectations are enough to move the MOSES economy. By endogenously changing the market regime characteristics, very different resource allocations and growth paths can be generated from the same initial state and the same, endogenous technology assumptions.

Since each firm cannot be in touch with all other firms individually, it *interprets various items of aggregate information ("indices") generated by the market process*, provided with a delay by traders, intermediaries and institutions that with a few exceptions are not explicit in the model. The nature and efficiency of this learning process depend on how the economy is organized into markets and hierarchies, but learning also affects this organization and hence the future efficiency of economic learning, and so on, creating a *path dependent* evolutionary process that cannot be predicted due to the complexity of the combinatorial, organizational possibilities facing the agents of the economy. On this point, an interesting theoretical development should be possible considering the two facts that this intermediation is the dominant resource-using activity in an economy and that very little seems to have been done in this area of research.

2.5 Competition in the Experimentally Organized Economy

Competition occurs in all markets of the MOSES model. It is represented by the shape of the Salter curves, their spread, representing the potential for competition (to pay wages, interest etc) and how much of the Salter landscape, and of its individual position, that each individual firm perceives (or misperceives) through learning. The latter dictates the action taken by the firm.

Firms are forced, in the MOSES model, to innovate, or fail and exit, thus driving the macroeconomic growth machinery.

No agent is safe, since it has to take into account that those firms that are marginally inferior feel threatened by themselves, and are trying to overcome that threat by innovation and upgrading. Similarly, marginally better firms represent already a direct competitive threat to "you", and even more so since they are also afraid that you will try to overcome them, and hence also strive to improve their performance.

2.6 Market Dynamics

The standard setting is that firms can compete freely in their markets, hire people in the entire labor market, including raiding competing firms for labor and borrowing money freely. The intensity by which firms pursue this competition affects the overall competitive situation of the economy, including market prices of other firms.

Various forms of dynamic feedback, hence, characterize the MOSES economy. There is direct interaction—through firms—between different markets (*multimarket interaction*). *Demand feedback* occurs through the macro expenditure system. Demand feedback affects domestic economic growth. Demand feedback is, however, complicated by *price feedbacks* making firms both *price makers* and *quantity setters*. Since this statement is somewhat controversial in economics some explication is in place. Firms in the model set both prices and quantities on the basis of their expectations. The price and quantity setting procedures involve certain prior trials when the firm checks out the market, reconsiders its expectations and revises its prior quantity plans. Next, however, agent confrontations in markets, notably in the labor market, mean revisions of both prices and quantities, within each period and between periods, and, finally, the entire macro outcome of multi-market interaction of all agents feeds back on each agent. While price and quantity setting of agents in the classical model has a very particular meaning (see, e.g., Marris 1991), we model the interaction of agents in markets as classical price and quantity setting in response to a perceived (of each agent) state at each point in time. During the course of this intermediation in markets, some time may have passed, thus making the simultaneity of the classical model sequential. The main characteristic of the MOSES model, however, is that it features firms as temporary monopolists competing with each other through all markets. This is also what Arrow (1959) called for. Since all individual price and quantity decisions are taken on expected data, each round of decisions throws the economy into a new, both ex ante and ex post state, thus, as a rule making the classical equilibrium state, where ex ante and ex post are equal, infeasible.

Even though the "domestic" MOSES model economy, hence, is in constant market disequilibrium, the model economy is placed in an assumed *steady-state, global ("world") market environment*, with all competing firms embodying best-practice technology and *taking* world market prices so as to achieve capital market equilibrium, i.e., rates of return being equal to the exogenous world market interest rate. Hence, *long-term economic development of the Swedish model economy is dominated by the capital market.* Investment and growth of potential capacity at the micro level are driven by the difference between the perceived rate of return of the firm and the interest rate. The interest rate imposes a rate of return requirement on the firms in the market.

Firms enter markets on the same profit signals and exit upon long-term failure to meet profit targets and/or when their net worth is exhausted. The overall outcome is a micro(organization)-based economic process model driven by profit-seeking firms, characterized by some endogenized, institutional change (entry, exit), but with other major technology-influencing reorganizations within firms being exogenously determined. While the capital market controls firm profit performance the labor market reallocates people. Depending on the market organization this reallocation can be potentially destabilizing through wage overshooting. The reason for this is partly asymmetric, downward rigidity in nominal wages (see Section 6).

2.7 Relation to the Standard General Equilibrium Model

Personally I would say that the micro-macro theory upon which the MOSES model has been designed puts life into the general equilibrium model and —with the complements suggested here—makes it *an ideal theoretical base for studying industrial organization problems.* The particular advantage is the possibility of understanding the macroeconomic consequences of microeconomic phenomena. Looked at from the perspective of economic doctrines it combines (exogenous) entrepreneurial activities à la the young Schumpeter (1912), and the Austrian tradition with Smithian (1776) dynamic coordination in markets, notably the capital market, characterized by a permanent state of Wicksellian (1898) capital market disequilibrium (see Tables 1). Innovations generate economies of scale. Concentration is checked by technological competition among all agents in the market. Salter curves are so to speak truncated at one end by Schumpeterian "creative destruction" (exit) and updated at the other end through innovative activity, including competitive entry. This general competitive game among a limited, but variable, number of players is endogenously carried on.

The capital market disequilibrium is defined as the expected return of the firm over the market loan rate. Hence, *rate of return criteria imposed through the capital market dominate long-term dynamics in the model.* A Smithian invisible hand coordinates the whole economy dynamically through monopolistic competition in the product, labor, and capital markets. All markets are interconnected through the administrative systems of firms, and the way this interconnection is organized defines the state of organizational technology of the firm. Prices in each market ultimately depend on competition among firms, and competition is ultimately driven by this organizational technology. Firms read off price and quantity signals in each market, interpret them and make appropriate (ex ante) price and quantity decisions that are ultimately modified in the competitive process. Since the organization (micro structure) of the economy and the interpretation mechanisms of the firm constitute the organizational memory of the economy that at each point in time controls overall information processes and the allocation of resources, the economy is so to speak *self-organizing* its micro structures through the experimental processes of the market. Foreign prices, the foreign interest rate, and the labor force are exogenous. Together these mechanisms determine the dynamics of *resource allocation. Keynesian demand feedback* is needed to keep the economy growing. It enters in three ways; through endogenous income formation and demand feedback (the system is closed), through exogenous government, fiscal and monetary policies, and through foreign trade.

The micro-macro economy is regulated by the interaction of domestic (endogenous) and foreign (exogenous) prices in four markets for manufacturing goods. Hence, Marxian demand deficiency (or excess demand) situations of varying length occur all the time in the model through failure of local demand plans to match local supply plans. Markets do not clear, and stocks and later prices adjust. Disequilibria then feed back into next period decisions. The dynamics of the macroeconomy originates in this failure of ex ante plans to match through the *realization functions* of markets (Modigliani and Cohen 1958, 1961; E 1967, 1969). This notion can be traced to Wicksell (1898) and Myrdal (1927, 1939), the Swedish School of Economics (also see Palander 1941), but for some reason was lost to economics in the postwar era, heavily influenced as it has been by the classical, static model in which a realization function has no economic meaning.

Experience from M–M model work, however, tells that the realization function is a critical factor behind macroeconomic dynamics. Endogenous growth cycles of different length occur as a consequence, and occasionally they develop into severe depressions of long duration (E 1983, 1984b, 1985a, Ch. V, and 1991c).

All theory has to be parsimonious in one way or another. Which way, however, depends on what analytical problem one has in mind. I look at theory as a way to organize your thoughts and your facts. There is always a large number of such ways. Hence, scientists, and especially social scientists, are all boundedly rational in their understanding of the world. Once the notion has been accepted that the problem chosen determines the analytical method ("theory"), *the* ultimate *scientific problem becomes the tacit art of choosing the relevant item from a menu of ad hoc theory.*

3 A Brief Mathematical Introduction to the Model

This section presents the mathematics needed to understand the measurement design of the Swedish microbased growth model. (For details see E 1977, 1978a, 1985a, 1991b,c). Focus is on the evolutionary features of the model. I thus exclude—in this mathematical presentation—the intermediate goods input/output structure of individual firms and all other production sectors than manufacturing (see Bergholm 1989 and *MOSES Code*, IUI 1989). Hence, all labor work in manufacturing, and manufacturing firms produce the investment goods. Gross production value and value added become identical.

3.1 Deriving the Control Function of the Firm—the Information and Short-Term Targeting System

The firms of the model are controlled through the rate of return requirements imposed by the rate of interest in the capital market. Rate of return targets control both production and investment decisions, and the interest rate is determined through supply and demand for funds in the financial system (see E 1985a, Ch. III, and Taymaz 1991). Ex ante rate of return targets guide the firm in its gradient search for a rate of return in excess of the market loan rate.

Defining the rate of return

To derive the control function we begin by decomposing total costs (TC) of a business firm, over a yearly planning horizon, into:

$$C = wL + (r + \rho - \frac{\Delta p^k}{p^k})\, p^k \cdot \overline{K} \tag{1}$$

w = wage cost per unit of L

L = units of labor input

r = interest rate

ρ = depreciation factor on $K = p^k \cdot \overline{K}$

p = product price, in this mathematical presentation equal to the value added price index

p^k = capital goods price

$\overline{K}$ = units of capital installed.

In principle the various factors (L, $\bar{K}$) *within* a firm can be combined differently, and still achieve the same total output. Depending upon the nature of this allocation the firm experiences higher or lower capital and labor productivity, as defined and measured below. In what follows we investigate the capital labor mix among firms as determined in dynamic markets.

Firm sales ($S = p \cdot \bar{S}$) over total costs generate surplus revenue, ε, or profit:

$$\varepsilon = p \cdot \bar{S} - TC. \tag{2}$$

Net profit per unit of total capital is R^N. We call the rate of return on capital in excess of the loan rate $\bar{\varepsilon}$:

$$\bar{\varepsilon} = \frac{\varepsilon}{K} = R^N - r. \tag{3}$$

The nominal rate of return then is;

$$R^N = \frac{\varepsilon + r \cdot K}{K}. \tag{3B}$$

In this formal presentation K has been valued at current reproduction costs. ε/K expresses a real excess return over the loan rate, but r is a nominal market interest rate. Ex post $\bar{\varepsilon}$ distributions over firms are shown in Figures 3.

In the micro-macro model firm owners and top management control the firm by applying targets on $\bar{\varepsilon}$, the rate of return over the interest rate. Thus, we have established a direct connection between the goal (target) structure of the firm and its operating characteristics in terms of its various cost items. The main purpose of the internal information system of a firm is to establish these links, so that top management can control and simulate internal efficiency reliably, without having to get involved in operational details (E 1976a, 1990e).

The control function of the firm

Using (1), (2) and (3) the fundamental control function of a MOSES firm can be derived as:

$$R^{EN} = M \cdot \alpha - \rho + \frac{\Delta p^K}{p^K} + \bar{\varepsilon} \cdot \phi = R^N + \bar{\varepsilon} \cdot \phi \tag{4}$$

$$R^N = M \cdot \alpha - \rho + \frac{\Delta p^K}{p^K} \tag{4B}$$

$$R = M \cdot \alpha - \rho \tag{4C}$$

$$M = 1 - \frac{w}{p} \cdot \frac{1}{\beta}, \tag{5}$$

where:
M = gross profit margin, i.e., value added less wage costs in percent of S
ρ = rate of economic depreciation
$\alpha = \bar{S}/\bar{K}$
$\beta = \bar{S}/L$
$\phi = D/E = (K-E)/E$; E being equity capital and D debt
$\varepsilon = (R^N - r)K$
$R = R^N - \frac{\Delta p^K}{p^K}$ = the real rate of return.

Management of the firm delegates responsibility over the operating departments through (4) and appropriate short-term targets on M (production control through (5)) and long-term targets on $\bar{\varepsilon}$ which control the investment decision.

$\bar{\varepsilon} \cdot \phi$ defines the contribution to overall firm profit performance from the financing department.

A target on M means a labor productivity target on $\bar{S}/L$ (see Figure 2), conditional on a set of expectations on (w, p) in (4) determined through individual firm adaptive error learning functions (see below). Thus, the profit margin can be viewed as a price-weighted, "inverted" labor productivity measure.

The effective rate of return

The above definitions represent standard measurement technique, using accumulated investments as the capital measure. This capital, however, is also valued in the market place by potential new owners. This valuation, hence, depends (1) on the existence or nature (effectiveness) of such markets, and (2) on the predictions market experts make on the future profit generation potential of firms.

Equation (4) can easily be reformulated as[9]:

$$R^{EN} = \frac{\Delta E}{E} + \theta$$
$$\theta = \frac{DIV}{E}. \qquad (6)$$

The corresponding market-based rate of return measure, the effective rate of return (ER), simply replaces the accumulated investment net of debt (E = K–D) with the corresponding market evaluation of E, i.e., with M. Rather than computing asset values, assuming a depreciation rate, this measure assumes the asset value, or takes it from the market, and instead endogenously determines its rate of depreciation. The accounting formulae are identical. Hence,

$$ER = \frac{\Delta ME}{ME} + \hat{\theta},$$

where

$$\hat{\theta} = \frac{DIV}{ME}.$$

In the long term

$$\frac{\Delta E}{E} + \theta$$

and

$$\frac{\Delta ME}{ME} + \hat{\theta}$$

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[9] Proof: Use the definition of investment

$$INV \equiv \Delta K - \bar{K} \cdot \Delta p + \rho K$$

and insert in cash flow identity:

$$MS - rK - DIV + \Delta D = INV.$$

After some reshuffling of terms, using definitions (4) and (4A), (6) is obtained. For details of the proof see E (1976a), p. 284 ff, or on separable Additive Targeting Theme in E (1985a), p. 110 ff.

should be the same. This has not been the case, not even for manufacturing as a whole (see Figure 9A). The stock market exhibits a strong tendency to undervalue the assets of firms, compared to incurred costs for accumulating them. This makes take-over action profitable, in the sense that the same capital value can sometimes be acquired cheaper as "used" capital equipment than as new equipment. This undervaluation appears most pronounced when it comes to soft, not activated capital like technical competence and market knowledge (see Section 4.4 and E 1990b). Taxes apparently play a role behind this undervaluation as does asymmetric information, in the sense that outsiders know less about the value of the firm than do insiders.

The interesting question is how to interpret the rate of return differences:

$ER - r$

$ER - R^N$

as they develop over time and corresponding wealth difference

$ME - E.$

$ME/E = q$, or Tobin's q-value, that is the value the market puts on E compared to its accrual value from the cost side.

The convention in finance theory has become to make (ER–r) a measure of the specific risk, or the risk premium associated with investments in the firm in question. For all industry, the aggregate difference, hence, becomes the premium that investors charge on moving out of a "riskfree" reference investment, like nominal interest carrying securities, into stock.

Production frontier

Like real firms do in their internal accounting systems (see E 1976a) the MOSES model does not use explicit capital stock measures to represent the production system. The reason is the unstable identity of any capital stock measure discussed in Section 4.4. The critical "capital stock variable" in the "production function" of each firm is its potential capacity to produce that determines the shape of the production frontier in Figure 2. The information needed to estimate that curve includes the prior assumption of functional form the assumed intersection with the origin (see *MOSES Code*, IUI 1989, Ch. I, Sec. 4, pp. 31 ff.), and answers to a set of *capacity utilization* questions (see questions in Sec. 3f in Albrecht's Chapter III in this volume). Using assumed or estimated marginal capital output and labor productivity ratios this frontier then can be re-estimated every quarter in the model. This procedure seemingly avoids using capital stock measures but does it, nevertheless, through the capital output and labor productivity measures. Capital stocks for production purposes can, so to speak, be derived every quarter for all other data generated in the model. This method, however, mimics the ways firms themselves compute their production capacity frontiers, avoiding the direct use of capital stock measures (see E 1976a).

3.2 Long-Term Objective Function (Investment Selection)

The objective function guiding long-term investment behavior selects investment projects that satisfy (ex ante):

$$\varepsilon/K = R^N - r_i > 0,$$

where r is the local loan rate of the firm. The local loan rate depends on the firm's financial risk exposure, measured by its debt-equity position.

$$r_i = F\,(r,\phi)$$

$$\frac{\partial F}{\partial \phi} > 0.$$

The $\bar{\varepsilon}$ of an individual firm is generated through technical improvements (innovations) at the firm level (Schumpeterian innovative rents) that constitute Wicksellian type capital market disequilibria, defined at the micro level. The $\bar{\varepsilon}$ drives the rate of investment spending of the individual firm. The standard notion of a Wicksellian capital market equilibrium is that of "average" $\bar{\varepsilon} = 0$ across the market. As a rule this state is never achieved (see Figures 3). Unused capacity may make the firm less inclined to expand capacity, even though long-term investment is expected to yield $\bar{\varepsilon} > 0$. More important, however, is the fact that realized investment comes much later than the current quarter and that firms continue to make mistakes.

3.3 How Do Firms Upgrade Their Performance—Four Kinds of Boundedly Rational Behavior

Innovation is largely a learning activity, spiced with an element of combinatorial creativity. The main learning activity, and cost in the experimentally organized economy and in the MOSES model occur *through the learning from and the absorption* of (respectively) business mistakes. This has strong implications for the state of information and equilibrium properties of the economy, and hence for the appropriate database design.

I *Creation of knowledge (innovation and reorganization)*

Innovative and reorganizational activities based on tacit, experience-based knowledge are exogenous. They include basic restructuring of the financial organization of the firm as described above. Also, major investment programs, particularly those into new areas, belong here. Costs are normally insignificant in comparison with the profit consequences of successful reorganization.

The dominant, "measured" intelligence gathering and interpretation activities of a manufacturing firm concern *technical information processing* creating new knowledge, mostly associated with product development. (This activity is driven by investment in R&D and shifts the technical specifications of the firm's production system). If this activity is not, somehow, explicitly accounted for, the firm is grossly misrepresented and aggregate dynamics misspecified. Lack of data on (and lack of academic insight into) the nature of information use in business organizations thus far means that we have had to be crude in modeling innovative behavior (see E 1985a, pp. 102ff, 280 ff).

II *Learning behavior in markets (coordination through boundedly rational expectations forming)*

Self-coordination in markets is achieved through intelligence gathering and learning behavior. Firms interpret price signals (prices, wages, interest rates and profits) and transform them into expectations. These transformations include correction learning and risk attitudes acquired from past mistakes. The self-coordinating properties of the entire company depend significantly on the specification of these intelligence gathering and expectations functions (see E 1977, 1985a, p. 154, 1991c).

There is, however, also the theoretical problem of whether the representation of the underlying fundamentals of the economy—its "structure"—through prices can be seen as a stationary process that will allow rational agents to learn, with the exception of random mistakes, and eventually place themselves (and the economy) in a stable expectations equilibrium.

III *Competitive selection (the filter)*

The Salter (1960) curves of each market are constantly upgraded endogenously through competitive exit ("creative destruction") and entry. Only firms which have acquired superior performance characteristics through innovative creation of new knowledge (item I above), through learning in markets (item II above), and through interior process efficiency (item IV below) survive in the long run.

IV *Learning about interior firm capacities*[10]

No firm management is fully informed about its own capacity to produce (see E 1976a). A boundedly rational search procedure that I call *MIP-targeting* (MIP = Maintain or Improve Profits) is applied from top management to force upward improvements on interior firm performance.

The MIP-targeting principle rests on four facts of life in all business organizations (E 1976a, 1977, 1985a, pp. 107ff, 1991c):

(1) The difficulty for top CHQ managers to set accurate targets for the interior of the organization, close to what is the maximum feasible.

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[10] A complete description of the firm from a database point of view requires that the character and estimation of the production frontier are presented. This is also where some of the most interesting features of the database design is to be found. See Albrecht's Chapter III in this volume, E (1978a, 1985a), *MOSES Code*, IUI 1989 (pp. 48 ff), and Figures 4 and 5.

(2) The experience that if targets are set *below* what is maximum possible, actual performance will be lowered to targets.

(3) The importance for target credibility and enforcement that targets be set above what is conceived to be feasible, but not unreasonably high. A "reasonable" standard is performance above that achieved in the recent past. "It was possible then"! Another reasonable method is to document superior performance of a competitor. "They can do it. Then we should also be able to!"

(4) The general experience that a substantially higher macro performance of the firm can normally be obtained if a good reason for the extra effort needed can be presented ("crisis situation") or if a different, organizational solution is chosen ("other firms do it better!"), if time to adjust is allowed for. MIP-targeting establishes an acceptable profit plan to constrain and force efficiency on production planning.

MIP-targeting is illustrated in Figure 2. It builds on the assumption of top management that the firm always operates somewhere below the feasible level of capacity. Past experience determines the level from which top management knows that an upward improvement in its profit rate can be achieved. The psychology of targeting is that top management knows that some improvements can be achieved. However, knowing that excessive, impossible targets are never taken seriously, not even if slack is quite large, it is ineffective to impose grossly infeasible targets. Hence, *targeting is organized only to push for gradual improvements. Targeting, then, becomes a form of learning*, or an upward transfer of knowledge of potential capacities within the firm organization. Top corporate management is probing for the limits of capacity, information that lower level management wants to conceal. The internal statistical (information) system of the firm supports that objective, and the MOSES firm model imitates this learning process. If new technology stops being created and introduced, targeting will eventually push the firm onto the feasibility (production) frontier.

Aggregation in MOSES

From above the MOSES model appears as an eleven-sector Leontief-

Keynesian sector model with certain dynamic features (see *MOSES Code*, IUI 1989, pp. 15 ff.). The standard assumptions of aggregation needed for such a sector model are, however, not satisfied in the MOSES market environment. Hence, one would not expect a standard macro model to perform well over a long time when estimated on simulated MOSES macrodata, without constant re-estimation of parameters (see Antonov and Trofimov 1991). The idea with MOSES is to make macro modeling unnecessary by moving the level of aggregation down to a natural, deciding and behaving entity, the firm or the division. Aggregation is endogenized through the dynamics of markets of the MOSES model economy. To the extent that market competition does not force recombination of interior units of the firm or the division that we model, we have no problem. This is, however, not true, and decision units constantly change character, making internal institutional structures endogenous. This internal institutional change is not modeled in MOSES. We aggregate over existing firms and divisions, including new entrants and accounting explicitly for exits.

Since the manufacturing firms reside in one of the four MOSES manufacturing sectors (markets) that in turn are sectors in an eleven-sector Leontief–Keynesian sector model with demand feedback, aggregation has to be exact at the initial state beginning of 1982. After that aggregate ex post data for the four manufacturing markets (sectors) are computed very much as is done by Central Bureaus of Statistics, by constructing various quantity indexes.

4 The MOSES Database

The database requirements of the MOSES micro simulation model are sizable. This section summarizes the principal composition of the data sets that have been compiled in the context of the MOSES project. The fundamental idea of micro-macro modeling is to systematize *the wealth of microdata that exists and to integrate them through the model for improved understanding of macro behavior. Hence, aggregation is made dynamically explicit through markets.*

MOSES is a dynamic micro-to-macro model that provides a satisfactory theoretical base for a consistent micro-to-macro database design. This is especially so when it comes to integrating production and financial data. The manufacturing sector is currently (the 1982 database) populated by 250 individual, real firms or divisions that set prices and wages, plan output, sell goods at home and abroad, recruit people and borrow money to invest and increase capacity. Firms act within the restrictions of rate of return targets that depend on the interest rate (see Section 3 above), demand from households and competition from all actors in the market. In making their plans each firm attempts to predict the behavior of other market agents, using statistical methods (intelligence gathering and expectations forming). They always fail more or less. Hence, the realization of plans in the market confrontation, where all ex ante/ex post inconsistencies are sorted out, provides the real short-term dynamics of price setting and quantity adjustment of the MOSES model. We have found that the initial state representation of the model matters importantly for dynamic simulation results. Internal database quality (consistency) is imperative for avoiding peculiar macro instabilities in simulations due to statistical errors. The internal information systems of firms are, however, also afflicted with the same kind of quality problems. Hence, adjusting database information to achieve consistency might mean that errors that in fact affect firm decisions are removed, as well as the corresponding effects on MOSES simulations.

4.1 *Sample Strategy and Sample Design*

This is not the first time micro panel data are being collected. Most such surveys, however, have been smaller in scope, or consisted in systematic reorganization of existing statistical files. Besides that, firm panel data, until very recently, has been a no-man's land. Most work has been done on panels of individuals or households, being inspired by Orcutt's early micro simulation work. The pair Ruggles and Ruggles at Yale University have pursued the latter ambition rigorously over many years, and it is sad that the economics profession has not put a higher value on such very long-term scientific efforts than it has, to the detriment of scientific progress. Many of the problems associated with creating consistent data sets from existing statistical files (registers) have been discussed also by Postner (1986, 1988). On this score it might be said here that one of the most well prepared household panels was designed partly as a complement to the MOSES modeling project, one idea being eventually to complement MOSES with a micro household sector (see

Eliasson and Klevmarken 1981, E 1982a, Klevmarken 1986). The project was designed comprehensively and ambitiously from the beginning, rather than sequentially as the MOSES database work, a strategy that was the best but proved less practical, due to the large costs. There is, of course, a huge sample design problem to consider in this context. While the complexity of the MOSES model prevents the use of standard simultaneous estimation techniques (we "calibrate"; see Eliasson and Olavi 1978, Klevmarken 1978, E 1985a, Ch. VIII, Brownstone 1983, Taymaz 1991, Ch. 3), the size of the database also prevents the use of recognized sampling techniques. Also practical and cost considerations have made it necessary to compromise. A modeling project of this kind, in fact, should not start too ambitiously. It should *grow ambitious.* Hence, database work builds on combining data from samples of firms, full coverage surveys, and the use of existing register data. Depending on country and model the mixes of these components will vary.

Cross-sectional characteristics have to be right, initially

First of all, in any economy some individual firms disproportionately influence the entire macro economy. It is, hence, desirable to have all large and/or particularly influential firms in the sample. This is possible for small countries like Sweden, if you have good contacts with firms, but difficult in a large economy, like the U.S. economy. The problem is that one *cannot assume* a priori that differently selected clusters of small groups of large firms will not create significantly different developments of the macro economy. This would have to be assumed if a MOSES-type economy were to be applied to the U.S. economy, where also large firms have to be sampled. The MOSES database for Sweden covers all large firms every year through the planning survey, even though we do not use the whole sample in the current initialization (see below).

Desirable and undesirable inconsistencies

The planning survey is the core firm data input, tapping firm internal data bases directly for critical financial and real variables, that are as internally consistent as the firm's own internal data sets.

So far small firms have been "synthetically created" through a technique whereby the residual firm is "cracked" into a number of firms such that the consolidated aggregate of real and synthetic firms agrees with the corresponding National accounts' aggregate of the whole industry (Albrecht and Lindberg 1989). A random sample of small firms, providing planning survey information, will soon be available for MOSES experiments. The problem we are trying to solve is not that individual firms may create significant and undesirable macro effects, at least not in the time perspectives we consider, but that the *distributional characteristics* across the whole initial state have to be reasonably right. Distributional characteristics matter significantly for macro behavior, as we have learned. As realism in this respect has been increasing, through an increase in the number of real firms, the model macro economy has also begun to exhibit increasingly more realistic behavior.

The integration of survey data with register data causes additional problems of consistency that have been discussed elsewhere in this chapter. The ex ante decision position of a firm is always errant to some extent, but we don't want the natural errors that generate dynamics in the MOSES economy to be influenced by bad data, only the bad data that firms themselves use.

The only way of avoiding this important problem is to collect data on the internal economy of the firms directly from the firms. To do that from the start would, however, not have been recommendable. At the beginning of this project (in 1975) no research pertaining to this problem, except my own study (E 1976a) on internal business information and planning systems, existed. My own study was excellent guidance to begin with, but the looks of an appropriately designed, full-scale firm database we have only recently understood. We have also learned that it is perfectly O.K. to collect data on the internal economy of a firm from different, often inconsistent sources within the firm, since this is exactly what is done within internal firm information systems. The problem is that one has to know how these systems are designed, built and maintained (E 1990e). Even though we are currently developing a method of asking for both financial and production data at the same time (see Braunerhjelm's Chapter IV in this volume), this is not the correct method—since this is not the way firm management gathers their own internal data centrally—albeit a convenient method. The analysis of these data is therefore understood only by those who have an academic experience from both business administration and economic theory, and indeed by those who have also an experience from actual firm management.

Splicing of firm data from different sources

For the time being, data on the production system of firms and divisions originate in the units' own cost accounts and assessments of executive staff of the same unit. Large firms are represented by several such units. For the very large firms (like Volvo or Electrolux) several units, notably non-manufacturing units, and foreign units are lacking. We do, however, possess separate information on foreign units and also data on the entire global enterprise. The problem that we have in creating viable domestic firm units is to allocate the assets of the total enterprise on its constituent divisions, having only partial data on capital, e.g. on inventories (see Albrecht's Chapter III in this volume), and machine capital and buildings (replacement valuation) for some years. This very complication means that a complete and consistent micro-to-macro database only exists for the base years 1976 and 1982, while the panel over all years refers to the enterprise as a whole (financially defined) and to the planning survey units.

4.2 General Comments on the Qualities of Microdata

The key problem of implementation has been to define a unit (of measurement) that *operates reasonably autonomously* as a price and quantity setting decision unit in all the three markets of the model—the product, labor, and capital markets. There is, however, also the practical problem of not taking measurements beyond the level of disaggregation where they can be carried out with reasonable precision; and precision is needed as we have learned. The strategic decision taken was to use the statistical information system of the decision unit itself, designed on the format of the decision maker (E 1976a); a decision process that we also try to mimic in the firm model. This means that real errors, inconsistencies and biases in measurements that enter firm decisions should also be reflected in micro behavior.

The unit chosen was the small *firm* or a *division* of the large firm. Production decisions are taken at the division level. The division maintains a statistical information system related to production decisions and control, and reports systematically upwards to the group or firm level (corporate headquarters, CHQ) in financial terms. The relationships between CHQ and group and division levels are becoming increasingly decentralized, making it increasingly difficult to collect operations data at (or even ask for via) CHQ. This in itself is a matter of firm modeling concern. It directly affects the data base design.

Using the MOSES model as a database organizer

The statistical system of the MOSES economy can best be presented (briefly) as follows. MOSES is a complete macro system. When seen from above it appears as an 11-sector Leontief-Keynesian growth model with dynamic demand feedback through investment and consumption. A novel feature is price feedback through explicit dynamic markets. To achieve that the manufacturing sector of the macro model has been replaced by individual firms that *interact with one another* in the three markets (for products, labor and capital), under the constraint of the rest of the economy, and with a "steady state" price-taking assumption for the international market environment.

Each manufacturing firm operates in one of four markets that correspond to four industries; *raw materials processing*, *intermediate and semi-manufactured goods production*, *durable goods manufacturing*, and the manufacture of *consumer nondurables*. Hence, the accounts of the macro system have been reclassified to reflect market categories. The OECD *end use classification code* has been used. This has required a radical reorganization of all macro accounts, including the input/output table (see Ahlström 1978 and Nordström's Chapter V in this volume). The market/product reorganization of macro accounts has uncovered a host of related definitional problems, many of which still remain to be attended to. First of all, one completely misses both the importance and the dynamics of manufacturing industry when viewing it through the goods processing taxonomy of the standard statistical accounts of the national economy (E 1990a).

Each industry consists of a number of firms, some of which are real and some of which are synthetic. Together, the synthetic firms in each industry make up the differences between the real firms and the aggregates of the four industries, or rather market totals in the national accounts. The real firms of the 1982 data set of the planning survey cover more than half of manufacturing employment and production in the base year (see further Albrecht's Chapter III in this volume). The normal runs of the model, however, use only the 225 real and synthetic firms that inhabit the manufacturing sector, 154 of which are real firms, or divisions. These firms cover only some 30 percent of manufacturing employment (see Taymaz' Chapter II in this volume). The model is based on a *quarterly* time specification, corresponding to a common production planning mode.

The model runs on data from (essentially) three different sources; (1) a separate, annual survey carried out jointly by IUI and the Federation of Swedish Industries (in fact originally designed in 1975 to fit the model exactly, see Albrecht's Chapter III in this volume, E 1976b and Virin 1976), (2) financial data for the firms, and (3) a complete set of macro national accounts statistics. Complete GNP accounts are generated *by quarter* during model simulations.

The planning survey, as mentioned, covers a much larger part of manufacturing industry than the firms currently used to initiate the model in 1982. There are two problems that restrict the use of real firm data. First, a history of each firm is needed for inclusion in the MOSES data set. Firms drop out of surveys and it is difficult to maintain a panel of a large number of firms for five consecutive years. Second, the planning survey data have to be complemented by financial data (see Taymaz' Chapter II in this volume). The consolidation of two data sets for each firm currently requires a major effort. This problem restricts the scope of the sample of firms used in initial data sets. It can be overcome by more prior database work, or by redesigning the planning survey, to include also financial data which has to some extent been done in some recent surveys (see Braunerhjelm 1991). Braunerhjelm (in Chapter IV in this volume) presents a design of a conversion matrix that requires data that *are* normally available at CHQ and that can be used to consolidate division, planning survey production data, with data on foreign subsidiary operations and corporate financial data. The possibilities of doing this depend on the possibilities of collecting a common set of data from the three data sets (financial, operational, foreign) from the same source within the firm. As mentioned above, the increased decentralization of firms, relying increasingly on internal markets for coordination, means that the data needed for consolidation become less and less easily available at CHQ. The conversion matrix, however, has been designed to require exactly the data CHQ needs to coordinate and control its own divisional activity (also see E 1990e). The automated initialization procedure, finally, makes it easy to expand the number of firms as more data are being readied. New entry, furthermore, if realistically modeled, rapidly increases the number of firms of a simulation (see Taymaz' Chapter VI for more on model sensitivity to number of firms).

There is, of course, a practical limit to the number of firms that can be both accommodated in model runs and constantly maintained on a panel format in the database. This means that the firm population residing in the MOSES model is dominated by divisions of the large firms (operating as individual decision makers) and some medium-sized firms, a few small firms, and some large, synthetic residual firms that make up the difference to the national accounts data for each market.

The general problem of inconsistency

A frustrating problem, discovered late, when the full-scale model had just been implemented, was the "general inconsistency" between the consolidated firm accounts and corresponding accounts of the National accounts. The sensitivity to initial conditions of a dynamic model of the MOSES kind means that the macro model economy reacts strongly to initial inconsistencies in the databases (errors of measurement) as if they were "real" ex ante inconsistencies created by the ways firms "interpret" information on their competitors. The macroeconomic consequences of such errors often accumulate for years (path dependency), creating now and then phases of seemingly "chaotic" behavior.

At this stage we had to make a decision: to rely on the high quality micro database we had and give up using well-known national accounts data as a benchmark to establish the statistical size of the entire economy; or to modify microdata to achieve initial state consistency. We preferred the first alternative, but nevertheless used the second. The National accounts' presentation of the economy is the officially authorized statistical representation, and we thought it wise—for the time being—to stay with it.

The problems of consistency are not trivial and relate to the main problem of informational efficiency of the economy discussed earlier. It has been thoroughly discussed by the pioneers in the field like Postner (1986, 1988), Ruggles (1987), Ruggles and Ruggles (1986, 1987). The deep insight (see, e.g., Schelling 1958) relating to the informational assumptions of economic modeling is that complete consistency is not feasible and that good national accounting systems should not aim for consistency, but rather "keep track of its inconsistencies" (op. cit., p. 329). In my interpretation (see above), this means that a full information equilibrium is a non-existent state.

On the overall design of the micro-macro database

The MOSES database task can now be summarized as follows. There are four different types of data sets involved. The *first* set concerns the *firms.* We need a complete representation of (a) the financial decision structure of the firm, of (b) the production structure of its constituent parts (divisions), and of (c) a statistical observation of where exactly the financial and real (production) entities cross the Swedish border. We furthermore (*second*) need a macro representation of the Swedish economy organized in such a way as to be an exact consolidation (aggregation) of all the firms in the data set, including one or more artificial firms, making up the difference between the real data set and the national economy. The micro-macro link then depends very much upon how we define the total economy.

Since the choice will be the official national accounts definition of the Swedish economy, the firm data sets and the variables and sectors measured will have to relate to an inappropriate statistical design. Hence, a *third* data set is needed to achieve a relevant representation of the production system of the economy, notably total value added generated in goods and associated service production up to their final end uses. This restructured definition of manufacturing which includes a significant upstream and downstream private service production has been planned to be included, but is not yet part of the MOSES model design.

The *fourth* data set is the rest which includes the household sector (the HUS-project) and an analytically relevant representation of the public sector, notably its provision of *infrastructure* and *welfare* services. This data set is to some extent available, but not yet part of the MOSES model design.

4.3 *The Necessity to Redefine the Concept of Manufacturing*

Manufacturing firms are increasingly operating simultaneously across both the private service and manufacturing sector accounts, and within several subsectors. Their statistical denominations change constantly as a consequence of the relative efficiency of operating various activities within the firm, relative to hiring the services in the market. We have already shown that the manufacturing firm itself essentially is a private service producer. Mergers, acquisitions and divestments add to complications, and while a firm may carry the same name and a reasonably consistent set of financial accounts for 50 to 100 years,[11] its interior life is constantly being revolutionized, quite often to the extent that the firm fails (E 1980b). Maintaining a set of panel financial life stories for divisions, hence, is very difficult, and for firms as a whole we get stranded with the group that happens to have survived. The only way of controlling for such *sample selection bias* is to use a model of the MOSES kind to generate the whole sample.

When all horizontal and vertical resource use, associated with making the goods of the manufacturing sector and distributing them to their final uses in the household sector in Sweden or abroad (including associated services and qualities), has been accumulated, the traditional manufacturing sector (3000 in the National accounts' code), making up almost 25 percent of GNP today, has been boosted to a "production engine" that (including related services) generated almost half (48.7 percent) of GNP in 1985. While manufacturing as traditionally measured, and especially if you include basic industries (1000+2000), has been steadily decreasing since 1950 (see Table 2), the extended manufacturing sector has in fact increased its GNP contribution slightly since 1950, and significantly if you add in foreign manufacturing production (see Table 4). Not only external, manufacturing related services increase. International service production within the manufacturing sector in fact accounts for more than half of total labor (cost) inputs and has been increasing. Most of it is very knowledge-intensive service production.

[11] or for about 700 years. See Figure 1.

4.4 Asset Structure of Firms

Even though not yet explicit in the model design, the rate of return requirements of a MOSES firm corresponds to a portfolio management decision model. Hence, the "old fashioned"[12] flow structure of the M–M firm model has a matching set of asset accounts that are generated in the model, but that—except for the influence of the debt/equity ratio on the local interest rate—exercise no additional influence on firm decisions.

How to look at the experimentally organized economy through equilibrium glasses

Theoretically, and practically there is nothing irrational in this procedure. Firms, in fact, avoid using asset measures in their internal accounting, the main reason being that assets are never well defined and, hence, too easy to manipulate (E 1976a, pp. 156 ff). Asset measures are reasonably well defined in static equilibrium, but in static equilibrium your flow model is a reliable approximation (or image) of your asset model. If you reason and compute ex ante as if you have placed your firm in a future static equilibrium setting, then you can use a flow model, or a portfolio model. They are mirror images of one another. And firms do. As I have argued above (and learned from empirical studies; E 1990e) a firm decision model must be an equilibrium model capable of coming up with single-valued solutions (decisions). Firms achieve that by assuming static expectations on all prices, including the interest rate, to be able to compute. The raison d'être for the M–M model of firm behavior, hence, is compatible both with actual firm behavior and a particular interpretation of the classical model (see E 1990e). In order to form a consistent view of its decision problem, facing an experimentally organized

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[12] The firm model shares significant characteristics with the old financial planning model, and it should do, since this *is* the way firms structure their internal decision processes as reflected in their internal information systems (E 1976a). Does this mean that firms behave irrationally in terms of modern finance theory? Not at all. For the reader updated on modern, post Modigliani–Miller–Markowitz–Sharpe modeling, significant market imperfections are shown to require the use of simple signaling devices, of the rules of thumb type, described in the early corporate finance literature. Under such circumstances the restrictions on the optimizing processes of the firms become more important than the optimizing itself. The new, now "rationally founded" models look very similar to the old financial models. See Miller (1988) or Harris and Raviv (1990, 1991).

economy, the firm has to simplify through narrowing down its mind set. A most natural such simplification is static expectations which allow the firm to compute in accordance with standard financial formulae. Since firm management can revise its position whenever it wants to, the error committed is only the irreversible part of the decision following from the position taken just then, which is normally small. One could then say that constantly making temporary static equilibrium decisions that are constantly being revised is a rational method of decision making which is also perfectly compatible with the design and use of the internal information systems that guide the firms through an experimentally organized and basically unpredictable market environment (E 1990e). Hence, asset accounts are not needed for internal control. The flow accounts have an exact ex ante mapping into the asset accounts, and under static expectations the rankings of the ex ante rates of return correspond to the rankings of present value computations. The theory or model of the firm, however, then also has to explain *how firms revise their decisions*, and the theory or model of the entire economy has to be explicit about *how* all revisions of plans upon revised ex ante perceptions eventually realize themselves into ex post behavior. This is exactly what the MOSES model does.

How to value assets

The valuation of assets, however, places the outside investigator in an uncomfortable position. His problem often requires a stock measure. Capital can be exactly measured from the investment cost side under the exogenous assumption of a rate of economic depreciation of its value from use or time. This is the standard measurement procedure to obtain capital stock estimates for production function analysis, capital stock measures which are assumed to be independent of the economic decisions affecting production. The capital stock so obtained, hence, should in principle be independent of the rate of return to which the assets have contributed.

The second approach would be to use outside expert evaluations, like the stock market evaluation. This measure, however, is dependent on the future profits expected to be generated by the application of the same capital stock, and the competence of market experts to make reliable such predictions (i.e., the efficiency of the market). In the context of the experimental organization of the MOSES model economy we know for sure (see E 1991c) that the stock market experts will be unable to produce unbiased estimates of these capital values. Such estimates will always be imperfect measures, however well informed the market experts are, since the state of full information is not defined.

The stock market capital measure will inform the outsider of the imperfect value that market experts put on assets. It carries no information on the production value capacity of the firm. On the other side, the cost accrual measure tells about the resources applied to hold the capital stock, at prevailing imperfect market prices. In principle, this measure should indicate the production potential at given market prices.

If markets were perfect and in static equilibrium the two measures would coincide. Hence, as the two measures bracket the "true" capital stock one desires to know. Measuring both, hence, should be more informative than measuring only one. And if one could design a model to stimulate more or less perfect markets, one could obtain better measures through narrowing the brackets. The crux is theoretical. If arbitrage costs associated with moving closer to equilibrium are large, such arbitrage costs would have to be part of the determinants of the "true" equilibrium capital stock. If such costs escalate unlimitedly, as you move closer, the equilibrium becomes unattainable. This appears to be the case in MOSES (E 1985a, Ch. VII, E 1991c).

The origin of invisible assets

An even more serious problem is the absence of certain capital and investment categories in the accounts of firms, making it difficult for firms to identify the sources of their profits. Both firms and government central bureaus of statistics use outmoded, statistical classification systems (see below). Statistical information systems are part of the internal information systems of firms imposed as a prior information or presentation filter that biases the data. They are as difficult to change as changing a language of a nation. These problems belong to the theory of database design. The problem is that in both cases lacking, or biased, information influences the decisions of firms or policy makers.

Also this "problem" has a past in the history of economic doctrines, notably capital theory and the "problem" of the absence of the diminishing returns that the convexity assumption of economic theory requires. I won't discuss (here at least) the problem of whether capital really exists as a measure distinct from the profits generated, even though this is a highly relevant database problem. The problem that, nevertheless, still remains to be explained is why total value added is systematically larger than recorded factor payments, after imputing a market interest rate to all measured assets, i.e., why on the average, and in the long run (see Figure 9B) $\bar{\varepsilon} > 0$ in eq. (3). This can be shown to correspond to the presence of increasing returns (see E 1990c). Knight (1944) suggested that such non-decreasing returns had to do with the presence of unrecorded knowledge. McKenzie (1959) addressed the problem of $\bar{\varepsilon} > 0$ directly, suggesting that it depended on the presence of knowledge capital, its rents being properly measured but the corresponding capital not being accounted for. To get the full theoretical picture, however, we have to remember that the $\bar{\varepsilon}$ is what is called the risk premium in modern finance theory, implying that whatever is not accounted for by factor payments, or imputed interest rates, is the residual payment to owners for taking on the financial risk, as it shows up ex post in firm accounts.[13]

All this considered, we have found it necessary to design a new database categorization to model M–M behavior relevantly. Since this database book not only accounts for existing inputs and outputs of the model but also for possible future improvements of the model, and the corresponding database needs, some of the work done will be documented here.

Capital can be measured in many ways, each method relating to a particular purpose. The value of capital always has something to do with (1) the present value of expected future profits. This is a wealth measure, and wealth considerations always creep into direct measurements, like insurance values and answers to direct questions, as in Table 5A. Indirectly the stock market puts a value to the capital (assets) of a registered firm every day. This measure, however, is also influenced by the competence of stock market experts to predict future firm profits and the financial environment of the firm. This expertise appears to be very limited, indeed (see E 1990b). Capital and production theorists, however, need a *technically defined capital measure* to put into their production functions. The distinction between the wealth-

[13] i.e. $\bar{\varepsilon}$ = RR–IR in Figure 9B. Personally, I have difficulties accepting that the average risk of investing in a representative basket of manufacturing stocks should be on the average 3 to 4 percent (average 1951–88) higher than the interest on government bonds.

oriented (profit-based) and technically defined capital measure has been the source of controversy for years, and it is safe to say today that the distinction cannot be principally or theoretically drawn, only arbitrarily, also making capital stock measurements for production function analysis an arbitrary affair. That is O.K. if one knows what one is doing. There are at least two ways to proceed. (2) Stock measures are computed through corrections and adjustments of book data from the official balance sheets. Such measures are, of course, very close to wealth measures. The third (3) method is to cumulate investment data, making assumptions about depreciation rates. This method has been used to get Table 6A, and the first column for 1985 in Table 5A. Again, profit considerations unavoidably creep into the depreciation assumptions, a circumstance that reveals, that the shift factor in production function analysis is dependent on changes in "excess returns" to measured capital or $\bar{\varepsilon}$ (see E 1987, pp. 90f, 1990c, 1991e). The economic content of total factor productivity growth also reveals itself when we use the MOSES model to decompose the productivity measure (see Section 6 below, E 1991e and Carlsson 1991). There is nothing principally different in applying these methods to compute hardware and software capital stocks.

How to make invisible assets visible

For future MOSES work we need a revised balance sheet that accounts also for the intangible capital that is not activated, but that can be activated (see E 1990a, p. 89) according to Table 3. Data to complete this table have been collected in recent surveys. At this point I have two comments to Table 3. First of all, if positive assets under B exist they will generate extra profits in the long run, that will appear, in traditionally designed books, *as if* generated by visible capital under B. Even if no extra profits ($\varepsilon \leq 0$) are recorded it may, nevertheless, be the case that B-assets exist and generate large profits, only that visible capital is employed in loss operations. There are numerous illustrations of this "aggregation error" from firms that are clearly "visible" in the sense that old industries have developed profitable sidelines with small visible assets that cover the losses of old, hardware production.

Second, some may, nevertheless, argue that intangibles are intrinsically unmeasurable. I agree to the extent that tacit knowledge cannot, by definition, be directly measured, even though it generates profits, and that– for that reason – it can neither be properly evaluated by "market experts" nor traded in "perfect" markets. This creates a deficient "lemons" market in corporate values that hampers manufacturing performance (E 1990b). The bulk of "invisible" assets, however, still consists of fairly "routine" investments in activities that have as well defined reproduction values as machinery and buildings. They share with the "visible capital" in Table 3 the general problems associated with measuring all kinds of capital. If we still do, we will find that these "invisible assets" are sizable compared to "visible assets" (see Table 5A).

4.5 *Sources of Data* [14]

The MOSES database covers systematically the most important business activities. To be consistent with the corresponding macro data, they have been brought together from the base years on a modified sector design (see Ahlström 1978 and Nordström, Chapter V in this volume). The design of the micro database has been formatted on the MOSES model. As has been mentioned, the planning survey was designed to suit the exact needs of the MOSES model. This survey has been carried out annually since 1975. It also provides useful information for a variety of other research activities (see Albrecht 1978a,b, 1979 and Albrecht's Chapter III in this volume).

The complete database, however, requires that several databases be merged. The following databases make up almost a complete listing of sources:

1. *Financial data for business group (global operations); panel beginning in 1965.*
   Source: Internal data from corporate accounts, by year (see Taymaz' Chapter II).

2. *Division data, production process oriented; panel beginning in 1974.*
   Source: Separate surveys (the "planning surveys") carried out annually by the Federation of Swedish Industries and IUI on all large firms, by

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[14] The data to be presented have been selected and organized to give an idea of the content of the MOSES database. Jörgen Nilson has done most of this work. He is also responsible at the institute for continued updating and access to the MOSES database.

division or establishment (see Albrecht's Chapter III).

3. Random sample of *small firms and subcontractors* using the same questions as the planning survey. This survey was first carried out for 1986, then for 1988 and again for 1989. This time the *firm* was the unit of observation. This survey has partly served the purpose to help develop a questioning technique to collect financial and production data under §§1 and 2 above simultaneously (see above and Braunerhjelm's Chapter IV).

4. *Foreign subsidiary operations.* Three special surveys by IUI covering all subsidiary operations of Swedish companies 1965, 1970, 1974, 1978 and 1986. A new survey is currently being planned for the year 1990 (see Braunerhjelm's Chapter IV).

5. The *content of manufacturing production*, covering resource use according to Table 1B and Figure 8 but at a somewhat more aggregate level for the years 1982, 1985, 1988 and 1989.

6. A *modified planning survey* including *adjusted balance sheet data* of firms as well as planning survey information, covering large firms 1988 and small firms for the years 1988 and 1989 (see Braunerhjelm's Chapter IV).

7. A planning survey to *private service* producing firms, tested and planned for 1989, but so far not carried out (see Braunerhjelm's Chapter IV).

8. *Macro national accounts* (see Nordström's Chapter V).

9. *Historic firm data panel* to study long-term growth characteristics of firms. (First done for Atlas Copco, MoDo, Ericsson and Sandviken in Eliasson 1980b. Also see Jagrén 1988).

10. *Synthetic micro data set* (see Supplement I and Taymaz 1991, Sec. 3.4).

11. *Exogenous data*, notably historic data on technical change at firm or division level. See Carlsson (1981).

Some of these data sets are presented in the following chapters. Supplement II to this chapter gives a complete list of all data sets plus references to sources.

The planning survey as a whole is not a random sample. Data are collected on all large manufacturing divisions (establishments) in Sweden of all firms with more than 200 employees. This means a coverage of some 60 percent of Swedish domestic manufacturing employment. We use a subsample of the planning survey sample as a base point for the other databases. Divisions and foreign subsidiaries can be grouped together to fit the financial groups under 1. Coverage on foreign subsidiary operations (under 3) is 100 percent for the years in question. For practically all large firms a significant "residual" up to the total remains when our units have been consolidated. Some divisions are simply missing, or they are engaged in non-manufacturing activities (wholesale distribution of other products, commercial cleaning (Electrolux, until recently), banking, data processing etc.). Our procedure has then been to define a residual up to the corporate group level. This consolidation work is still in progress, and will be documented later.

To create life histories of individual divisions is difficult. The response rate is reasonably high—consistently in the neighborhood of 85–90 percent—and particularly so if we consider the extent of questioning and the confidential nature of several questions.[15] (For details, see Albrecht's Chapter III in this volume.) Non-response, however, varies from year to year, and the life history sample, consequently, is much smaller than the number of responding firms of one particular year. The current life history sample consists of some 100 divisions and is used to initiate MOSES simulations beginning in 1976 and in 1982. The MOSES model, however, has been designed to avoid being dependent on this particular problem. Besides the initial state description which is not very demanding, only four historic (5 years) variables are needed; *prices* (for the market), *sales*, *wage costs*, and *profit margins.* These data are fairly easy to maintain for a rather large sample on a panel basis.

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[15] There are two reasons for the high response rate, the most important reason probably being the good contacts with the firms that IUI entertains together with the Federation of Swedish Industries. However, we also believe that our database idea, to ask questions on the format of the internal statistical systems of firms, matters significantly for the high response rate. The questioning reveals that we understand what the firms are doing and use their own internal information for (E 1976a, 1984a, 1990e).

The problem of sample representativity in MOSES analysis is handled in what we call the initialization process. Each division is placed in one of the four manufacturing final product markets; (1) *raw materials*, (2) *intermediate products*, (3) *durable goods* for manufacturing investment as well as household durables, and (4) *non-durable household consumption goods.* Consistent aggregation up to the levels of official national accounts is imposed. A residual firm (division) is computed for each of the four markets. To achieve this consistency through all levels of aggregation has been no minor task. The aggregate national accounts data have been redefined to fit the "market format" and "massaged" significantly to fit together at the macro level. Even so, the residual firm, or rather firms, since we cut the residual into several synthetic firms, in MOSES simulations tend to be afflicted with peculiar characteristics reflecting, we believe, the quality of official statistics (see further Albrecht and Lindberg 1989).

The MOSES model has, of course, not been a sufficient reason for carrying on a major micro-to-macro database activity like this one. We have also chosen not to make MOSES dependent on a full-scale database activity year after year. There are too many research institutes that have (almost) killed themselves on such ambitions. The full-scale format is, however, directly matched by the input and output formats of MOSES.

There have always been supplementary users of the MOSES database, especially the planning survey, which is currently a main information input in business cycle forecasting at the Federation of Swedish Industries. Current research at IUI, to a large extent, also leads a symbiotic life with the MOSES database. For a project to draw on the database it also has to chip in on complementing and updating the base and on carrying out estimation work on the model. Supplement II and the following chapters give more detail on the content of the MOSES firm/division database.

The macro database and the macro part of the model are not presented in this paper. The macro accounts, as mentioned, have been reclassified to fit the OECD end user classification. This has been done to make it possible to classify divisions or firms in *markets*—in a meaningful way—and to link their accounts systematically with the macro accounts. The input/output table has caused most trouble in this respect (see Ahlström 1978, Bergholm 1989). For details on the macro database, see Nordström's Chapter V in this volume. For information on how the micro units interact through markets with the rest of the economy, the non-manufacturing part, modeled as a traditional Leontief–Keynesian sector model, see E (1978a, 1985a), and *MOSES Code* (IUI 1989).

Part of the M–M modeling ambition has been, not only to capture the dynamics of the endogenous growth cycle but, also to study the nature of firm establishment, growth and exit. We have therefore carried on a historic firm panel database work (E 1980a, Jagrén 1988), and special studies on the new entry characteristics of markets (Granstrand 1986, Hanson 1986, 1989, E 1978a, pp. 52ff, 1991a). On this, earlier IUI studies have provided valuable information, notably du Rietz (1975, 1980).

A "synthetic database" from 1990 has been created in conjunction with the transfer of MOSES to PC. To make MOSES portable a deidentified micro dataset had to be created. This was done by calibrating the model on historical data (time-series and cross-sectional) from 1982 through 1990. The nonlinear nature and complexity of the MOSES model make "reverse-identification" impossible.[16] The so simulated firm and macro data sets will, hence, be made available for outside use. This synthetic database work will also be further extended (see Supplement I and Taymaz 1991, Sec. 3.4).

An equally important "database" task has been to establish consistent projections of *exogenous variables*, the most important being prices in foreign markets, assumed to be in a steady state (for an explanation, see E 1983, pp. 313ff and E 1991c), and projections on the performance characteristics of best practice, new technology, embodied in new investment. This amounts to an entirely separate empirical inquiry, where Bo Carlsson has been instrumental in loading MOSES with relevant assumptions (see Carlsson 1981, 1991, etc.). We expect to be able to do more on this within an ongoing project on new technology, factory automation and economic growth.

4.6 *Cross Sectional Characteristics—the Salter Structures, Used to Represent Initial States*

It is impossible both to explain and illustrate the MOSES micro-to-macro database in full detail, not even in a Database book. In the following sections I will put together a cocktail of tables and figures that convey an idea of the

[16] and for the same reasons prevent the external observers from learning the parameters of (decoding) the structural model. See E 1991a, and Antonov and Trofimov (1991).

content and size of the total MOSES database, beginning with an illustration of "firm dynamics", that can only be captured through micro-macro theory.

The MOSES model aggregates quantities through the dynamics of market pricing, and prices (price indexes) through the dynamics of quantity setting at the micro level. Expected market price dynamics, however, controls quantity setting in markets. Both sides are sequentially interdependent, even though there is no one-to-one mapping (duality) as in static equilibrium. I will here illustrate the dynamic properties of the most important of all prices, namely $\bar{\varepsilon}$, and relate $\bar{\varepsilon}$ to a variable of considerable, recent interest, namely productivity.

The most important initial state representations of the model are shown in Figures 3 and 4, exhibiting cross sectional distributions of returns over the interest rate (or $\bar{\varepsilon}$ in equation (3)) and labor productivities (or β in equation (5)). All the other data also "exist" in the initial state description, but $\bar{\varepsilon}$ is particularly important since it drives the investment process of the individual firm and defines profit margin targets (imposed through the capital market). β together with profit margin targets initiate MIP-targeting (see Figure 2) that determines the production plan. Together the shapes of the so-called Salter (1960) curves of $\bar{\varepsilon}$ and β set the standards of competition in the markets of the model. Initial states for many years are shown in the figures. We have already observed that preserved diversity of structure is vital for macro systems stability. Apparently the real Swedish manufacturing sector went through a precarious phase of "potential" macro instability in the midst of the 70s that we have reproduced in simulation experiments (E 1983, 1984a, 1991c. See also Figures 3 and 9). We have also learned over the years that reasonable consistency of internal firm data and micro-to-macro data is important for reasonable macro behavior of the model. The real world exhibits some inconsistency which is part of the characterization of the dynamics of the economy. But extreme inconsistencies usually signal a crisis situation and tend to affect macro behavior strongly. Hence, we have to be careful in getting a realistic design of the initial state measurements. Figure 4E shows that we have a problem. The labor productivity distributions of the raw planning survey data are significantly higher than the corresponding 1982 initial state of the MOSES model. The reason for this (discussed also in Section 4.2 above) is that, using the raw planning survey data, the residual firm making up the difference to the corresponding National accounts' data becomes an extreme and unrealistically low performer. We have therefore adjusted planning survey data to achieve a reasonable distribution and the adjustment had to be large.

4.7 *Cross Sectional Dynamics*

Firm dynamics arises in the intersection between financial and real markets. The pivoting variable is $\bar{\varepsilon}$ in equation (3) which controls the firm investment and production decisions, and is traded in the form of claims to future profits (wealth) in the stockmarket.

Internal firm dynamics

Figure 2 shows the internal firm production planning process. Figure 5A shows the consequences for the same firm for the years 1982, 1992, and 2002 in a simulation, the path of labor input/output combinations and the shifting of production frontiers, the boundary B in Figure 2. The vertical distance between actual position and the corresponding production frontier corresponds to the shaded area of unused capacity in Figure 4D which firms quantify in the planning survey.

The stability of profits

The expected rate of return over the interest rate influences investment and, hence, productivity. Expectations concern prices (see equations (4) and (5) and the text) and new technology associated with new investment. Many researchers have attempted to test the old Schumpeter (1942) hypothesis of continued concentration through the establishment of permanent monopoly positions in markets (Mueller 1977, 1985). There is a host of methodological problems associated with the testing of this hypothesis, notably the problem of sample selectivity. The large firms remaining in the market "at sample time" are those that have survived ex post, like Stora Kopparberg in Figure 1. To test for Schumpeter (1942), we would need a huge, historic panel, accounting also for the firms that have vanished, i.e. most firms (Jagrén 1988). Nobody has properly done that. A shortcut would be provided by using the MOSES model as a prior in sample design (the entry and exit features, see Supplement I) which would show, that out of a large initial sample there would always, after 50 to 100 years, be a small group appearing to exhibit great permanence of profits. However, even these long-term surviving large firms (see Figure 5B) experience turbulence, that now and then kills a few of them. The figure follows 42 large industrial groups in the MOSES Database over four five-year periods. Average $\bar{\varepsilon}$ for each firm for the period 1966–70 is related to the corresponding average $\bar{\varepsilon}$ for 1971–75, 1976–80 and 1981–85, respectively. The three scatters are drawn in the same figure, using different point characters. Regression lines have been computed for each scatter. A certain stability in the average individual firm $\bar{\varepsilon}$ exists between the first three five-year periods. The second and third periods were the crisis years of the 70s. All performance rates came down but relative positions were maintained. During the last period, however, a new set of firms came out as winners and broke the ranking of the past. The oil crisis has dramatically changed market conditions for the large Swedish firms. During the years 1976–80 new market conditions established themselves. These new conditions, have only marginally changed the product and production orientation of the firms, only their price structure. Three, once very large firms, however, went out of business and are not part of the sample. We did not have time to do the same computation for 1986–89, but I would expect part of the early correlation to have been restored, since several firms have successfully reorganized themselves internally, and old relative prices have partly returned. This comparison would also require the removal of some failing or acquired firms, reinforcing the false picture of "stable" profit rates.

Productivity and the rate of return

Labor productivity is essentially a price-corrected profit margin (see equation (5)). Similarly, but in a more complicated way, $\hat{\varepsilon}$ relates to total factor productivity growth. Despite all the problems of measuring productivity, high rates of productivity growth, or higher productivity rates, are considered socially good (see e.g. Solow 1990). Firms are, however, not really interested in productivity per se. They first of all want to capture the good consequences for them by fetching high rents through operating in the right market price environment. They are interested in the return to investment, or in $\bar{\varepsilon}$. There should, however, be some sort of Adam Smithian harmony in the sense that higher rates of return correspond to high productivity performance. It had better be, since Bo Carlsson and Erol Taymaz (see Carlsson 1991, and Carlsson and Taymaz 1991) have shown that the main determinant of macroeconomic growth in the 20- or so year perspective is the ability of markets to reallocate new investment and people to the most *profitable* activities. If the most profitable activities are not the most productive there may be a problem, and this was clearly the case for a ten-year period, beginning in the mid-60s.

Figure 5C, however, also shows that there is no strong correlation between the rates of return to capital and labor productivity; neither across firms nor over time. What does this tell? It partially explains the fact that macroeconomic growth has been slow (which is true for that period) and suggests inefficient factor (re)allocation in the economy to be the reason, i.e., a dynamically inefficient use of existing resources. Part of this inefficiency has to do with labor, another part with capital. Labor can be moved and to some extent retrained. Capital installations may, however, be irreversibly sunk, and a permanent waste. There is no way of testing this hypothesis except through dynamic micro-macro simulation. This was done in Eliasson and Lindberg (1981). It was found there that misallocated investment, induced by the corporate tax system, involved a direct loss, if scrapped. This loss was, however, of minor importance compared to the production loss from continuing production at low and negative rates of return, locking up labor that could have been more productively employed elsewhere. The really large production loss, however, came from the fact that labor supply to the rest of the economy was lowered, pushing up wages and causing not only inflation but also a slower growth in other firms. The results of Carlsson and Taymaz (1991) are, hence, radical in their implications. Contrary to the policy advice flowing out of standard production function analysis, the problem of (for instance) the Swedish and U.S. economies is not lack of traditional technical innovations, but lack of competitive market performance. If there is a traditional problem it is not (for the economy) lack of new technology, but the inability (lack of receiver competence in firms) to convert globally available innovations into industrial scale production (E 1990c).

How the interest rate controls wages and productivity growth

The above is a two-dimensional description of a multidimensional economic process. Real dynamics arises from the simultaneous interaction of all markets. Only then will it be possible to explain how price dynamics and macroeconomic growth interact. The most interesting link runs from interest rate determination in financial markets, via profit targeting in firms to the consequent investment and production decisions. To understand what is going on the whole "model machinery" of the M–M model has to be turned on. This is done in Section 6.3.

4.8 Export Characteristics and Foreign Operations of Firms

Swedish firms are very export intensive (see Figures 6A, B). The development of the export ratio is endogenously explained for each MOSES firm model. Swedish firms are, however, also very international (Table 4), with sizable operations abroad, most of foreign activity being oriented towards marketing and distribution or final production close to the customer. Figure 6A shows the distribution of export rates 1982, 1986 and 1988 from the planning survey. Apparently the proportion of firms with high export ratios was larger in 1988 than in 1982 and 1986. A similar comparison 1988 (Figure 6B) of export ratios from two independent surveys, the planning survey and the same distribution from the firm survey (Braunerhjelm 1991), exhibits some differences, the firm survey having more domestically oriented units and, hence, overall lower export ratios. The reason is explained in Figure 6E that shows that small firms and subcontractors (not in the planning survey) have systematically lower export ratios than the larger firms.

Apparently (Figure 6D) the correlation between the degree of internationalization and the rate of exports out of Swedish plants is rather small. It was higher earlier (Swedenborg 1979). The reason appears to be higher productivity (Figure 6C) and higher rates of return (cf. Figure 6F and see Figure 1 in Braunerhjelm's Chapter IV in this volume) in foreign production than in domestic production, providing incentives to move new investments out of the country (Braunerhjelm 1990, 1991).

The computation of rates of return in different parts of one firm poses a well-known, difficult problem in database design and use. The allocation of profits, and to a lesser degree value added within the firm, depends on the internal transfer prices used in registering transactions within the firm. It is often argued that firms manipulate transfer prices to show profits where they want them to be, to avoid taxes. The answer to this claim (E 1972a, 1976a) is that each chosen transfer price system always, and to some unknown extent allocates accounted profits arbitrarily, but that once an arbitrary system has been determined firms tend to stay with it for a long time. If transfer prices are changed too often the information value of the internal statistical system of the firm is reduced, something that is potentially far more costly than saving a few dollars in avoided taxes (see further Section 5 below). The common transfer price inadequacy pointed to is that domestic CHQs do not charge their subsidiaries for technical and R&D services delivered from home, hence, biasing foreign subsidiary profits upwards. Such arguments, often formulated to make a political point, only reveal lack of knowledge. It is true that multinational firms normally do not explicitly charge their foreign subsidiaries fully for R&D services delivered from home. Such changes are more frequently lumped together with other costs as an overhead charge in the price paid by the subsidiary. Hence, direct data on the charges to foreign subsidiaries tend to be underestimated. The bulk of the marketing investment of a multinational, furthermore, resides in its foreign subsidiaries, and this marketing investment is normally larger than the R&D investment at home (see Table 5A, and E 1985b, p. 53). The international marketing network and know-how often determine profitability on all other assets, something East European firms are currently realizing. The proper charges on foreign subsidiaries of the parent, hence, might be much larger than the profit margins recorded in the internal books, and probably larger than the presumed undercharging for R&D services. Hence, one might more credibly make the reverse statement that foreign profits are underestimated, and Figure 6F supports that view. The large international firms have exhibited, since the mid-70s, systematically higher rates of return on their total (foreign and Swedish) operations than domestic Swedish manufacturing, including the domestic parts of the large international firms.

4.9 *Comparison of Small and Large Firms and Subcontractors*

Figure 7A shows size distributions of firms/divisions 1982 and 1986 by number of employees. The size distributions exhibit a slight drift towards larger units, but on the whole they are quite stable.

Figure 7D relates the size of the firm (production value) to its return over the interest rate in 1988. The correlation is positive but not very strong, suggesting the presence of scale economies that cannot, however, be directly explained by international size (see above).

Apparently the differences are to be looked for in the definition of categories. Subcontractors earn on the average less than large and small firms (Figures 7B,C), even though their labor productivity is high. The spread in performance rates (productivity and $\bar{\varepsilon}$) is much higher for the small firms and for subcontractors than it is for the large firms (Figure 7E), even though the wage cost levels are very equal.

4.10 Content of Operations

The fact that firms, defined as decision units, should not be represented as production establishments is a source of concern in firm panel studies. The "softening of manufacturing business" into service producers makes it inexcusable not to collect data on private service producers also. To represent firms in models as "production plants" is simply wrong. As can be seen from Figure 8 this is as far from reality as one can go. Manufacturing firms are dominant service producers and information processors (E 1990a). These data sets for 1978, 1982, 1988 and 1989 include information to be used in the future to improve the MOSES firm model. The very fact, however, that a large and growing intersection between the manufacturing and the private service sectors is occupied by firms that can no longer be classified neither as manufacturing nor service producers, makes it necessary to consider reorganizing the entire classification system of industrial statistics (see E 1990a). To that end a planning survey to private service producers has been designed and tested, but not yet carried out (see Braunerhjelm's Chapter IV in this volume).

4.11 Asset Structures of Different Firm Categories

The "softening of manufacturing" is also reflected in the balance sheets. Tables 5A–C give a summary presentation of the corresponding (to content of production) data in the balance sheet. These tables exhibit relative sizes of different asset categories that are expected to influence firm performance. The "soft capital" appears sizable compared to hardware capital. The problem (already discussed in Section 4.4) is how to measure those categories. With additional survey and econometric work, however, these data are expected to be an important source of information for improved specification of firm innovative and profit behavior. (Pontus Braunerhjelm is working on this project. See also Eliasson and Braunerhjelm 1991).

For one thing the two sets of data for identical firms 1985 (composed from different sources) and 1988 (direct questions) exhibit fair consistency. When the 1988 group is enlarged to include also basic industries, the machine and plant item, as expected, increases as a percent of the total.

Columns (4)–(6) offer an interesting comparison. The small resources invested in marketing capital and knowledge (marketing and R&D) in subcontractors compare with the higher (11 percent) investments in R&D spending in small firms, and with the very high investments in both marketing and R&D on the average in the whole sample (21+10 percent). The 10 percent investment in marketing is probably downward biased because the sample includes a too low proportion of Swedish multinationals (of columns (2) and (3)) which exhibits much larger investments in marketing.

4.12 Macro Financial Time-Series Development

To compute macro national accounts data sets and I/0 tables we have used official statistics, as detailed in Nordström's Chapter V in this volume. The macrodata set (e.g. GNP composition etc.) used for MOSES historic calibration of National accounts' categories has only required relatively easily available time-series material.

The data situation has, however, been much more complicated on the firm financial side, especially in computing the residual firms, making up the difference between consolidated real MOSES firms and the National accounts' representation of the entire manufacturing sector. Official statistics could not be used. Fortunately, such data existed within IUI, being the result of database work over the years, including my own research (E 1967, 1969, 1972a,b, 1974, 1976c). This database work was continued by Södersten (1978, 1985, and Södersten and Lindberg (1983, 1984). Tables 6A,B and Figures 9A, B exhibit the results. There are more detailed data sets from 1976 and 1982 on the MOSES industry/market break-down used for initialization. The time series material of the tables has been used for calibration of MOSES.

Figures 9 have been particularly demanding, since they require that many different sources of data be used. They give a rather vivid account of the dramatic shift in business conditions that occurred in the 70s, a disequilibrium situation that the economy is still suffering from. One could also speculate whether the steady lowering of the average industry $\bar{\varepsilon}$ during the entire postwar period (Figure 9B) has something to do with the macro problems of the Swedish economy. Simulation experiments on the MOSES model economy would say yes, but the underlying mechanisms are complex. For the first twenty-five years the real rate of return declined, while the real interest rate (IR) was politically kept low, probably contributing to the downward trend in the rate of return, through creating a less disciplined investment project selection. The low interest rates were politically possible as long as the Swedish economy was a financially rather closed system. When international financial market arbitrage opened up the financial system of Sweden in the early 80s, a strong increase in real interest rates outpaced the ability of firms to increase their rates of return. Contrary to the past, however, the high real interest rates forced firms to check wage increases to stem the downward trend in $\bar{\varepsilon}$ (see Section 4.7 above).

5 The Firm, Its Organization, Its Statistical Information System and the MOSES Micro Database

In this section I compare our database needs for the model with the corresponding information support needs of CHQ management to identify the optimal sourcing point in the firm and the nature of the data that we will obtain.

5.1 Access to Information and the Nature of Corporate Decisions

Control and coordination are the key purposes of internal information systems of large business firms. The firm's top management (CHQ) recognizes that they are facing a largely unpredictable environment and (in addition) that they have only limited information on the internal capacities of their own organization. They, nevertheless, have to make up the "mind of the firm" so as to be able to reach single-valued decisions. Hence, it becomes very natural for firm management at each point in time to narrow down their perceptions of the environment they are facing to be able to quantify and compute. This is essentially the same thing as to design an equilibrium model as the (boundedly rational) filter through which the firm sees the world around itself. In that trivial sense firm management optimizes. The most competence-demanding part of the decision, however, is the act of delimiting the opportunity set, i.e., of setting the restrictions of the trivial optimization, i.e., to decide what aspects of reality to exclude from consideration. The design of statistical information systems of firms are based on these considerations (E 1976a, 1990e). This fact has to be recognized when firms are asked to give statistical information about themselves. The data put together have been designed to serve a particular information purpose within the organization, *as firm management sees its decision problem.* This conceptualization exhibits great heterogeneity among firms. This is what I observed already in my 1976 study on *Business Economic Planning*, namely *bounded rationality*, even though I was not aware of the term, at the time. The quality of the data received will be best when one understands why and how the firm organizes its own internal statistical system, how it uses the information and when the questions asked relate to questions the data are supposed to answer. This is also the way we define and use micro databases in the MOSES context. Separate and elaborate formal (statistical) systems are needed to control and to guide the various activities of a large business organization. We tap them directly and model the use of these data for decision making within firms.

At this stage it is not difficult to see why *a financial definition of the firm* as *the observation unit* is the natural one. The financial group operates under a fairly well defined, and tight monolithic control system. Responsibility upwards is towards owners and the capital market. Downwards and inwards the firm is run through administrative controls that transform the externally imposed rate of return requirement into more detailed operations criteria. A statistical system related to the same entity exists and can be tapped directly. It is bad empirical methodology to cut the unit of measurement some other way and to lose this source of high quality data that firm management uses for its own purposes. And the main purpose of MOSES modeling has been to tap the existing wealth of internal firm data for a better understanding of firm and of macroeconomic behavior.

To attempt to extract more information from firms than corporate management finds useful to collect, and to go beyond the explicit knowledge that can be communicated outside the business organization means asking for data of doubtful information content which the statistical investigator might as well cook up on his own.

Theorizing and research then naturally divide into understanding the interior decision machinery of the financial unit, on the one hand, and how the financial units interact in markets, with each other and with households, on the other. Together this is micro-to-macro theorizing. And for research to be properly and relevantly conducted economics, business administration and engineering have to join forces.

The MOSES model applies the same set of algorithms to a large number of firms. These algorithms mimic the capital budgeting and production planning process of a firm as financially controlled (from levels 0 and 1 in Table 7) production systems (levels 2, 3, 4, 5). The databases used provide quantitative measurement to specify and initiate these algorithms differently for each firm, and to place them in the macro market framework of the rest of the economy.

5.2 Limited Internal Insight

To look through the various layers of management—to make the firm interior transparent—is almost as much of a problem for central management of the firm as it is for us. It is completely wrong (E 1976a) to assume, as was standard practice in economics for many years, that top firm management is fully informed about interior firm life.[17]

Complexity and "muddled insights" rule, when it comes to running big corporations, and interior statistical reach from Corporate Headquarters is, indeed, very limited. In general, CHQ has reasonable control down to product group level (see Table 8), not more. The product group is the finest classification level where well-defined interfaces with both final goods and factor markets (input goods, labor) exist. In fact, product groups are defined accordingly. At this level profit responsibility can be monitored without synthetic transfer-pricing arrangements. Most decisions, except investment and finance, can be delegated. Finance and investment decisions are kept

[17] The break in this tradition did not emerge from theorizing about the firm, but in the (principal agent) literature concerned with efficient monitoring of public utilities.

central, largely because of the difficulties of measuring capital inputs and monitoring rates of return (E 1976a).

The natural aggregation of data, hence, runs from product groups through the division to CHQ. Division management controls a bunch of product groups, and CHQ management controls a bunch of divisions. The data sets used to run operations at each level are different, due to the more limited market contacts the further down you go, and the different nature of operations. These data sets are not necessarily consistent, and they are becoming less so the more decentralized the firm is. This poses a particular problem in MOSES database work, since both financial and production decisions are integrated in the firm model, and the data needed cannot really be accessed at one location. We can model the CHQ investment and financing decision and how it is converted into targets and production plans at division level. The model that drives the realization of plans into ex post data is, however, controlled not only by the division, but also by the realities of the division that the CHQ is not aware of. Despite these problems we are working on a revised survey form that collects all the data needed from CHQ (see Braunerhjelm's Chapter IV).

When it comes to operational control, the concept of capital is as badly defined as capital theory tells. Data on capital are regarded as more or less useless for internal control purposes and corporate headquarters management avoids such concepts, because the measurements used can be manipulated by those who are to be controlled (E 1976a).

5.3 The Unstable Identity of the Observation Units

There is one additional element of complexity that frustrates corporate managers, namely the impossibility of maintaining a reliable centralized information system when the institutional (organizational) structure of the firm changes. This difficulty has to do with the identity of our observation unit. *Internal reorganization is the main vehicle for achieving productivity gains at corporate levels.* Internal reorganization, however, diminishes, or even destroys the information content of internal databases. There is no general solution to this problem. Corporate managers have learned to work with "deficient" information systems which to my mind precludes generalized (all purpose) database designs. I will leave the subject at that (see further E 1990e).

It appears that firm management, the survey people, and the theorist have a common problem here, *if* the theorist has done a good job. Figure 8 gives a principal illustration of the problem. The firm organization and the measurement system overlap partially (taxonomy level). The degree of overlapping depends on the purpose of the description, what it is supposed to be good for (use level). The intended use affects the optimal decision theory to use to organize facts for a particular purpose, i.e. to guide database design, but this is only possible when one's intended use is fairly stable. The feasibility of generalized measurement systems to cope with a multitude of intended uses is currently a topical concern to management (E 1984a, 1990e). Firms which produce similarly composed products for very different markets illustrate this problem. Certain machines can be used both in agriculture, certain manufacturing processes and in private households, the only difference being that larger sizes are more frequently used in industrial applications than in homes. The same factories, however, produce the same components. Hence, proper profit control requires a dual organizational system. The solution is normally to define divisions by market type and then organize a separate production organization (sometimes also divisionalized) from which market defined divisions buy components or product systems. The internal organizational design and corresponding information systems are therefore very complex, and internal databases are rarely consistent. Swedish organizational designs often make it difficult to collect data on prices, profits, finance and production from one single source.

5.4 *The Profit Control Hierarchy*

The major ambition of top level executives is to control a complex business organization without all the time getting involved in lower level operations problems. The executive level in Table 7 carries the ultimate responsibility to the owners of the firm. The task of managing the innovative function rests there, at least in theory. Control (total systems coordination) is always managed at the next level, i.e., between levels 0 and 1 in Table 7. Effective coordination (control) is achieved through setting reasonable profit targets against which formalized reporting and control can be applied. At lower (process) levels (market, product/process, distribution) the executive people do not know *how* these processes are run. They need information (database) support from the level below to set reasonable targets, i.e., not overly high, and definitely not too low. This task is always engineered through the *budgeting process* (E 1976a), supported by the cost accounting system of the business units. The method is to learn from records of past performance to set targets for future performance on the same, similar or standardized activities. This is what I have called MIP-targeting, (see E 1976a, p. 236ff and E 1991c) The finer the measurement grid—the more perfect the overlap in Figure 10—the more precisely these targets can be set. However, the more dynamic the interior firm organization the more difficult it is to maintain a detailed measurement system, and the more difficult it is to precisely estimate what is reasonable performance. If dynamics, however, moves the right way, profitability is not the major problem. The deeper into the organization one looks the more organizational float one encounters. The technique of efficient database design for control purposes, hence, is to find a rough compromise between precision in controls and costs associated with achieving control, and curbs on reorganization to maintain a viable measurement system.

5.5 How Far into the Firm Can CHQ See?

Table 8 gives an idea of how this compromise looks in practice. This table also suggests the technical limits of resolution that the outside economic investigator has to accept. There is no meaning in asking for more details since the Corporate Headquarters people do not know themselves, and they have abstained themselves from attempting to get more detailed data, because the measurement system of the firm is not reliable at lower levels of aggregation. (As a rule, confidentiality limits stop the investigator long before that). In a large business entity, Corporate Headquarters' (executive level in Table 7) routine access to data never reaches below the *product group level* (3) in Table 8. Product groups are defined and organized to be the minimal unit of profit and cost control accessed from CHQ. CHQ control often stops at the division level. At product group level standardized cost comparisons are possible. Factor prices are normally market prices. At the division or subsidiary levels all prices related to the physical side of production are normally market determined. The division, therefore, is the appropriate elementary unit to observe statistically over time. It is usually organized for one particular external product market and exhibits a well-defined decision autonomy. The product group definition sometimes can be used for the same purpose and one finds different solutions in different companies. It is impossible in practice (and theory) to base panel data on anything below the product group level. As a rule, access—from CHQ level—to data below division level is very difficult. The product group level sometimes corresponds to what is often termed a production "activity" in input/output analysis, but this concept is not very useful, because in a firm a process or an activity is only one part of a much more complex and integrated product group activity. Product groups are rarely stable units when management reorganizes the firm into a new combination. Reorganizations of firm activities occur below level (3) in Table 8.

6 Applications and Illustrations

In conclusion I will demonstrate certain aspects of MOSES database work through two applications. *First*, a non-linear, dynamic economic system of the MOSES kind is path-dependent and sensitive to initial conditions and prone to exhibit phases of non-predictable behavior. I will discuss this verbally, with reference to several publications on the model. *Second*, one novel feature of the model is that it exhibits price and quantity setting behavior of firms. The model mimics a general monopolistic game among a limited, but *variable* number of players (there is endogenous entry and exit), all of them being strongly influenced by the joint outcome of their dynamic interaction, transmitted through pricing in three markets, all activity being "dominated" by pricing in the capital market. The applications will illustrate how ex ante rate of return targeting interacts with wage setting behavior of firms and affects production growth. I won't go through the analytical part. This would be a separate paper (see Eliasson and Lindberg 1986). But the presentation allows me to illustrate both the rich initial state description of the MOSES database, the nature of the competitive potential of its firms and of industry as exhibited by the Salter structures of the model economy, and one particular detail of the calibration of the model. First, the dynamic properties of the model system.

6.1 Micro-Macro Dynamics

Dynamics in the micro-macro model arises out of the confrontation in markets of many, very differently perceived, and inconsistent decisions. Price adjustment resolves the issue and creates new quantity adjustments—the plan realization process. This realization also reallocates resources in the economy and creates endogenous new entry, and exit of defunct firms. Hence, the composition of production structures and output (the organizational "state" or memory of the model) is affected by the development of relative qualities of entering, incumbent, and existing firms. This micro life is normally quite turbulent (E 1991a). We know that stable macro development requires Brownian motion-type behavior at the micro level. We also know that if sufficient diversity of structure in terms of Salter curves cannot be maintained through simulations, latent structural instability develops (E 1978b, 1983, 1984b, 1991c).

We observed above that the endogenously evolving structural or organizational memory of the model defined its state of technology, or the "organization technology" that at each point in time coordinated all activities in the economy. Erratic price and quantity signals, being transmitted back and forth between the micro and macro levels, affect the evolution of that memory through the learning mechanisms by which firms attempt to forecast future development of—for them—important variables. The normal macroeconomic consequences of a disturbed and inflating relative price system were lower predictability and lower productivity development.

6.2 Path Dependency Creates Non-Stationary, Non-Learnable Behavior

Initial conditions keep playing a role for as long as we have managed to run the model (a hundred years or so, by quarter). Sometimes small variations in the initial setting cumulate in importance for long periods, then reversing themselves. Certain combinations of initial states and market characteristics, notably very fast price arbitrage (efficient markets) can generate a collapse of macro output and a long period of stagnation, a development entirely unpredictable from earlier historic data generated by the experiment. The model appears prone to such volatile, unstable behavior the closer its operating range comes to what may be characterized as a steady-state equilibrium growth path (E 1984b, 1985a, Ch. VII). All facets of this exotic behavior have not yet been explored, neither numerically nor theoretically. Suffice it to note, however, that these results have been a persistent property of the model from its implementation (see, e.g., E 1978a, p. 118), but were looked at with skepticism at the time by 'Besserwissers' of the profession. With unpredictable chaotic behavior having been demonstrated to be an expected mathematical property of a wide class of non-linear dynamic systems—to which MOSES belongs—these properties are now more widely accepted. The important learning experience, however, is that such economic systems are not easily controllable entities from a central policy point of view (E 1991c). A host of policy conclusions associated with the controllable steady-state equilibrium models, or the manipulable macro demand models of the 60s, have to be revised.

We observed earlier that the market exercises two important functions; a disciplining (competition) and a signaling (information) function. The more efficient the disciplining or growth-promoting function, the more organizational change forced on the model structure, and the more unreliable the signaling functions of markets. There is an optimal balance between the efficiency of the two functions (E 1983, 1985a, Ch. VII). This fundamental uncertainty in itself, however, prevents the state of full information equilibrium from being attainable. It arises out of the path dependency and, hence, the non-stationarity of the realization process (E 1991c) which makes classical, statistical learning infeasible. Antonov and Trofimov (1991) have carried out an interesting set of experiments on the model that illustrate the "limits of learning" in a dynamic, experimentally organized market environment. They introduce "statistical bureaus" in the MOSES model which produce forecasts of relevant firm expectations variables that the firms can use, or have to use depending upon the experimental setting. The forecasts of the statistical bureaus are generated by traditional macro models (Keynesian or neoclassical—there are two statistical bureaus), estimated on the macro output of the model during a simulation and constantly updated, as such forecasting models are used by "real forecasting institutes". In a reference case each firm uses its own adaptive learning functions. In another experiment (the central planning experiment) all firms are forced to use the forecasts of one statistical bureau. Whichever bureau is "enforced" macro growth performance of the model economy suffers in comparison with the reference simulation. On the other hand, when firms are free to choose between their own forecasts and any forecast of two statistical bureaus, in any inconsistent combination they find best according to partial fitness criteria for individual expectations variables, macro performance of the model economy improves. The reason is simple. With the increased variation in outcomes made possible by the "free" and often inconsistent behavior of all firms, new superior business plans are realized by pure chance, such that economic growth in the long term improves.

Our growing set of micro-macro databases is currently used to calibrate the model in an attempt to ascertain the range of numerical structures of the model that is compatible with observed variations in micro outcomes, to establish the propensity of the so calibrated model to generate different, desirable or undesirable structural developments. Some of these attempts are illustrated in Taymaz (1991). This work so far has repeatedly indicated the critical significance of good quality measurement, especially of initial conditions. If you don't know "where you are" when you run a model experiment, or carry out a policy measure on a real economy, as a rule you have little control of the policy results.[18] We have also learned that there is no end to such experimental work from which a glimpse will be offered in the next, final section.

6.3 *Price and Quantity Interaction—How the Interest Rate Affects both Wages and Growth in Output*

This experiment illustrates the macro sensitivity of the model economy to the nature of price-quantity interactions at the micro level; and the importance of a balance between stable and flexible relative prices to achieve stable macroeconomic growth.

Figure 4C presents three sets of data on Swedish manufacturing; value productivity and wage cost distributions ($p \cdot \beta$ and w distributions in equation (5)), real initial state data for 1982, and real and simulated data for 1985. The reader should observe from equation (5), that the profit margin (M) is a linear function of the difference between $p \cdot \beta$ and w, and how M in (4) relates

[18] For policies—I hasten to add—on which standard macro models gave very precise, albeit incorrect answers in the past.

to various rate of return measures. The first observation is that the "calibrated" reference case of the model (see Ch. VIII in E 1985a) projects Salter productivity and wage distributions quite well (see also Taymaz 1991).

Second, and this was one reason for the experiments, the firm's objective is to keep $\bar{\varepsilon}$ in equation (3) positive and as high as possible in the long run. The firm strives to achieve that through ex ante hill-climbing behavior. Hence, the interest rate, r, affects both price and quantity decisions of firms. If the interest rate is high, firms have (1) to improve productivity, or (2) to hold back wage increases to maintain profit standards, or both. The choice between (1) and (2) in the MIP-targeting and labor wage-setting search processes is endogenous in the MOSES model. Hence, *a high interest rate policy operates directly on wages through forcing firms to raise their profit margins through increasing productivity and/or holding back wages.* The sensitivity of wage-setting behavior to capital market conditions was the reason for the study (Eliasson and Lindberg 1986) from which the illustrations have been taken. The shape of the Salter curves defines potential competition. You can design an aggressive MOSES market experiment in which firms compete fiercely with each other, and for labor in the labor market (fast markets), and a slower market scenario in which firms are not at each other's throats (see further E 1983, 1991c). The fast market scenario creates a "mini cost crisis". When the best (top left on Salter curves) producers bid up wages to get labor, low end producers are killed and exit, forcing remaining producers to step up productivity ($p \cdot \beta$ in equation (5)), inter alia through laying off labor,[19] thus running up unemployment in the economy. The overall outcome is much higher productivity in the medium term (10 years or so; see Figure 11), higher output and lower average rates of return (lower average $\bar{\varepsilon}$) and much higher unemployment. The economy is operating closer to "static equilibrium". In the longer run (ca 20 years), however, the output level suffers significantly relative to the "slower" reference case. The reason is less investment, because of a lower rate of return compared to the interest rate (see Eliasson and Lindberg 1986). If the interest rate is lowered, however, investment increases and long-term output is higher (E 1984b), provided cost inflation can be contained. The latter test has not yet been run in this particular experimental setting. It is, however, my

[19] Firms that want to continue in business cannot hold back wages, because then they will lose labor to raiding firms.

conjecture—being rather familiar with the properties of the model—that if new investment, induced by a lower interest rate, is not sufficient to maintain sufficient diversity of Salter productivity distributions, the cost inflation generated in the fast market regime, reinforced by sloppy wage setting, due to the lower interest rate (see equation (5) again) will generate inflation and a macro output collapse, when low end producers operating on the right end of the Salter curve exit 'en masse'. If and when this happens is entirely an empirical problem, that cannot be analytically resolved, only through improved measurement. This closes the circle.

SUPPLEMENT I

Using the M–M Model to Generate Structural Data

Any data set that you may use contains certain priors associated with its presentation. Questions have been formulated, definitions made and adjustments imposed to obtain consistency. When respondents are asked to provide data on a different format than their own, they will have to enter judgment, which will "pollute" data.

You may have data for some years, or you may miss some data for some firms. You may then attempt to fill in the holes through interpolation, making certain assumptions about how the missing items depart from trends and structures you may have in the rest of your data set. You may even want to eliminate certain properties of your data set by filtering out systematic elements like cycles etc., or creating composite data by weighting several data series together. All sampling techniques are based on prior assumptions about what you are looking for. Each statistical classification system incorporates a hypothesis about what you are going to use the data for, a circumstance that will clearly influence your results when you later test this, or some other hypothesis. However you do it, priors enter your statistical output.

The large effort needed to create micro panel data sets causes particular problems, essentially making it impossible to test certain hypotheses that require a full-fledged micro data set. One might therefore want to create a statistical method whereby existing data sets are more efficiently exploited through the introduction of priors, based on exogenous (to the data set) information. This method is commonly used in other fields. Computer enhancement of pictures or pattern recognition are methods whereby blurred pictures are made more clear or are interpreted by computer programs that extract images out of the blur.

The micro-macro model is an enhancement instrument through which the statistical representation of reality can be more exactly made, and data generated that are perhaps of a much higher quality than those produced "by hand" in bureaus of statistics. The MOSES model is internally consistent, and hence generates internally consistent data sets. It then treats those data through the behavioral decision machinery of all its agents and the market process. These behavioral equations have been estimated by the application of standard statistical methods, and/or calibrated on historic data. If the parameterization is accepted as a prior exogenous information source some nice data sets, "that do not exist", can be created, in which fragmented statistical information has been merged with exogenously researched and consistent assumptions.

The MOSES Model traces a large number of variables over time using a rather modest initial statistical input. Through a simulation

– consistent quarterly national accounts data on the manufacturing sector and

– firm panels of financial and production data

can easily be generated. This is a use of the model that we may pursue in the future. This is also a possible technique of deidentifying confidential micro data sets. You run the calibrated model for several years and then take out the microdata for a particular year. Reverse econometric engineering, i.e., identifying the original, confidential data set, is impossible for exactly the same reasons that made it impossible for an external observer to identify the code of the model from observing its performance. An attempt in this direction has been made in conjunction with making MOSES portable (see Taymaz 1991, Sec. 3.4). The model has first been calibrated on historic data from 1982 to 1990, including also an attempt to reproduce cross sectional characteristics along the way. The surviving population of firms as they look in 1990, after the simulation, including new entrants is then transferred to a disc together with the simulated macro database. The plan is to make this "synthetic" macro database available for outside use.

SUPPLEMENT II
Summary of the Various Surveys together Making up the MOSES Database

1. Production—planning survey

The core micro-unit of the MOSES economy is the firm or the division. A firm may be represented by one or more divisions that produce for a particular market. This survey is limited to domestic establishments. Data needed are:

for historic period
- value added
- sales
- profits
- market price index
- wages

for initial period
- employment
- ingoing and outgoing inventories
- unused machine capacity
- unused labor capacity
- export ratio
- capital use per unit of value added
- etc.

This allows us to estimate a short-term production frontier for the unit (for production planning) and a shift function of the production frontier in response to investment. This is described by Albrecht and Lindberg (1989) and in Albrecht's Chapter III in this book.

2. Financial unit—the firm

We need a balance sheet, a profit and loss statement, and a cash flow balance for the financial unit. The balance sheet distinguishes (on the asset side) between production assets (replacement valuation), inventories, and other assets. On the debt side, external debt is explicit and net worth is computed as a residual between total assets and debt.

The financial database draws on an external analysis of company (group) accounts. There are significantly more detailed data in the database than needed for MOSES simulations. These data are, however, very useful to compare with the more detailed output of MOSES experiments for individual firms.

The observation unit of the financial database is viewed as the theoretical decision unit or basic measurement unit that we have discussed above. There is an elaborate *initialization* program, presented in Albrecht and Lindberg (1989), that initiates the set of real and artificial firms through which the model is run.

We are currently experimenting with a questionnaire that collects both financial data from the firm (globally defined), and production data on the division from the same source, namely the CHQ of the firm. This questionnaire would then combine the planning survey, the external financial analysis and the (not regular) IUI survey of Swedish multinationals on a less detailed format. On this see Braunerhjelm's Chapter IV in this volume and above.

3. Foreign subsidiaries

An extensive database on all foreign production establishments of Swedish firms exists for the years 1965, 1970, 1974, 1978 and 1986 (see i.a. Swedenborg 1979, and Swedenborg, Johansson-Grahn and Kinnwall 1988).

This database includes information on:

- employment
- value added
- profit margins
- etc.

in foreign subsidiaries and in domestic operations.

Investment data have been collected in the recent surveys and have been computed for 1974–1978 by Bergholm (1983).

Preliminary work has been carried out to connect foreign subsidiaries with the matching planning survey units. Only a minor fraction of this database will (eventually) be used directly as inputs in MOSES simulations. The database will, however, be used as a test material for model performance. A new survey of Swedish multinationals is currently being conducted for 1990.

4. Small firm sample

The planning survey units are mainly divisions of large firms. Data on a complementary sample of small firms were collected for 1986, 1988 and 1989, this time using the *firm* as a financially defined decision entity, as unit of measurement. For more on this see Braunerhjelm's Chapter IV in this volume.

5. Content of establishment (division) production activities

These surveys have been appended to the regular planning surveys. Data on internal firm-type of activity, markets, R&D etc. by costs and employment have been collected. These surveys are recent and exploratory. A new survey is currently being collected. This information has not yet been integrated in the MOSES model design. The survey was, however, initiated to make it possible to deal with the institutional characteristics that have been discussed in this paper. The same establishments as in the planning survey have been questioned. See Eliasson, Fölster, Lindberg, Pousette and Taymaz (1990) for a summary presentation, Tables 5A, C and Figure 8 for illustrations, and for sources:

Year: 1978
Source: Eliasson, G., 1985, De svenska storföretagen; Chapter I in Eliasson, Bergholm, Horwitz and Jagrén, *De svenska storföretagen—en studie av internationaliseringens konsekvenser för den svenska ekonomin*, IUI, Stockholm 1985, p. 53.

Year: 1982 (The IUI service survey):
Source: Eliasson, Carlsson, Deiaco, Lindberg and Pousette, 1986, *Kunskap, information och tjänster—en studie av svenska industriföretag*, IUI,

Stockholm, p. 17, and Chapter IV (Pousette, T. and Lindberg, T.). Also see *The Knowledge Based Information Economy*, IUI, Stockholm 1990.

***Year:* 1988, 1989**
Source: See Braunerhjelm (1990, 1991) and Chapter IV in this volume.

6. Firm capital structure—soft capital

This data set includes both data on the content of production used to generate a revised balance sheet for the 10 largest firms (see E 1990a, p. 80f and 1990b), and data from a separate survey in which firms were asked directly to provide estimates on "soft capital" (see Braunerhjelm 1990, 1991, Chapter IV in this volume, and Eliasson and Braunerhjelm 1991). Table 5A summarizes these data sets. Chapter IV explains the data.

This work marks the beginning of a new capital measurement project at IUI that has just been started.

Table 1A Levels of ambition of the micro-macro modeling project

Tasks	
1. Choice of Problem	
2. Conceptualization/ Theory	The Experimentally Organized Economy (EOE)
2. Measurement	The Knowledge-Based Information Economy
3. Modeling	The Micro-Macro Model (MOSES)
4. Application/Analysis	

Table 1B The statistical accounts of the knowledge-based information economy

1. COORDINATION (organizational structure)	The invisible and visible hands at work – competition (in markets; Smith 1776) – management (of hierarchies; Chandler 1977)
2. INNOVATION	Creation and exploitation of new business opportunities (Schumpeter 1912) – innovation – entrepreneurship – technical development
3. SELECTION (organizational change)	Incentives for change – entry – exit – mobility
4. LEARNING	Knowledge transfer (Mill 1848) – education – imitation – diffusion

Source: Modified version of E (1987, p. 12).

Table 2 Swedish GNP decomposed according to end use classification

		1950	1970	1980	1985
1	Primary goods production	13.0	5.6	4.1	4.1
2	Manufacturing and related service production	45.3	49.6	47.0	48.7
	a) Manufacturing according to the National accounts (SNR code 3000)	30.3	28.0	23.7	24.8
	b) related services	15.0	21.6	23.3	23.9
3	Public utilities and construction	10.5	11.3	110	10.74
4	Service production for direct private consumption	(14.9)	13.9	12.3	12.7
5	Infrastructure (health, research, education and insurance)	–	13.5	17.2	15.3
6	Information design production, including social distributional charges	–	6.1	8.4	8.5
7	Total GNP at production costs				
	a) percent	100.0	100.0	100.0	100.0
	b) Billion, current SEK	30.4	154.0	469.3	748.9

Source: Condensed version of Table I.6 in E (1990a, p. 79).

Table 3 The complete balance sheet of a firm

A. ***"Visible" capital***
1 Machines, buildings, inventories (replacement valuation)
2 Financial assets, net
3 Total visible assets (replacement valuation) [(1) + (2)]

B. ***"Not visible" capital***
4 Software
5 Technical knowledge
6 Marketing knowledge
7 "Educational" capital
8 Entrepreneurial competence

9 *Sum*: Total assets (replacement valuation) according to the revised books

10 Debt
11 Net worth (9 – 10) according to the revised books
12 For comparison: Market value

Table 4 Swedish foreign manufacturing employment
Number of people

	1960	1965	1970	1974	1978	1986
In goods production	105 510	147 290	182 090	221 110	227 110	259 820
In percent of Swedish domestic manufacturing employment	12	16	20	24	26	33
Total foreign employment	–	(172 117)*	(224 800)*	292 400	300 000	369 800
In percent of Swedish domestic manufacturing employment	–	(18)*	(24)*	31	34	48
Total domestic manufacturing employment	**880 260**	**938 915**	**921 780**	**929 200**	**874 230**	**777 270**

* Excl. employment in not goods producing and not marketing or distribution subsidiaries; 15 520 in 1974.

Source: Compiled from IUI surveys of Swedish foreign investments.

Table 5A **The composition of capital in Swedish firms**
Percent

	9 largest manufacturing firms, global operations, end of 1985* (1)	9 largest manufacturing firms, global operations, end of 1988 (2)	17 largest manufacturing firms, global operations, end of 1988 (3)	Planning survey firms, end of 1988: all sample (4)	Planning survey firms, end of 1988: sample of subcontractors (ISIC 38) (5)	Planning survey firms, end of 1988: sample of small firms (ISIC 38) (6)
1. Machinery and buildings	54	50	70	62	89	80
2. Software	n.a.	7	6	5	2	4
3. Technical know-how (R&D)	17	16	13	21	4	11
4. Marketing	20	19	6	10	3	3
5. Education	10	8	5	2	2	2
6. Total (percent)	**100**	**100**	**100**	**100**	**100**	**100**
7. Debt	65	66	77			
8. Market value; end of year in percent of (6)	30	37	51			

* *Source*: Table 5B.

Source: Eliasson (1990a,b), and Eliasson and Braunerhjelm (1991).

Table 5B **The composition of capital in the 10 largest Swedish manufacturing firms**

	Invest-ment	Capital		
		Alt I	II	III
(1) Machinery and buildings	39	39	60	100
(2) R&D	22	22	19	0
(3) Marketing	26	26	15	0
(4) Education	13	13	6	0
Total	**100**	**100**	**100**	**100**

Alt I: Depreciation: 5.6 percent for all categories
Alt II: Depreciation: 5.6, 15, 25, 35 percent, respectively
Alt III: Depreciation: 5.6, 100, 100, 100 percent, respectively.

Sources: Eliasson (1990a, p.80, 1990b).

Table 5C **Quality of employed labor**

	Small firms 1990	Subcontrac-tors, 1990	Large firms 1988	1982
Executive staff	5	3	2	4
Specialists, middle management	9	7	11	12
White collar	16	15	29	20
Blue collar	46	35	25	–
No training and low education	24	40	33	64
Total	**100**	**100**	**100**	**100**

Sources: Braunerhjelm (1990, p.138, 1991, p.40, Chapter IV in this volume), and Deiaco (1986, p.142).

Table 6A **Macro balance sheets of Swedish manufacturing, 1949-1988**
Current prices

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1949	16.4	6.7	3.6	11.8	38.5	10.9	27.6	.	38.5
1950a	18.0	7.4	3.9	12.4	41.7	11.7	30.0	.	41.7
1950b	10.7	7.5	3.5	10.7	32.4	12.6	19.8	.	32.4
1951	16.5	9.3	4.1	11.4	41.3	15.3	26.0	.	41.3
1952	19.9	11.0	3.7	11.4	46.0	15.8	30.2	.	46.0
1953	19.0	10.8	4.6	11.6	46.0	15.6	30.4	.	46.0
1954	19.3	12.4	4.6	12.0	48.3	15.9	32.4	.	48.3
1955	21.0	12.8	4.2	12.8	50.8	17.4	33.4	.	50.8
1956	23.6	13.9	3.9	13.3	54.7	18.6	36.1	.	54.7
1957	24.5	14.7	3.6	13.6	56.4	19.4	37.0	.	56.4
1958	25.0	15.7	4.7	14.2	59.6	19.7	39.9	.	59.6
1959	26.0	15.4	6.4	15.6	63.4	21.5	41.9	.	63.4
1960	28.9	15.4	4.8	18.0	67.1	24.2	42.9	.	67.1
1961	31.4	16.4	3.9	19.4	71.1	25.8	45.3	.	71.1
1962	36.0	18.5	4.8	19.8	79.1	27.4	51.7	.	79.1
1963	38.7	19.6	5.1	21.3	84.7	29.3	55.4	.	84.7
1964	42.8	21.3	5.8	25.1	95.0	34.5	60.5	.	95.0
1965a	47.1	23.5	5.9	30.0	106.5	40.8	65.7	.	106.5
1965b	47.1	22.8	6.3	29.0	105.2	42.4	62.8	37.8	105.2
1966	50.4	24.5	5.4	32.2	112.6	47.1	65.5	39.1	112.6
1967	55.8	24.0	6.4	34.7	120.9	51.0	69.9	40.0	120.9
1968	59.5	23.7	7.3	36.9	127.3	54.4	72.9	40.3	127.3
1969	60.7	25.3	6.6	43.3	135.9	61.4	74.5	41.7	135.9
1970	67.9	30.7	6.6	49.3	154.5	73.7	80.8	45.2	154.5
1971	75.4	33.1	7.5	52.9	168.9	81.2	87.6	46.6	168.9
1972	82.9	32.7	9.7	56.7	182.0	87.7	94.3	47.5	182.0
1973	93.4	34.6	11.3	62.1	201.3	94.3	107.0	50.2	201.3
1974	113.0	45.1	12.4	73.1	243.5	109.2	134.3	60.4	243.5
1975	133.0	59.3	12.7	89.8	294.8	138.1	156.7	71.0	294.8
1976	154.5	66.6	12.4	96.5	330.0	152.7	177.3	74.5	330.0
1977	179.0	63.9	13.5	119.9	376.2	177.2	199.0	77.1	376.2
1978	201.3	66.0	17.1	137.9	422.2	192.6	229.7	89.1	422.2
1979	219.7	72.2	20.3	138.9	451.0	208.2	242.8	86.3	451.0
1980	243.3	81.7	20.3	165.1	510.5	227.2	283.3	108.3	510.5
1981	269.7	87.1	22.5	183.5	562.9	248.9	313.9	116.9	562.9
1982	301.7	93.1	27.1	210.7	632.7	271.6	361.0	135.6	632.7
1983	332.5	95.3	33.3	240.4	701.5	284.9	416.6	164.4	701.5
1984	346.6	105.2	35.4	295.7	782.8	322.7	460.1	191.9	782.8
1985	368.6	111.9	30.6	337.2	848.2	355.8	492.5	.	848.2
1986	395.0	112.5	33.2	410.3	951.0	405.9	545.1	.	951.0
1987	421.3	114.5	35.9	485.1	1056.7	460.3	596.4	.	1056.7
1988	461.6	120.4	30.7	551.9	1164.5	511.4	653.2	.	1164.5

(1) Machinery and buildings
(2) Inventories
(3) Cash and bank deposits
(4) Other assets, incl. receivables
(5) Total assets
(6) Total debt, long and short term
(7) Net worth (residually determined) [(5)-(6)]
(8) Thereof: Equity according to the books
(9) Total liabilities (5)

Note: Initial values for stock of machinery and buildings end of 1949 have been computed as in Eliasson (1972b, 1976c). Depreciation assumptions for the whole period are 3.3 percent for buildings and 12.5 percent for machinery. This is a change from earlier tables in the references. The change has been motivated by the Hulten and Wykoff (1981) study. Until 1965 data have been based on the above studies by Eliasson. For 1965 we have used a different set of data from the Central Bureau of Statistics which is close to the National Accounts' definition of the manufacturing sector. Both data sets are coded for 1965.

Sources: See Table 6C.

Table 6B Profit and loss statements, 1950-1988

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1950	.	.	8.9	0.6	.	.	.	.	.
1951	6.7	5.5	12.2	1.0	4.5	0.5	0.4	4.7	0.9
1952	7.6	3.6	11.2	1.2	2.5	0.5	0.4	2.6	0.6
1953	7.7	3.6	11.4	1.1	2.5	0.5	0.5	2.5	0.8
1954	8.3	4.1	12.4	1.1	3.0	0.6	0.5	3.1	0.9
1955	9.1	4.1	13.3	1.2	2.9	0.6	0.5	3.0	1.0
1956	9.7	4.5	14.3	1.4	3.2	0.6	0.5	3.3	0.9
1957	10.4	5.0	15.4	1.4	3.6	0.7	0.6	3.8	1.0
1958	10.9	5.1	16.0	1.4	3.7	0.9	0.6	3.9	0.9
1959	11.3	5.8	17.1	1.5	4.3	1.1	0.8	4.7	0.9
1960	12.8	6.1	18.9	1.6	4.5	1.0	0.8	4.7	0.9
1961	14.3	6.2	20.5	1.7	4.5	1.1	0.9	4.7	1.0
1962	16.0	6.5	22.4	2.0	4.5	1.6	1.1	4.9	0.9
1963	17.5	6.5	23.9	2.1	4.3	1.7	1.2	4.8	1.1
1964	19.0	7.9	26.9	2.3	5.6	1.9	1.4	6.0	1.3
1965a	20.8	8.8	29.7	2.6	6.3	2.4	1.7	6.9	1.3
1965b	15.3	7.7	23.0	2.6	5.1	1.2	1.2	5.1	1.3
1966	18.7	6.7	25.4	2.8	3.9	1.3	1.5	3.8	1.0
1967	20.1	6.8	26.9	3.0	3.8	1.4	1.7	3.5	1.0
1968	20.2	7.4	27.7	3.2	4.2	1.6	1.8	4.0	1.2
1969	27.8	9.2	37.0	3.3	6.0	1.9	2.1	5.8	1.3
1970	32.6	9.8	42.4	3.7	6.1	2.2	2.6	5.6	1.3
1971	35.4	9.3	44.7	4.1	5.1	2.2	2.9	4.4	0.9
1972	37.2	10.2	47.4	4.5	5.6	2.4	2.9	5.1	1.2
1973	38.9	14.7	53.6	5.1	9.6	2.7	3.1	9.1	1.5
1974	46.7	21.6	68.4	6.2	15.4	3.2	3.8	14.8	1.3
1975	59.3	18.0	77.4	7.4	10.6	4.1	5.2	9.6	2.0
1976	66.3	15.6	82.0	8.5	7.1	4.5	6.5	5.1	1.7
1977	67.8	13.0	80.8	9.8	3.2	6.7	9.2	0.7	1.6
1978	74.7	12.8	87.5	11.1	1.7	7.3	10.3	-1.3	1.8
1979	79.0	21.8	100.8	12.0	9.7	8.2	10.9	7.0	2.1
1980	88.4	24.3	112.6	13.3	11.0	11.0	13.8	8.2	1.8
1981	93.9	23.8	117.6	14.7	9.0	12.4	17.1	4.3	2.6
1982	98.7	31.7	130.5	16.7	15.0	15.6	18.8	11.8	3.4
1983	105.1	45.1	150.2	18.6	26.5	16.1	17.6	25.0	4.8
1984	117.2	52.0	169.2	19.4	32.7	19.5	20.9	31.3	5.5
1985	129.1	48.3	177.4	20.7	27.6	24.5	21.4	30.8	6.2
1986	139.8	48.4	188.2	22.2	26.2	25.9	21.3	30.8	7.5
1987	148.0	55.2	203.2	23.6	31.7	27.4	21.3	37.9	8.6
1988	159.0	63.2	222.3	25.7	37.5	31.5	24.3	44.7	10.7

(1) Wages and salaries incl. social charges
(2) Gross operating profits
(3) Value added [(1)+(2)]
(4) Economic depreciation
(5) Net operating profits before financial charges [(2)-(4)]
(6) Interest and capital income excl. capital gains
(7) Interest costs
(8) Net profits before tax [(5)+(6)-(7)]
(9) Corporate income taxes

Sources: See Table 6C.

Table 6C **Macro cashflow balances of Swedish manufacturing, 1950-1988**

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1950	1.4	.	.	.	.	.	.	.	.	.
1951	1.8	.	0.4	0.3	0.9	.	5.5	.	.	.
1952	1.7	1.3	0.4	0.4	0.6	4.5	3.6	0.4	0.5	4.5
1953	1.5	0.9	0.5	0.4	0.8	4.0	3.6	0.6	-0.2	4.0
1954	1.8	2.0	0.5	0.4	0.9	5.6	4.1	1.2	0.3	5.6
1955	1.9	0.8	0.5	0.5	1.0	4.7	4.1	-1.0	1.5	4.7
1956	2.1	1.3	0.5	0.5	0.9	5.3	4.5	-0.4	1.2	5.3
1957	2.0	0.8	0.6	0.5	1.0	5.0	5.0	-0.9	0.8	5.0
1958	2.4	2.7	0.6	0.5	0.9	7.2	5.1	1.8	0.3	7.2
1959	2.7	2.8	0.8	0.6	0.9	7.7	5.8	0.2	1.8	7.7
1960	3.2	0.8	0.8	0.6	0.9	6.3	6.1	-2.5	2.7	6.3
1961	3.9	1.5	0.9	0.7	1.0	7.9	6.2	0.1	1.6	7.9
1962	4.2	3.4	1.1	0.8	0.9	10.4	6.5	2.3	1.6	10.4
1963	4.3	2.9	1.2	0.8	1.1	10.3	6.5	2.0	1.9	10.3
1964	4.1	6.2	1.4	0.9	1.3	13.9	7.9	0.8	5.2	13.9
1965a	4.7	7.2	1.7	1.0	1.3	15.9	8.8	0.8	6.3	15.9
1965b	4.7	.	1.2	1.0	1.3	.	7.7	.	.	.
1966	5.3	4.0	1.5	1.0	1.0	12.9	6.7	1.4	4.7	12.9
1967	5.6	3.0	1.7	1.0	1.0	12.3	6.8	1.6	3.9	12.3
1968	5.6	2.7	1.8	1.0	1.2	12.3	7.4	1.5	3.4	12.3
1969	5.9	7.4	2.1	1.1	1.3	17.7	9.2	1.5	7.0	17.7
1970	6.6	11.4	2.6	1.1	1.3	23.0	9.8	1.0	12.2	23.0
1971	7.0	6.9	2.9	1.1	0.9	18.9	9.3	2.1	7.6	18.9
1972	7.7	5.6	2.9	1.2	1.2	18.6	10.2	2.0	6.5	18.6
1973	9.2	8.8	3.1	1.2	1.5	23.9	14.7	2.6	6.6	23.9
1974	12.0	22.6	3.8	1.4	1.3	41.2	21.6	4.7	14.9	41.2
1975	13.7	31.3	5.2	1.7	2.0	53.8	18.0	6.9	28.9	53.8
1976	15.1	13.7	6.5	1.7	1.7	38.7	15.6	8.5	14.6	38.7
1977	13.6	21.8	9.2	1.9	1.6	48.0	13.0	10.5	24.5	48.0
1978	12.2	23.7	10.3	2.2	1.8	50.2	12.8	22.0	15.4	50.2
1979	13.8	10.4	10.9	3.6	2.1	40.7	21.8	3.3	15.7	40.7
1980	18.2	35.8	13.8	3.3	1.8	72.9	24.3	29.7	19.0	72.9
1981	18.2	26.0	17.1	3.8	2.6	67.8	23.8	22.3	21.7	67.8
1982	17.5	37.8	18.8	5.2	3.4	82.6	31.7	28.2	22.7	82.6
1983	20.8	38.1	17.6	6.6	4.8	87.8	45.1	29.4	13.3	87.8
1984	24.7	67.1	20.9	7.3	5.5	125.6	52.0	35.8	37.7	125.6
1985	31.4	43.5	21.4	8.4	6.2	110.9	48.3	29.5	33.1	110.9
1986	32.9	76.3	21.3	12.9	7.5	150.9	48.4	52.3	50.2	150.9
1987	38.4	79.5	21.3	12.2	8.6	159.9	55.2	50.3	54.4	159.9
1988	42.0	67.5	24.3	14.0	10.7	158.6	63.2	44.3	51.0	158.6

(1) Investments in machinery and buildings
(2) Net change in inventories and accounts receivable
(3) Interest payments
(4) Dividend payments
(5) Corporate tax payments
(6) Total uses [(1)+(2)+(3)+(4)+(5)]
(7) Gross operating income
(8) Financial income, incl. capital gains
(9) Net borrowing
(10) Total sources [(7)+(8)+(9)=(6)]

Sources: Eliasson (1967, 1972b, 1976c), Södersten (1978, 1985), Södersten and Lindberg (1983, 1984).

Table 7 The functions of a large firm

0	Executive
1	Finance and control
2	Market
3	Product/process
4	Distribution
5	Administration

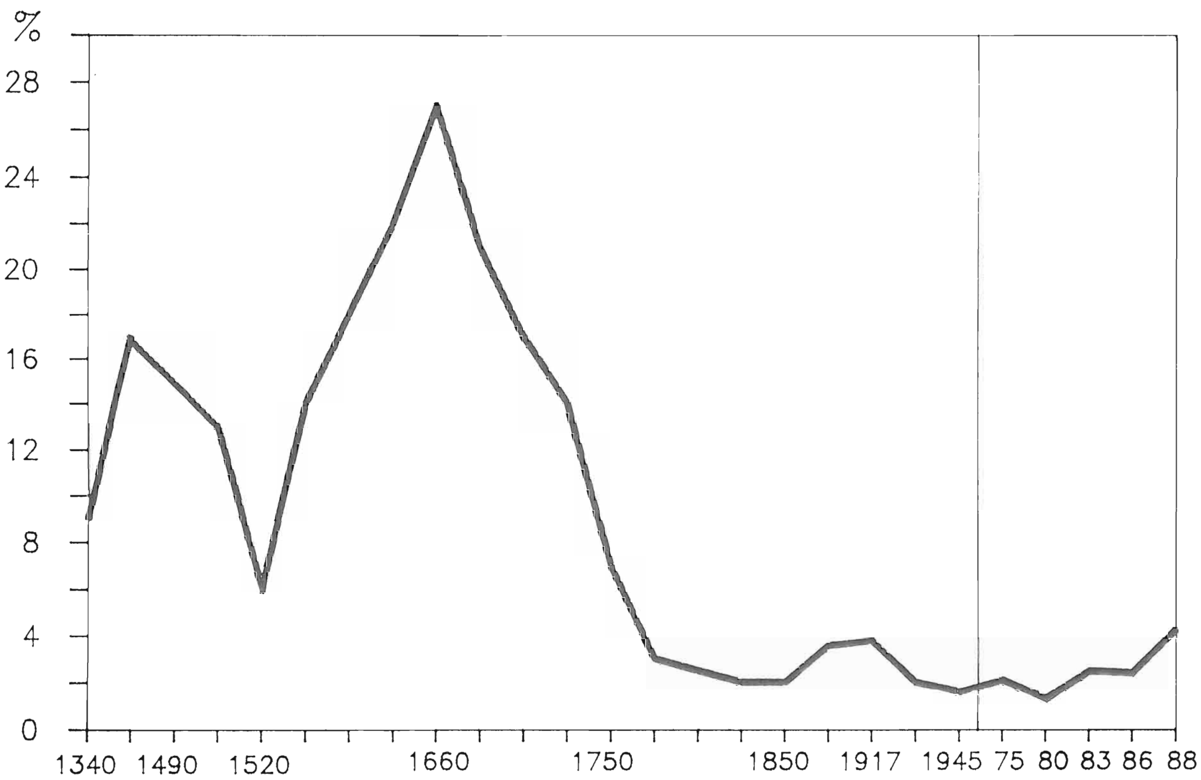
Table 8 Organizational hierarchies

(1) Level of aggregation	(2) Organization	(3) Activity	(4) Target (performance criterion)	(5) Database (measurement system)	(6) Market contact surface
(1)	Group (concern)	Financial guidance	Rate of return on net worth	Balance sheet & profit and loss statement	I,L,P,K
(2A)	Division	Financial and profit control	Rate of return on total capital	Profit and loss statement and partial balance sheet	I,L,P
(2B)	Subsidiary	Profit control	Rate of return on total capital	Profit and loss statement and partial balance sheet	I,L,P
(3)	Product group	Factory production	Profit margin	Profit and loss statement	I,L,P
(4)	Product	Process	Costs	Cost accounts	I,L
(5)	Component	Process element	Cost element	Cost accounts	I,L

I = Market for intermediate goods
L = Labor market
P = Product market
K = Credit market

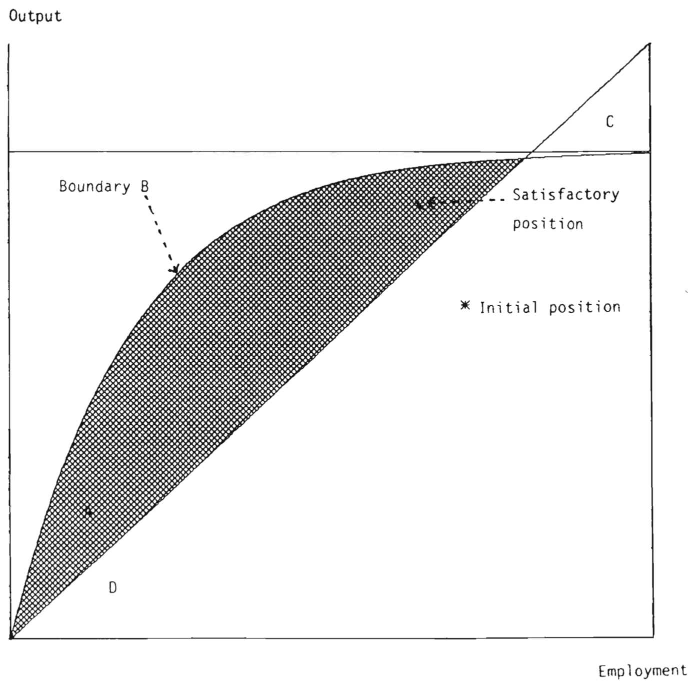
Source: Eliasson (1987, p. 72).

Figure 1 **The share of Swedish manufacturing output of Stora Kopparberg, 1340–1988**
Company turn-over in percent of total manufacturing and mining production



Source: **MOSES Database** (Lars Jagrén).

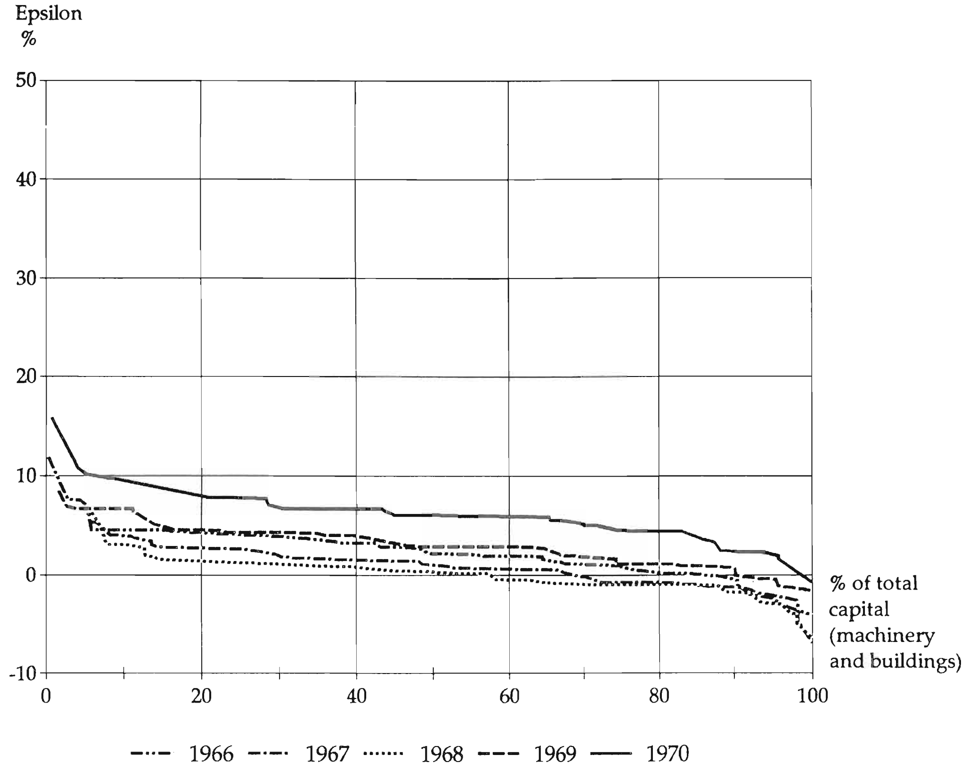
Figure 2 MIP-targeting in real MOSES firm, first quarter 1983



Explanation: On the basis of data, initially from the planning survey, then on from data endogenously created in the model, each firm computes the *boundary* B, the production frontier. The *"Profit Target Line"* through the origin is computed on the basis of past profit margins and expected prices in equation (5). The boundary and the profit target line delimit the feasible and satisfactory area of production (shaded) within which the MOSES firm can be, and desires to be. From its initial position, algorithms determine how the firm searches its way into the satisfactory, shaded region, bounded from above by the production frontier B.

Source: Eliasson (1991c, p. 161).

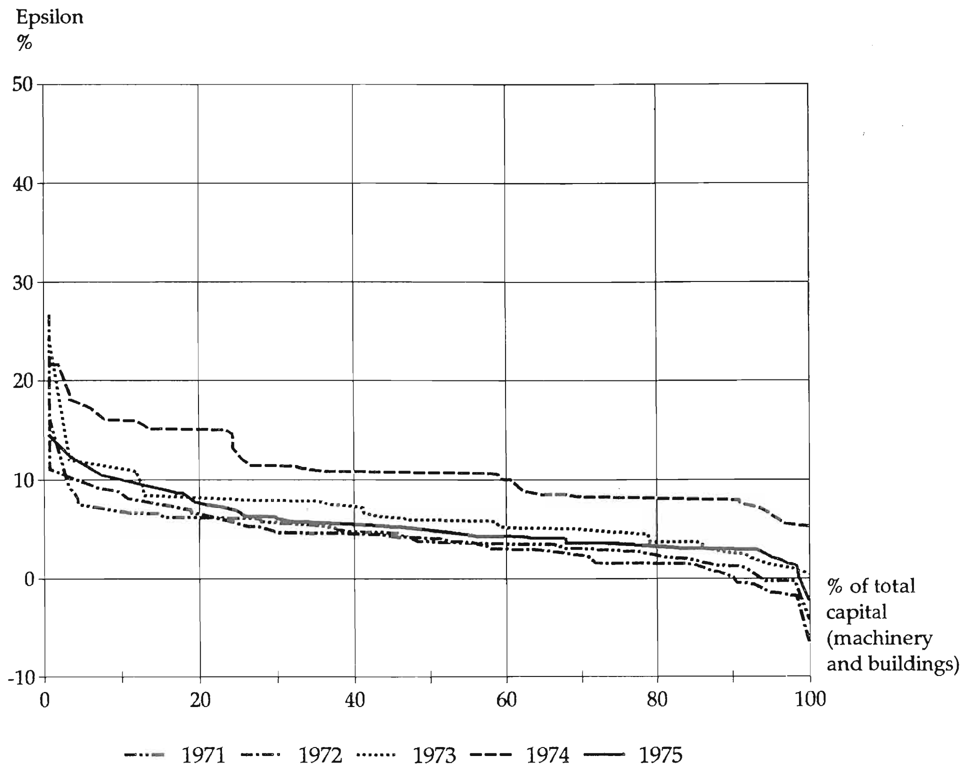
Figure 3A **Distributions of rates of return over interest rates (epsilon), 1966-1970**



Note: The epsilon is defined as $[R^N\text{-}r]$ in (3). We have computed the real rate of return on total assets by removing the capital gains factor in (4B) and then deflated the long-term interest rate r with the consumer price index. In computing depreciation charges we have used the reported rate of depreciation "according to plan" in the books and applied that rate to the depreciated capital stock according to a replacement valuation. All firm accounts are consistent. The depreciation method used in these figures, however, differs somewhat from the one used in the macro accounts in Tables 6. The above method happens to be most practical in these illustrations. In the MOSES model, however, all calculations are properly and consistently done each quarter for each firm. The definitional problems that may arise concern the use of the macro accounts for calibrating the model historically.

Source: Own calculations from annual reports, Findata etc.

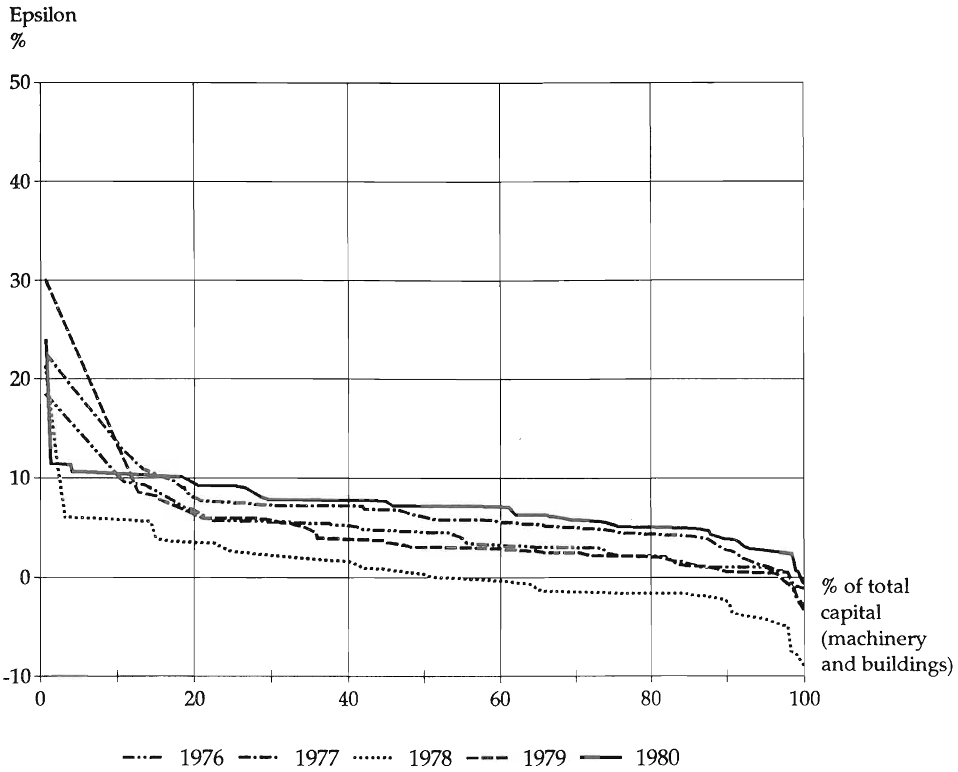
Figure 3B **Distributions of rates of return over interest rates (epsilon), 1971-1975**



Note: See Figure 3A.

Source: Own calculations from annual reports, Findata etc.

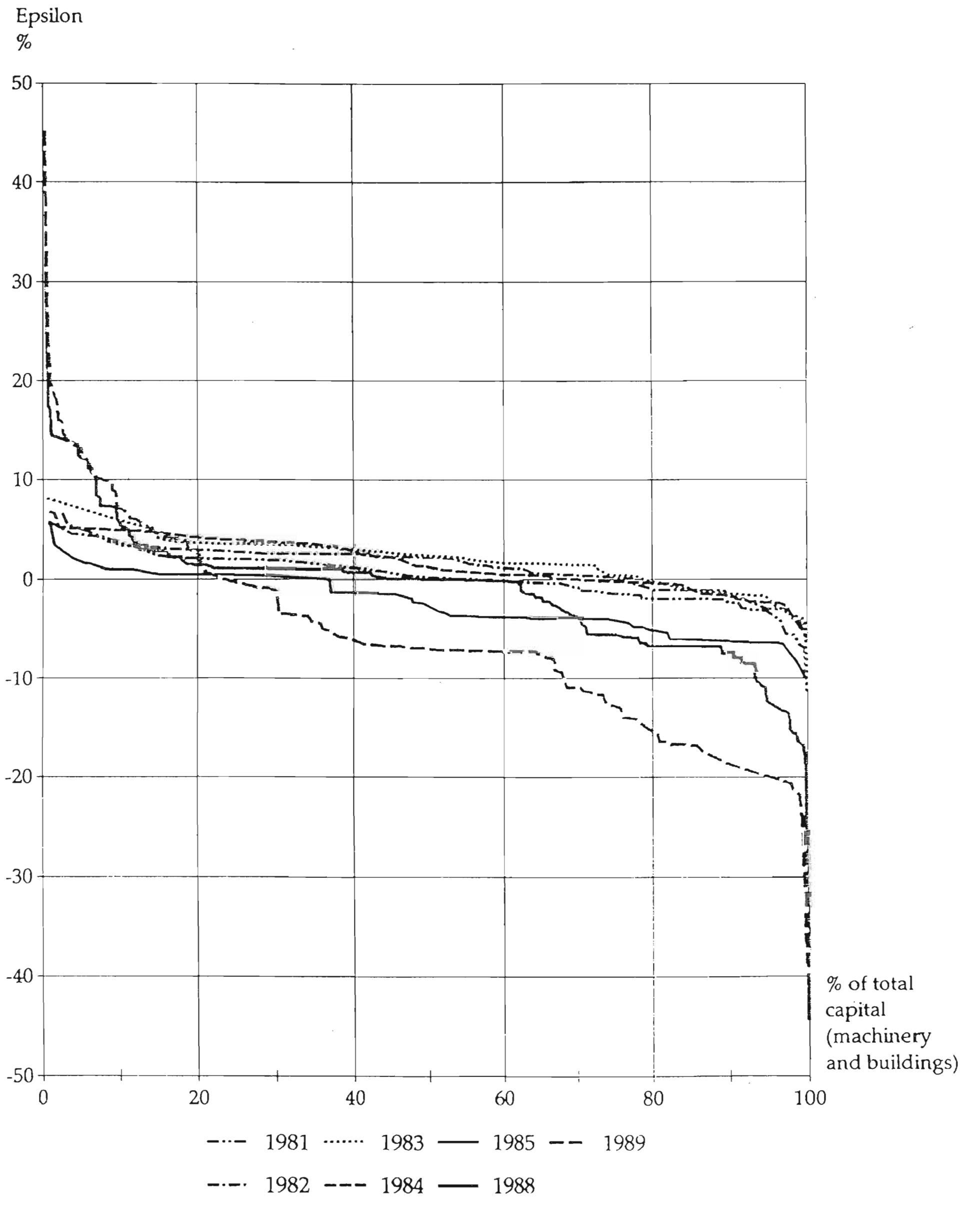
Figure 3C **Distributions of rates of return over interest rates (epsilon), 1976-1980**



Note: See Figure 3A.

Source: Own calculations from annual reports, Findata etc.

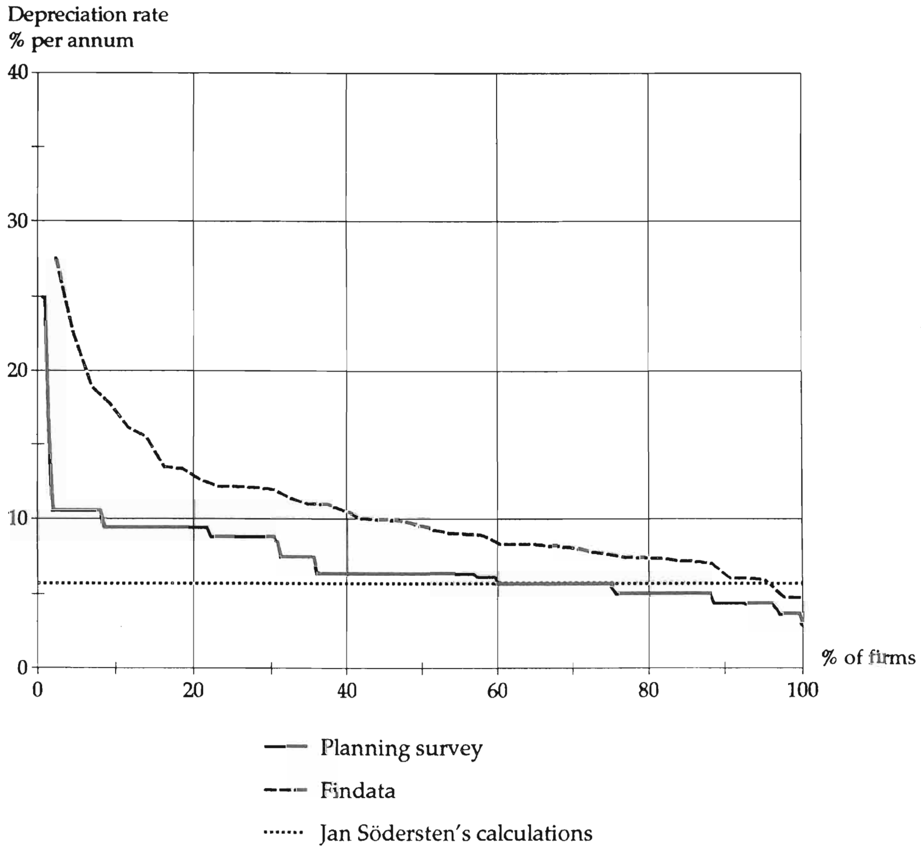
Figure 3D **Distributions of rates of return over interest rates (epsilon), 1981-1985, 1988, 1989**



Note: See Figure 3A.

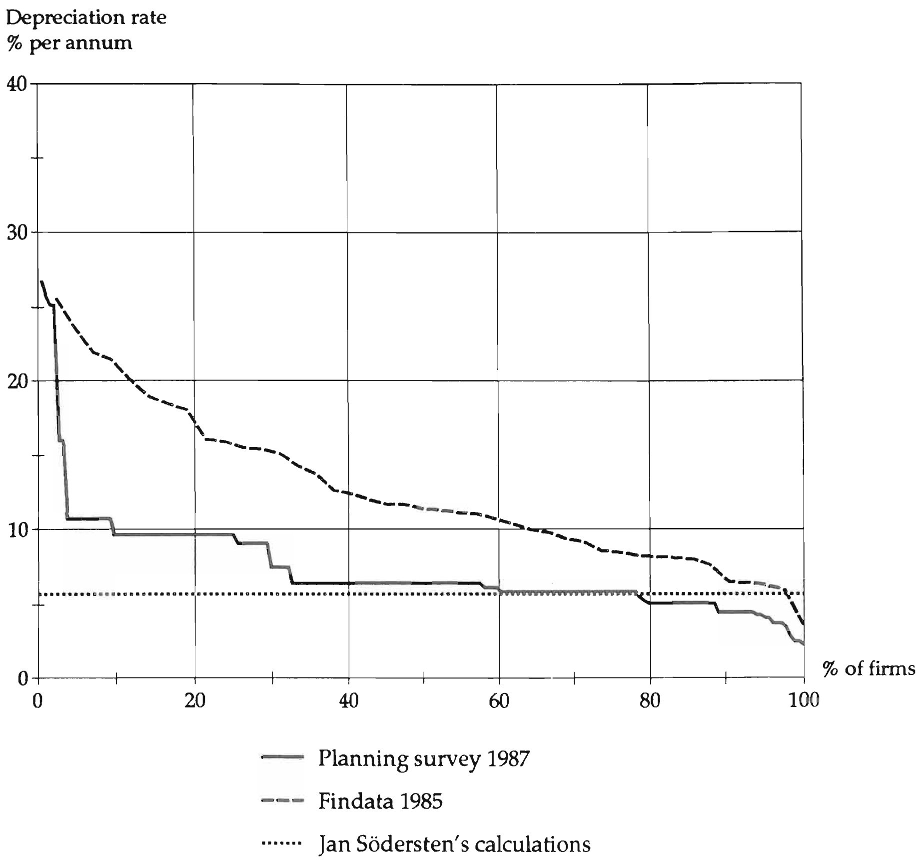
Sources: 1981-85: Large firms: Findata.
1988: All firms: IUI firm survey (Braunerhjelm 1991 and Chapter IV in this volume).
1989: Small firms and subcontractors: IUI firm survey (Braunerhjelm 1991 and Chapter IV in this volume).

Figure 3E **Depreciation rates 1978 according to different sources**



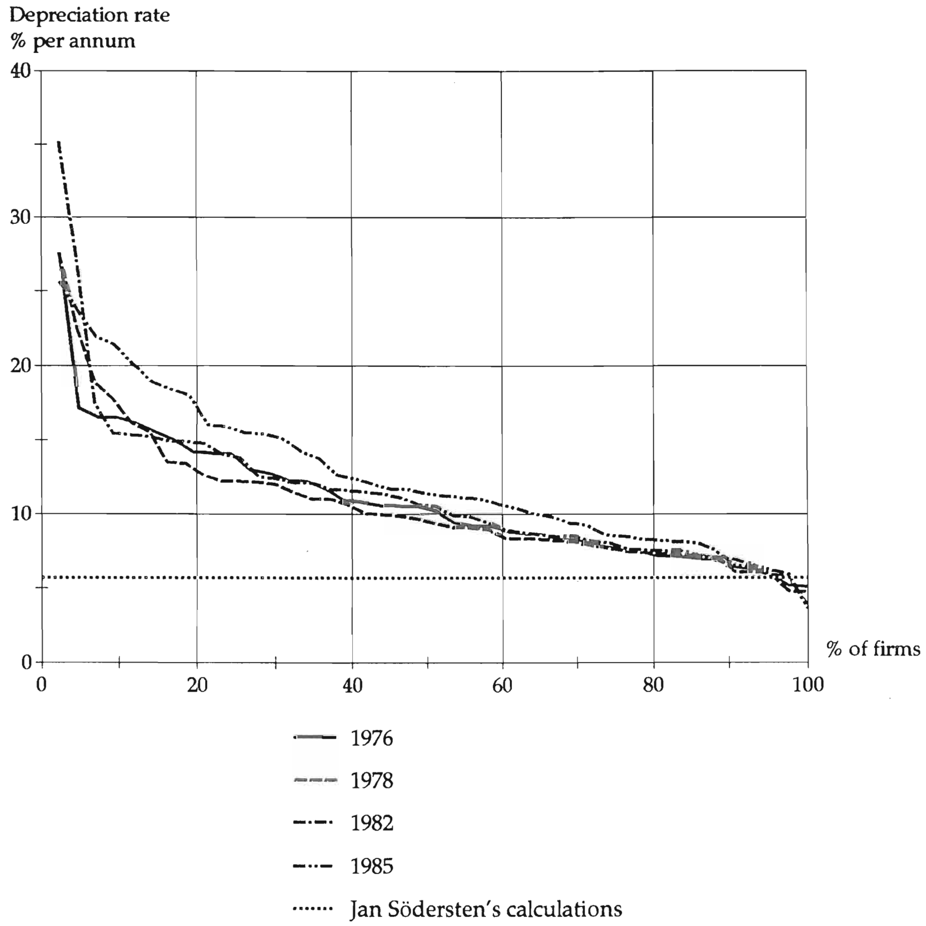
Explanation: The planning surveys of 1978, 1987 and 1990 requested depreciation rate or life-length estimates from divisions or firms as they should apply to replacement valued capital.
The Findata depreciation rates by firm are explained in note to Figure 3A.
For explanation of Jan Södersten's calculations, see Södersten (1985). These estimates are used in Tables 6A, B, C.

Figure 3F **Depreciation rates 1985 and 1987 according to different sources**



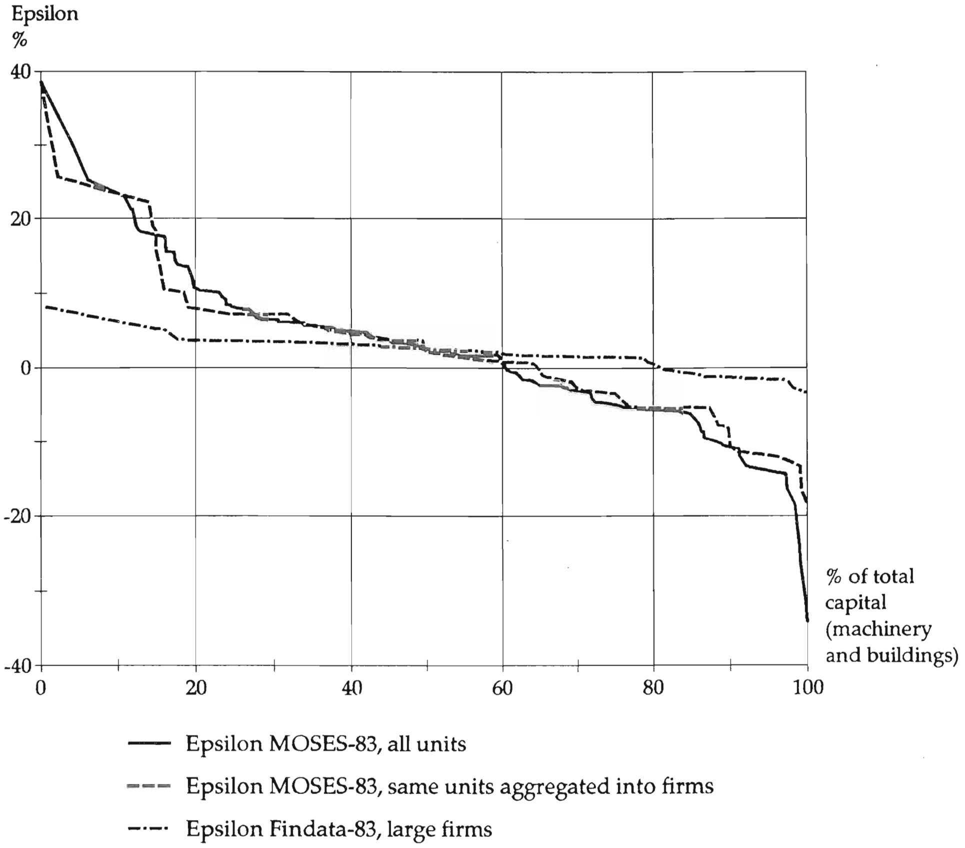
Explanation: See Figure 3E.

Figure 3G   Depreciation rate distributions, different years



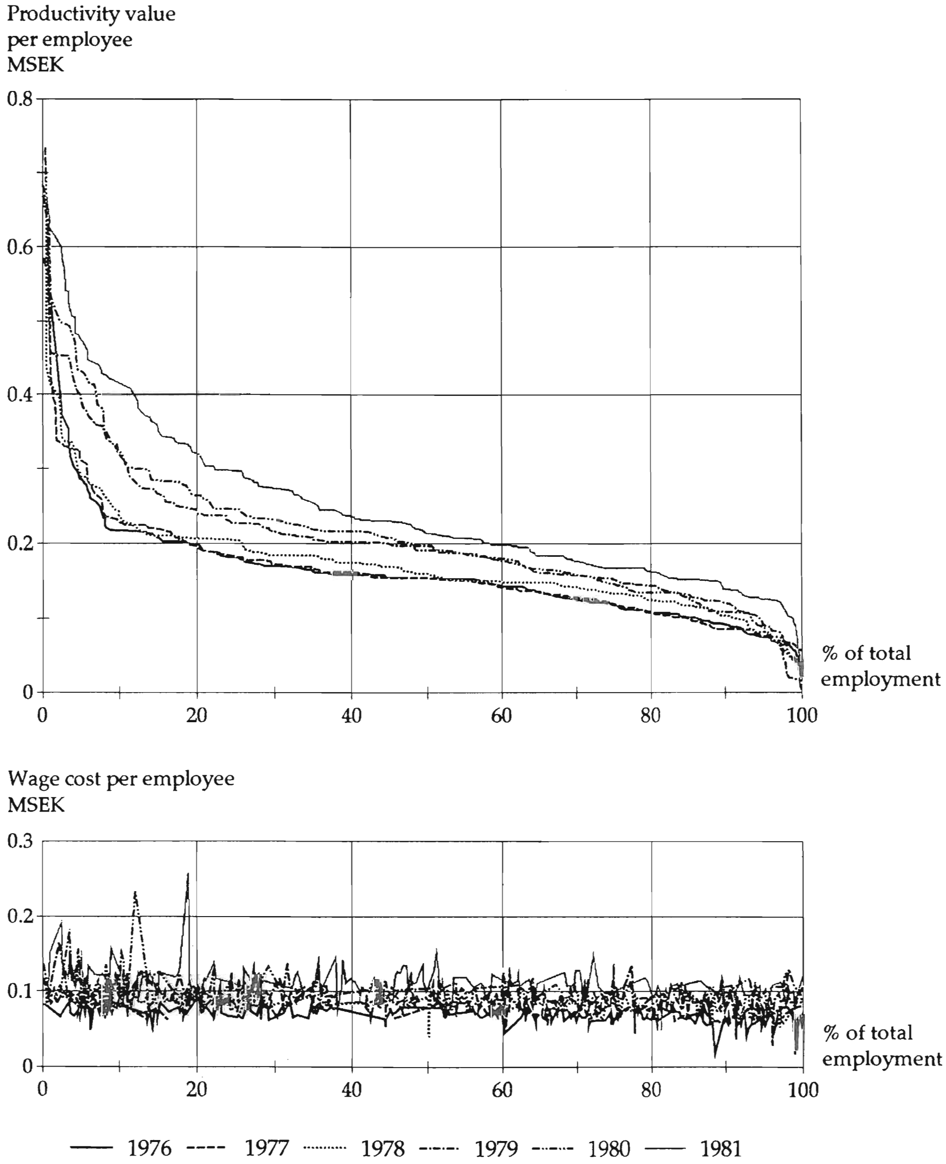
Explanation: See Figure 3E.

Figure 3H **Epsilon distributions from two different sources, beginning of 1983**



Explanation: The three distributions use somewhat different definitions and illustrate the consequences of aggregation. The MOSES-83 distribution is the first simulated year after the initial year, 1982. The *aggregated* MOSES-83 distribution is the same distribution, except that all divisions belonging to the same firm or group ("koncern") have been aggregated. The Findata-83 distribution includes the 29 largest Swedish manufacturing firms.

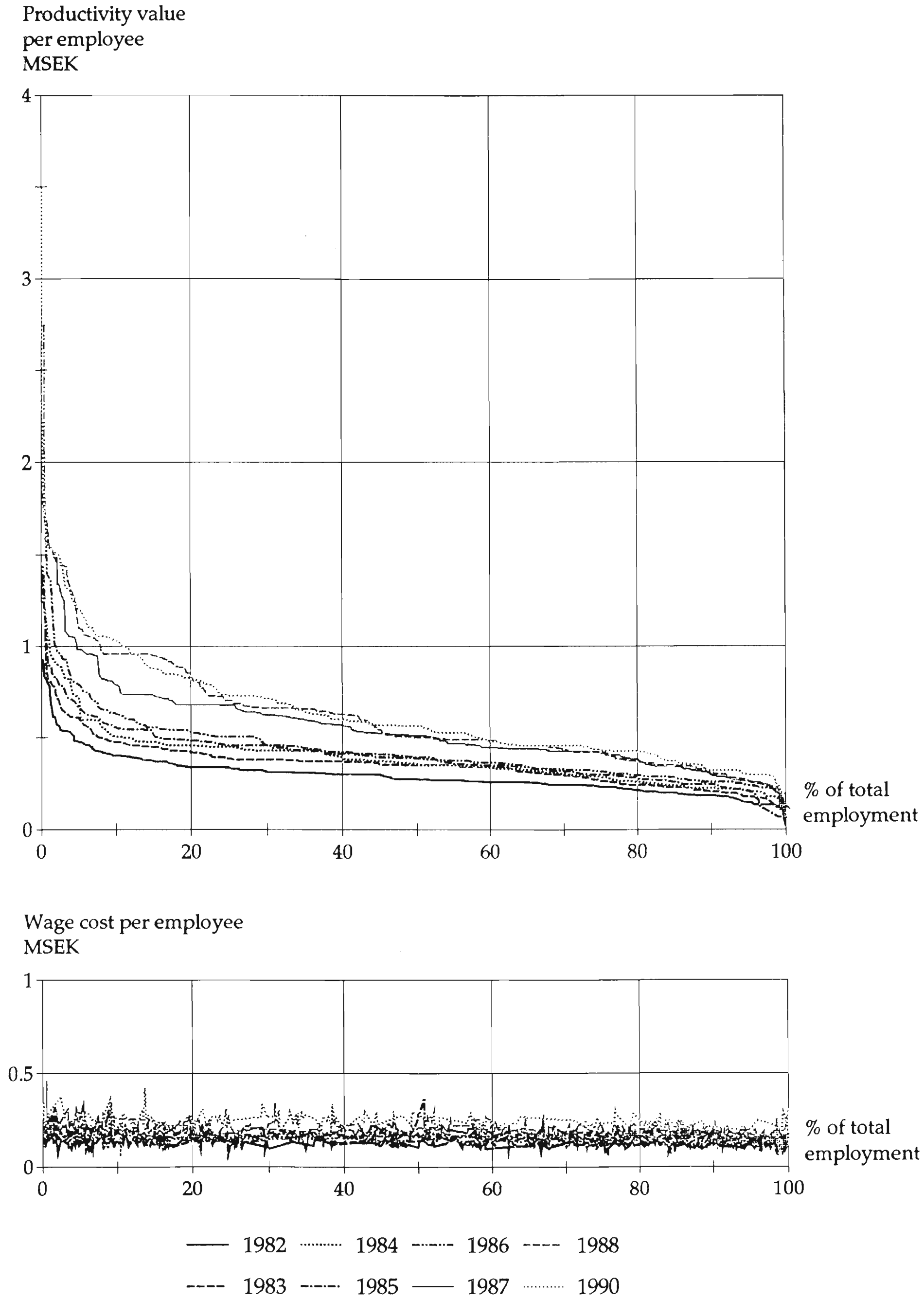
Figure 4A **Labor productivity and wage cost distributions, 1976-1981**



Note: Productivity value per employee minus wage cost per unit of labor equals gross profit per unit of labor.

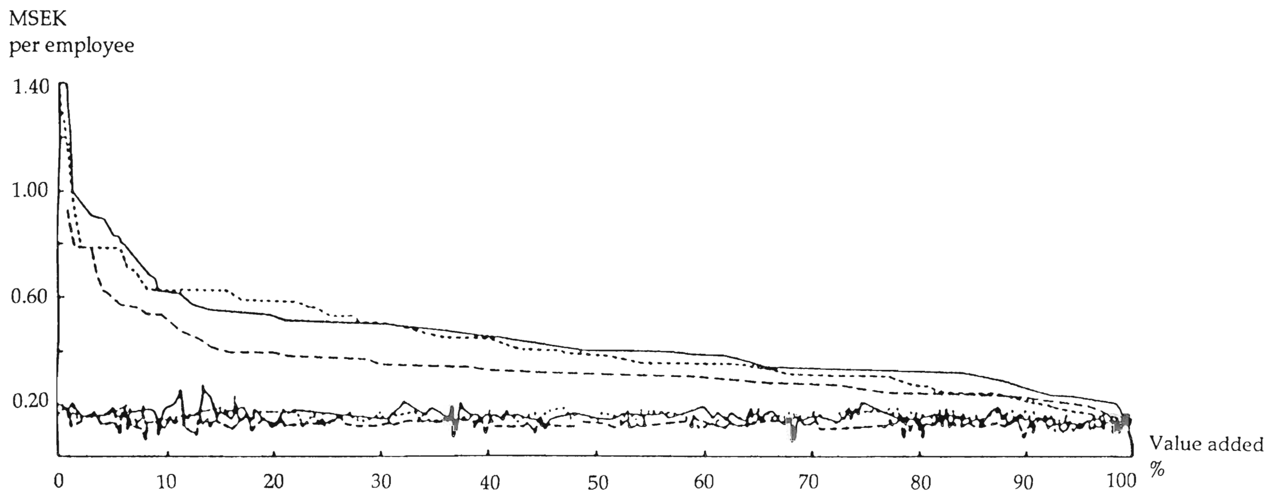
Source: Planning surveys, 1976-1981.

Figure 4B **Labor productivity and wage cost distributions, 1982-1990**



Source: Planning surveys, 1982-1990.

Figure 4C **Productivity and wage distributions 1982 and 1985, and simulated distributions, 1985**

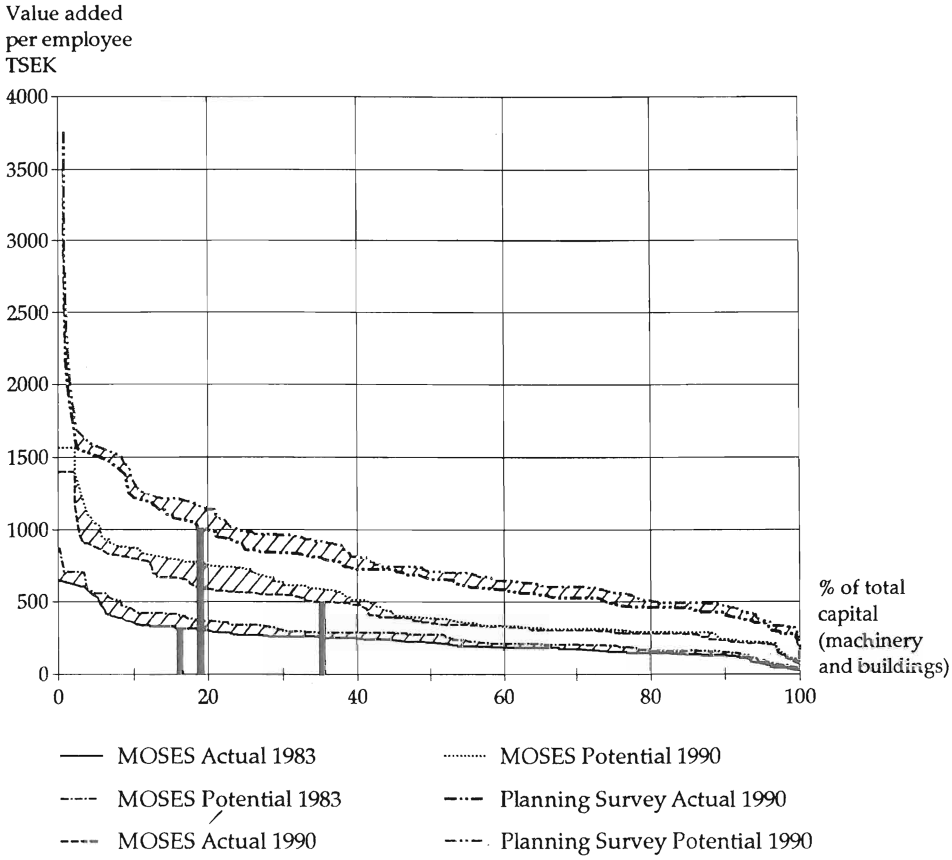


Note: The upper curves show distributions of productivity values, ranked in decreasing order over firms and weighted by value added. The lower curves show matching nominal wage cost distributions.

The simulation began on the 1982 initial database (- - -). The outcome of the simulation (.....) can be compared with real 1985 state from the database (——).

Source: Eliasson and Lindberg (1986).

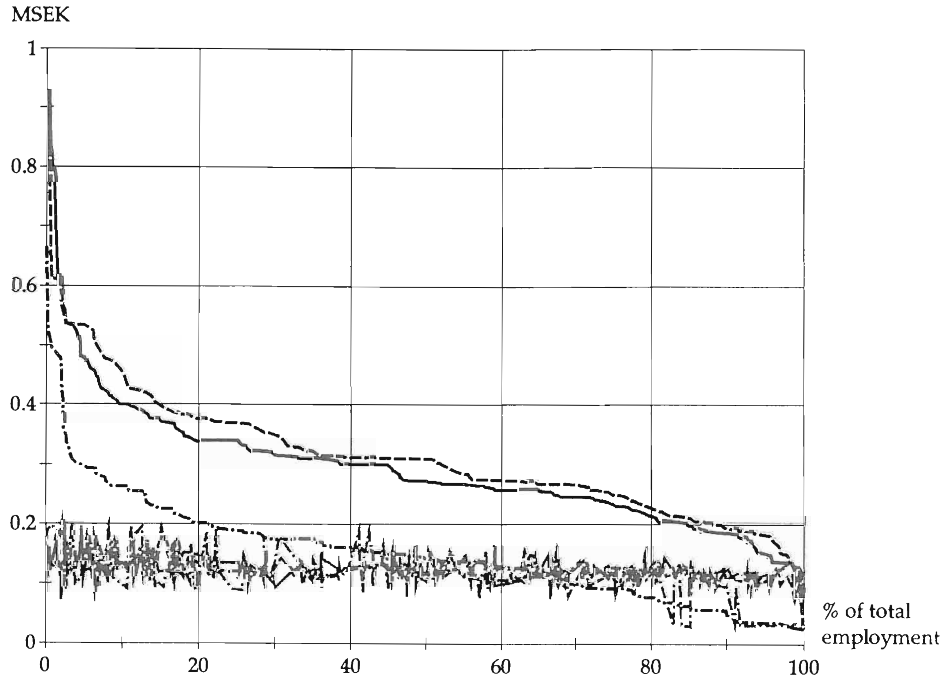
Figure 4D **Actual and potential labor productivity distributions, 1983 and 1990**



Comment: Actual and potential labor productivities, beginning 1983, according to planning survey, and same from 1990 in "synthetic" MOSES Database to be made available externally (see Taymaz 1991). The other 1990 distributions represent the entire planning survey for that year.
Shaded areas denote unused labor capacity.

Source: Planning survey 1990. See also Eliasson (1991c).

Figure 4E **Labor productivity and wage cost distribution 1982 according to:**
a) MOSES initial state, including synthetic firms
b) all planning survey sample
c) Albrecht's panel (see Chapter III in this volume)

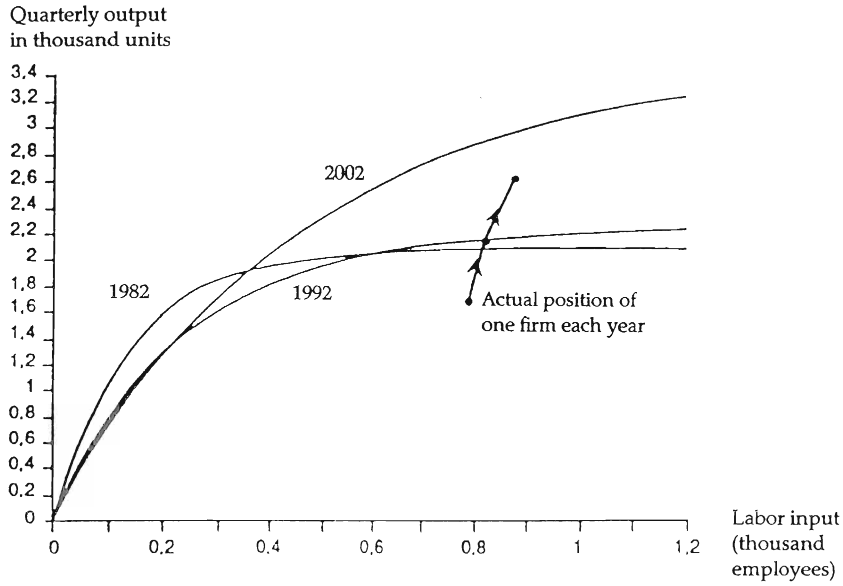


Productivity: —— Planning survey - - - Albrecht's panel -·-· MOSES initial state

Wages: —— Planning survey - - - Albrecht's panel -·-· MOSES initial state

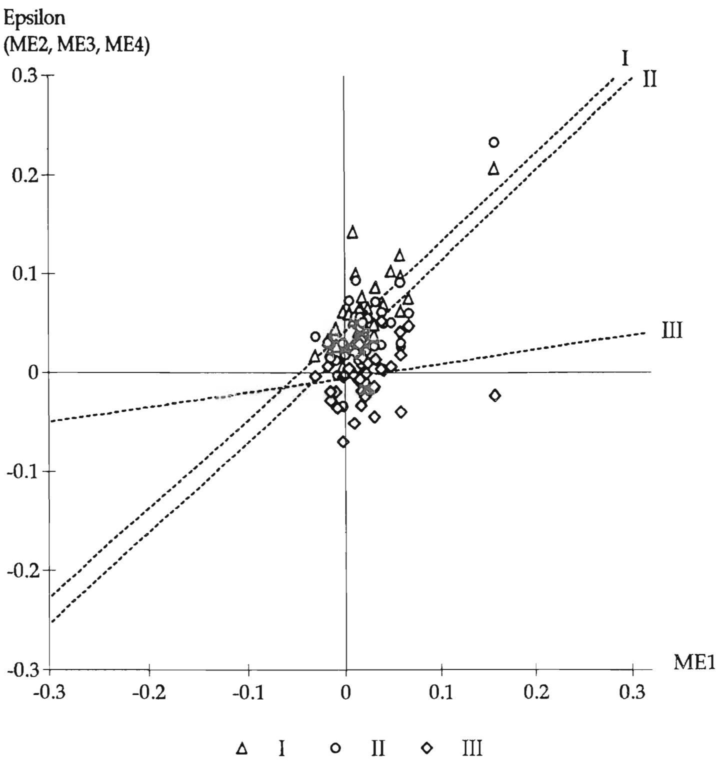
Figure 5 **Firm dynamics**

Figure 5A **Production frontiers and real firm positions 1982 (initial planning survey), 1992 and 2002 (simulated)**



Explanation: The three curves are the production frontiers of one firm (the boundaries B in Figure 2) for years 1982, 1992 and 2002, respectively. The points linked by arrows represent the position of one firm for each of the years. Apparently the firm was operating just below its frontier in 1982 (the initial year).

Figure 5B **The stability of individual firm rates of return over the interest rate (epsilon), 1966-1985**

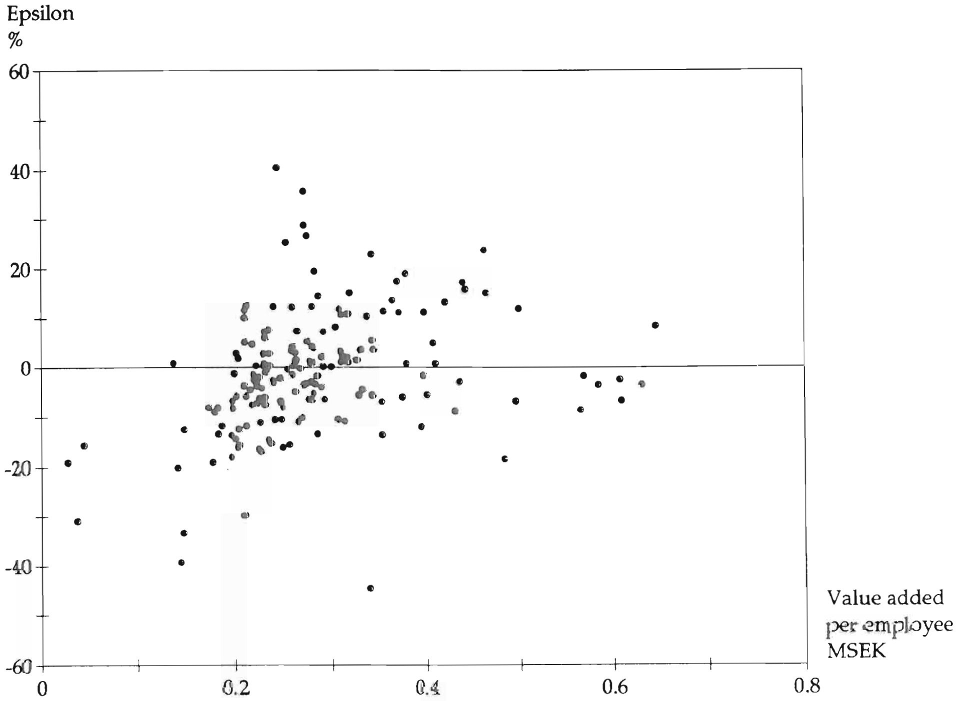


ME1: 1966-70	I :	ME1 against ME2	r = 0.76
ME2: 1971-75	II :	ME1 against ME3	r = 0.69
ME3: 1976-80	III :	ME1 against ME4	r = 0.17
ME4: 1981-85			

Note: ME = average rate of return over interest rate for five-year period.

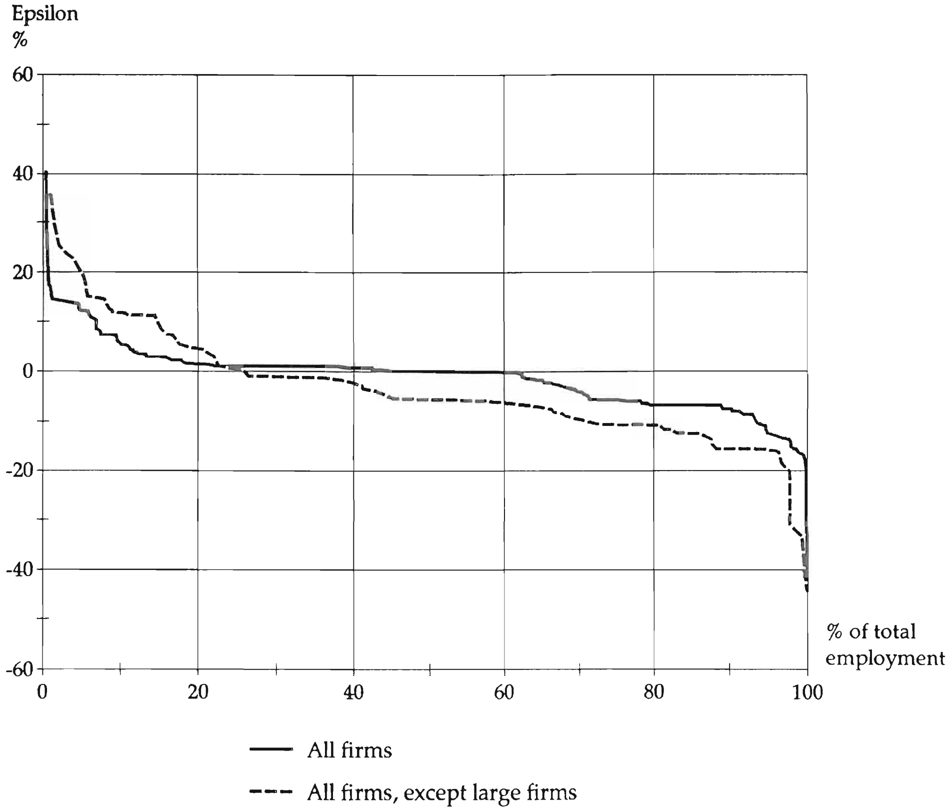
Source: Eliasson and Lindberg (1988, p. 97).

Figure 5C **Relation between rates of return over the interest rate (epsilon) and labor productivity, 1988.**



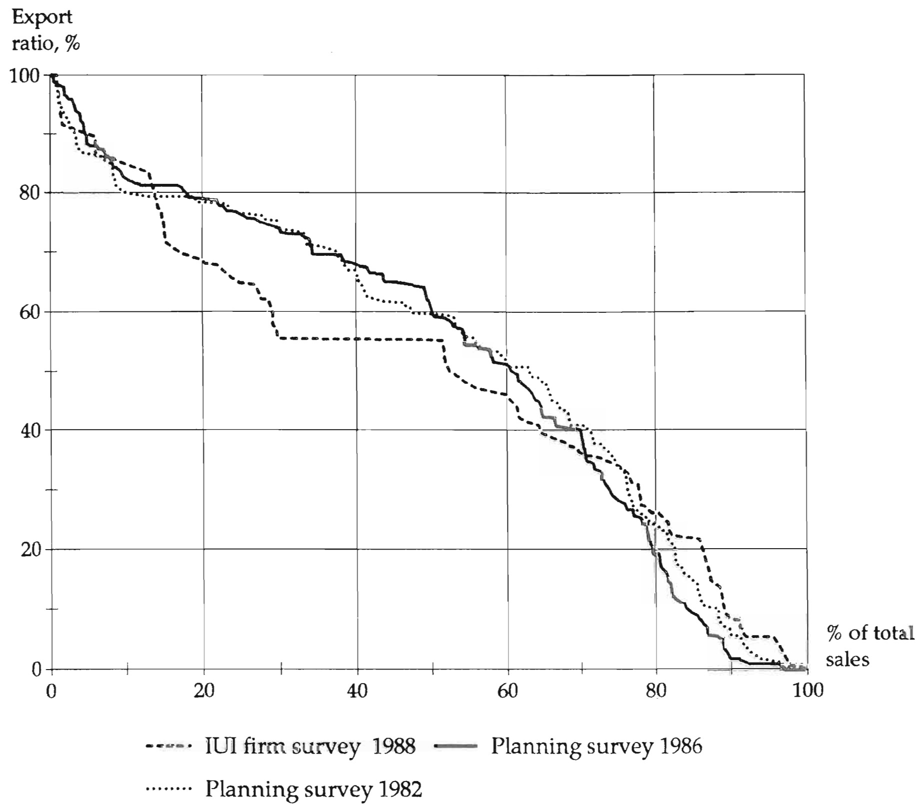
Sources: IUI firm survey 1988, and Braunerhjelm (1991, p.52).

Figure 5D **Epsilon distributions of all firms, and of all firms excluding the large firms, 1988.**



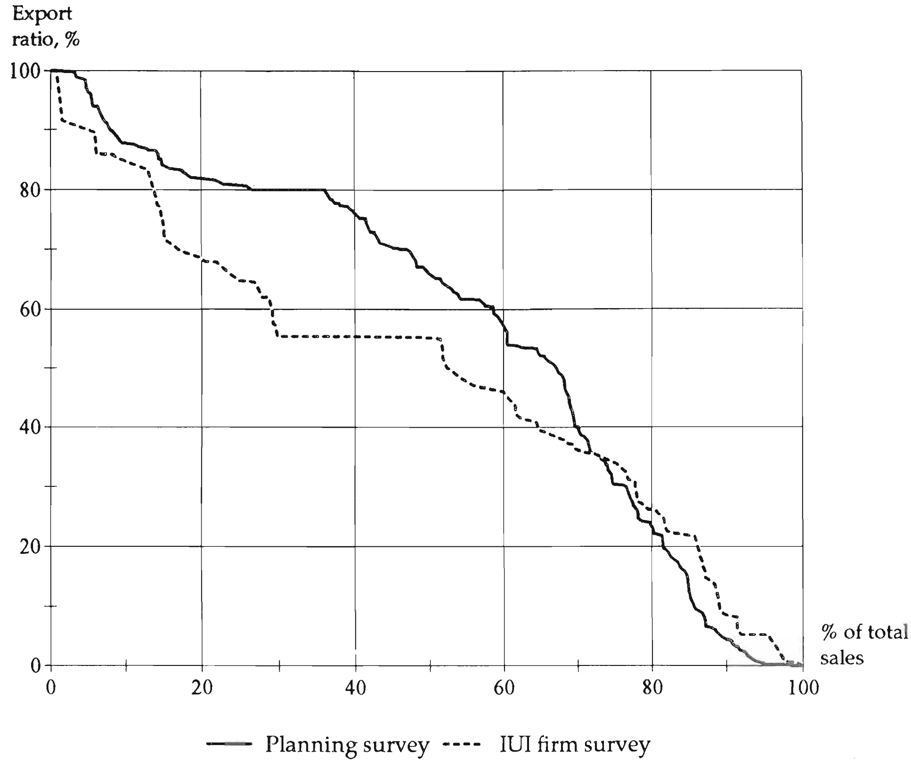
Source: Chapter IV in this volume.

Figure 6A **Export ratio distributions according to planning survey 1982 (initialization year), 1986 and special IUI firm survey 1988**



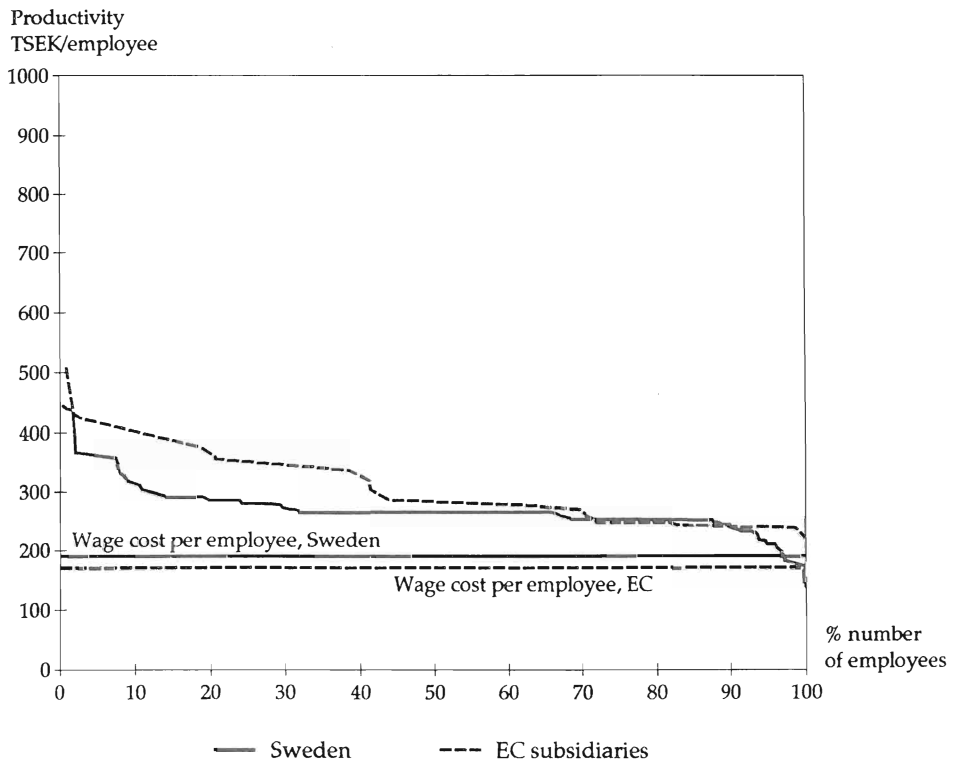
Definitions: Export deliveries in percent of Swedish gross production. This calculation uses survey data on internal group deliveries from Swedish plants to EC subsidiaries. Due to an oversight such data were not collected for internal deliveries to subsidiaries in other countries. We did, however, have data on plant investments in Sweden, in EC, and in rest of the world. These data were used to approximate non-EC internal group deliveries from Swedish plants.

Figure 6B **Export ratio distributions of planning survey units 1988, and of separate IUI firm survey 1988**



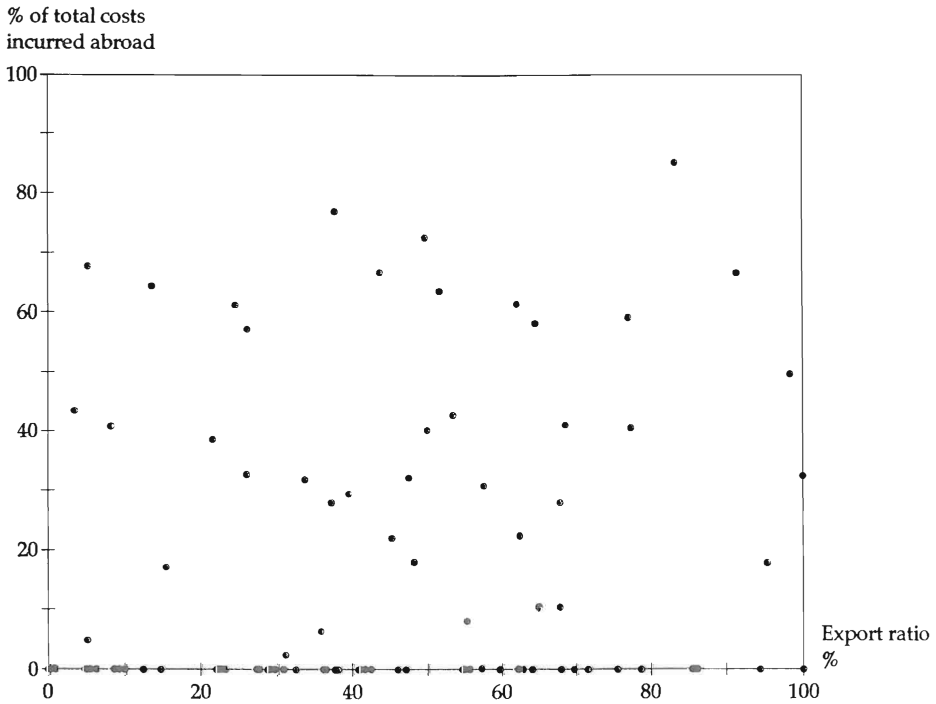
Sources: Planning survey 1988, and Braunerhjelm (1991).

Figure 6C **Labor productivity and wage distributions of domestic and foreign (EC) parts of Swedish engineering firms, 1988**



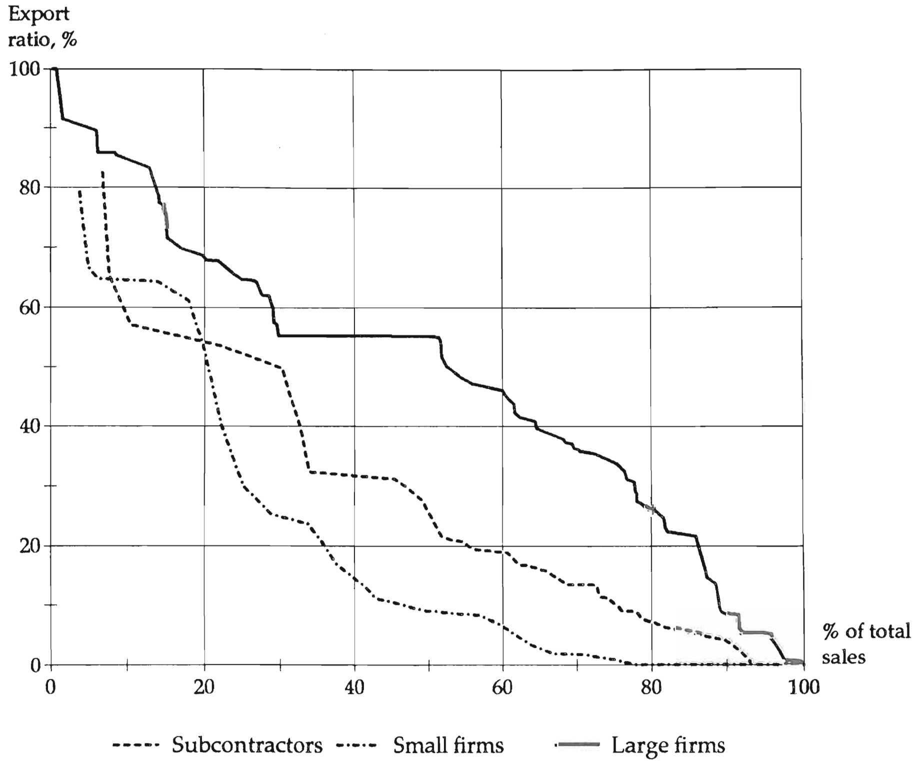
Source: Braunerhjelm (1990).

Figure 6D **Rate of internationalization and exports out of Swedish plants according to special IUI firm survey 1988**



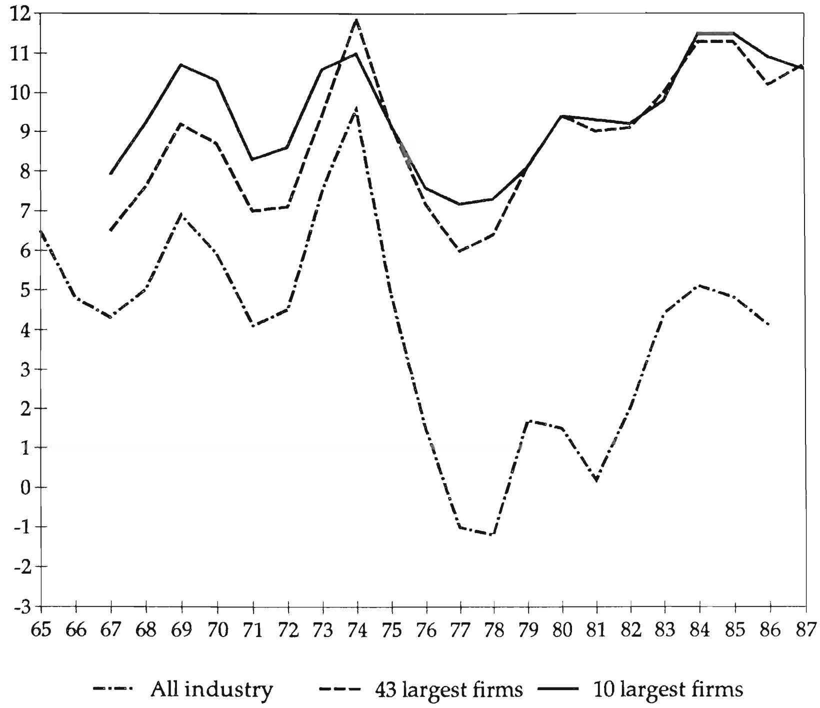
Note: The export ratio (horizontal axis) is computed as export deliveries out of Swedish plants in percent of Swedish gross output. The foreign share of production is the share of value added abroad, in percent of total (global) value added. Export ratios are based on the same approximation as in Figure 6A.

Figure 6E **Export ratio distributions 1988 of large firms, small firms and subcontractors 1988, according to special IUI firm surveys**



Sources: Braunerhjelm (1991), and Chapter IV in this volume.

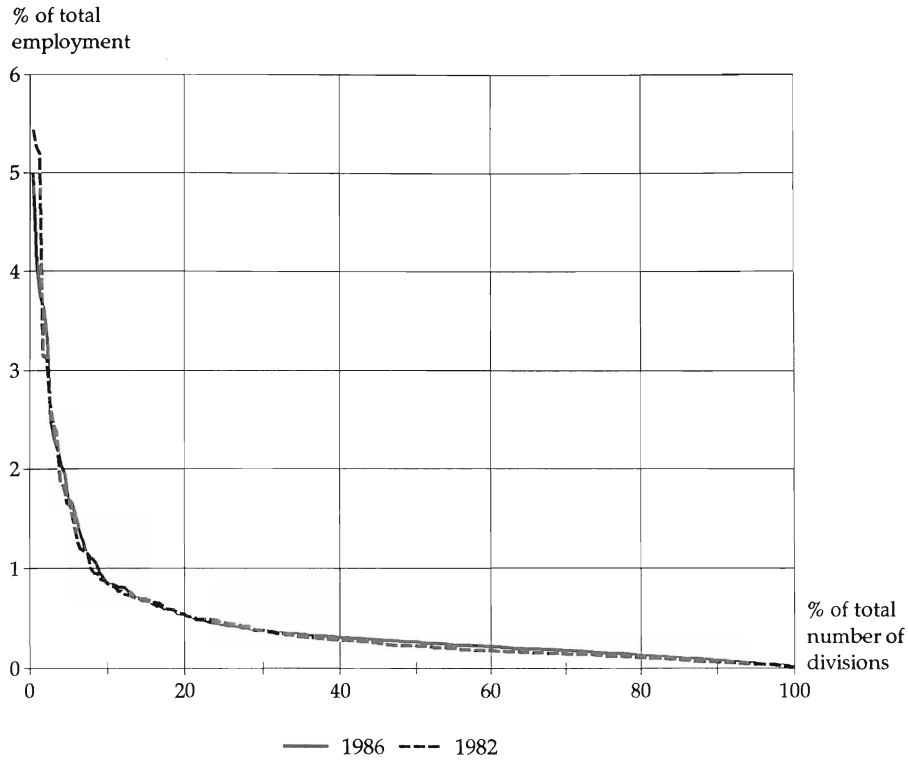
Figure 6F **The real rate of return of all manufacturing, domestic operations, the 10 and the 43 largest firms respectively, global operations, 1965-1987**



Note: The definitions of the real rate of return are identical for the three groups of firms. Please, observe that the domestic rates of return include the domestic parts of all international firms.

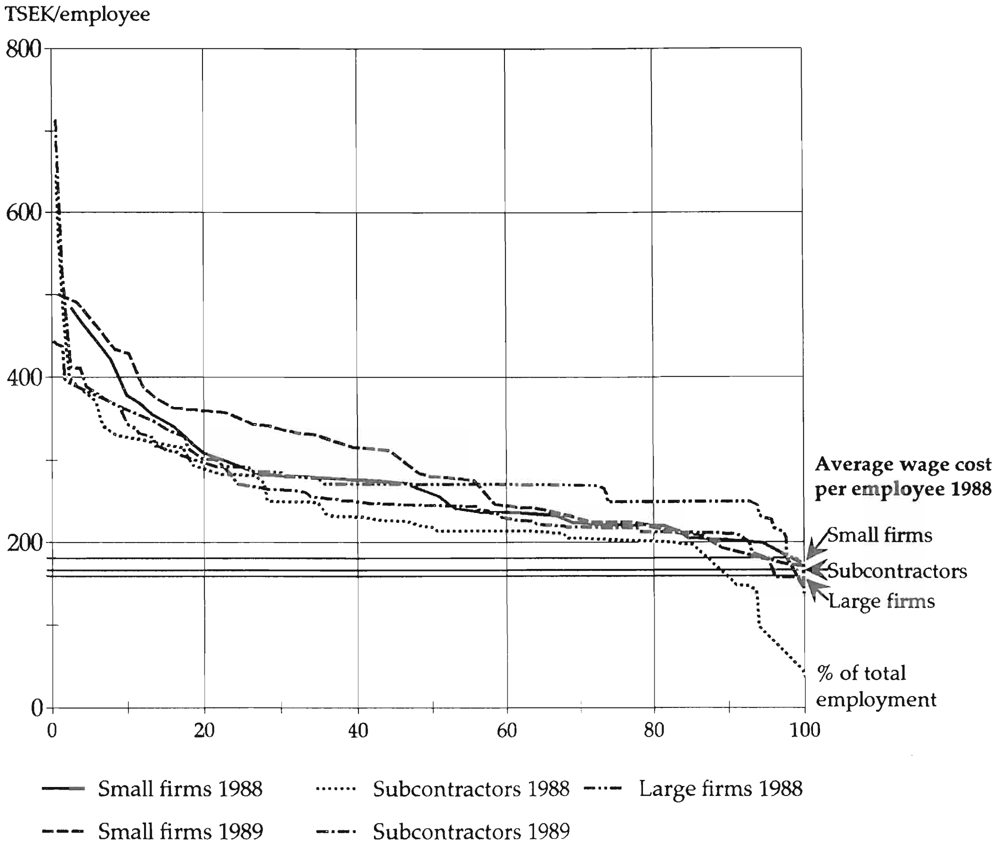
Sources: MOSES Database and Direct Foreign Investment Surveys.

Figure 7A **Size distributions of planning survey units, 1982 and 1986**



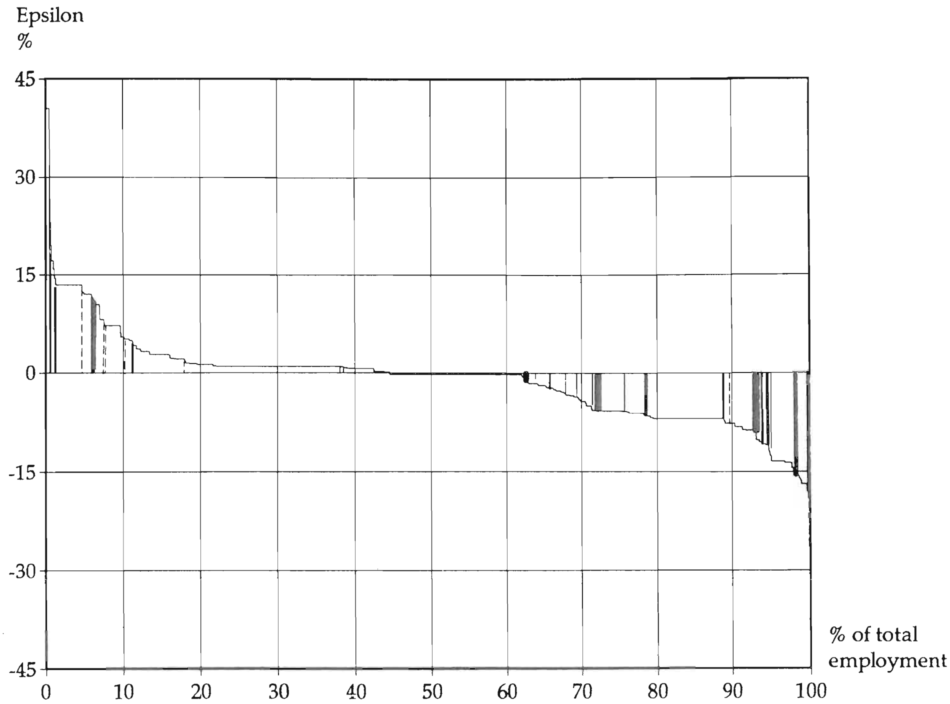
Sources: Planning surveys 1982 and 1986.

Figure 7B **Labor productivity distributions and average wage of small and large firms and of subcontractors, 1988, according to special IUI firm surveys**



Source: Braunerhjelm (1991).

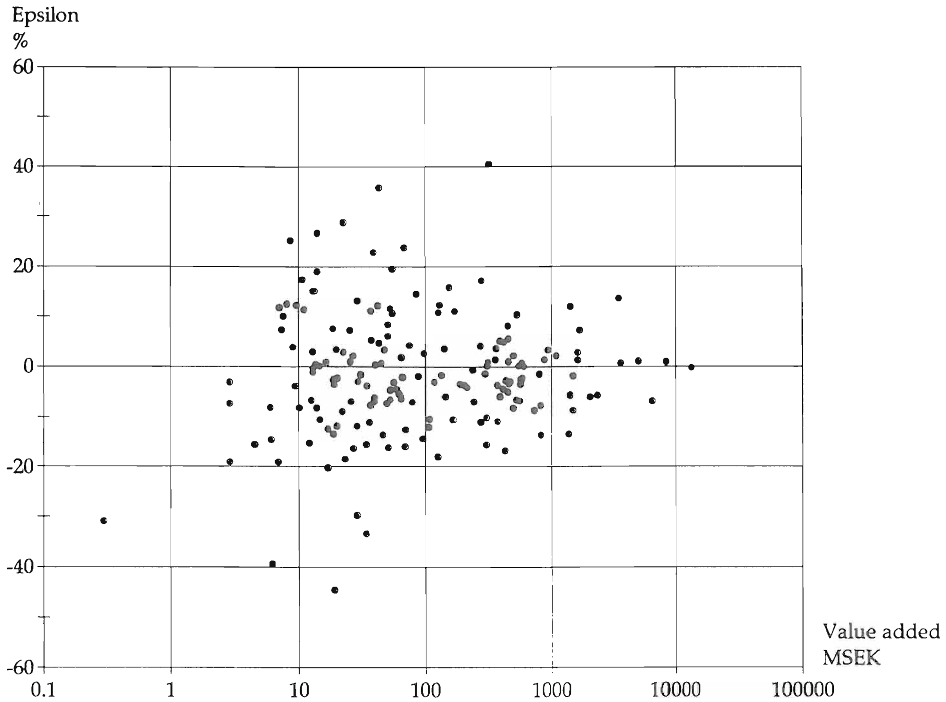
Figure 7C **Rate of return over the interest rate (epsilon) of small firms, large firms, and of subcontractors, 1988**



Subcontractors: Black areas
Small firms: Dotted lines
Large firms: Blank areas

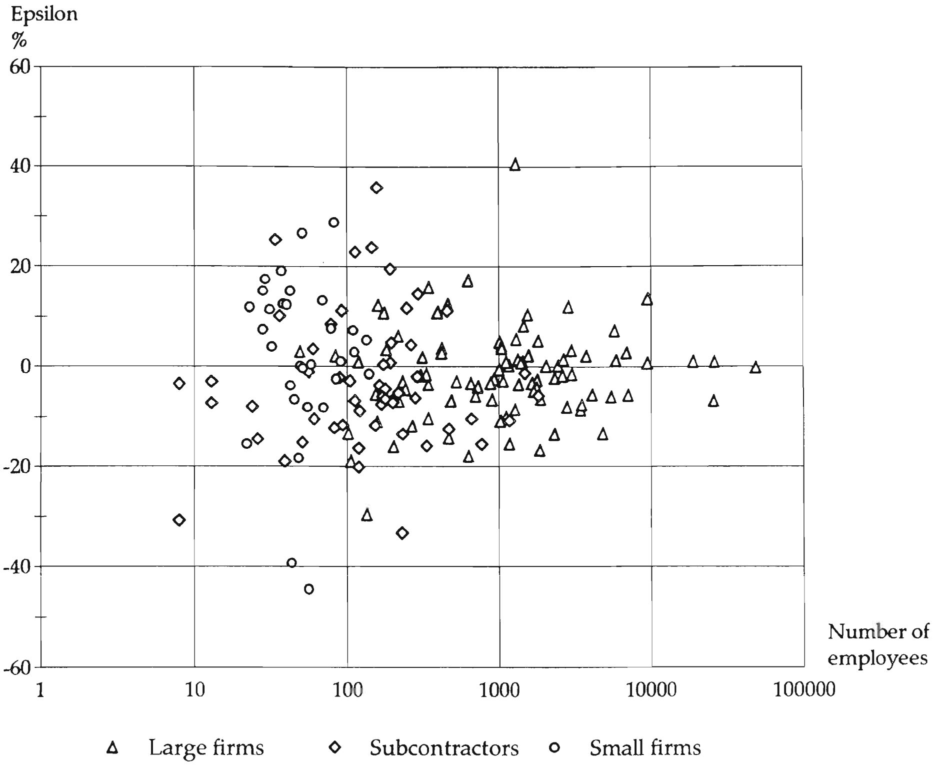
Source: Braunerhjelm (1991).

Figure 7D **Comparison of rates of return of firms of different sizes, measured in value added, 1988**



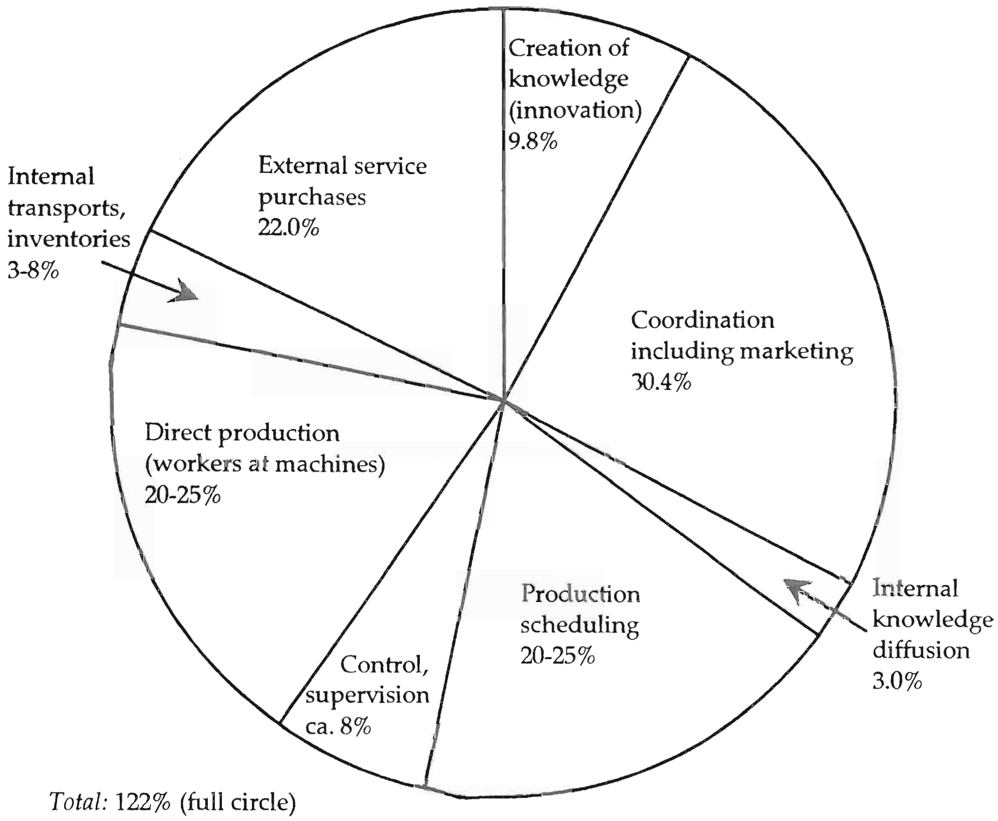
Source: IUI firm survey 1988 (see Chapter IV in this volume).

Figure 7E **Comparison of rates of return of firms of different sizes, measured by number of employees, 1988**



Source: IUI firm survey 1988 (see Chapter IV in this volume).

Figure 8 **Distribution of labor costs, percent, large Swedish firms, global operations**

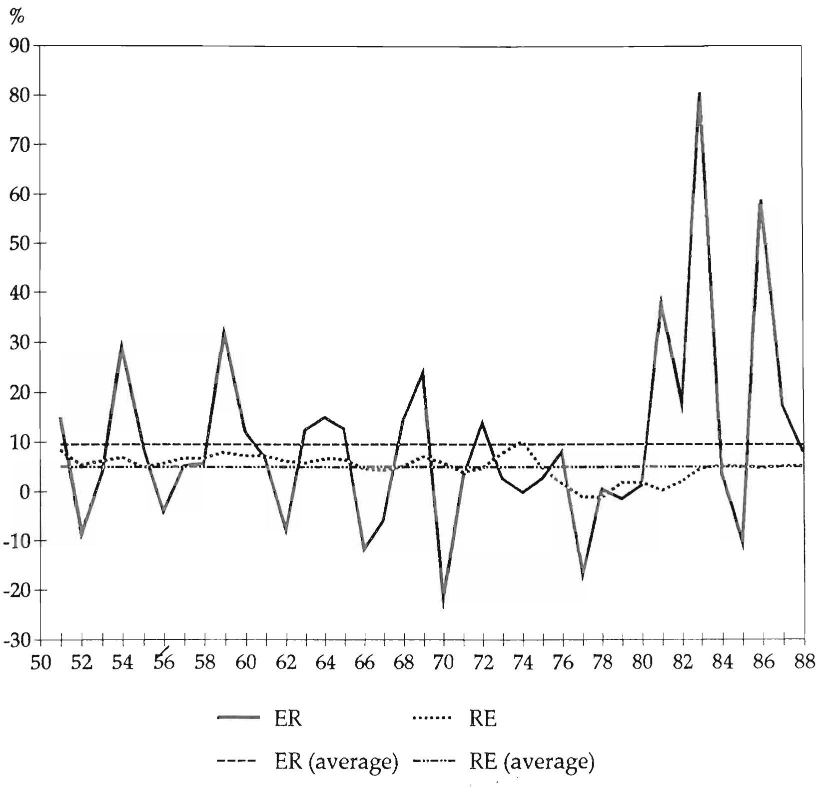


Total: 122% (full circle)

Source: Eliasson (1990a, p. 68).

Figure 9 **Effective and real rates of return in Swedish manufacturing, compared to financial costs, 1951-1988**

Figure 9A **Effective real rate of return (ER), compared to the real, before tax, rate of return on equity (RE)**



Note: Horizontal lines indicate corresponding averages. ER is the rate of change in the market value of stock minus the rate of change in the consumer price index plus the rate of dividend pay-out of the market value of stock. The real rate of return on equity is the nominal rate of return minus the rate of change in the capital goods price index. See Section 3.1.

Source: See Tables 6A and B.

Figure 9B **Real rate of return on total assets (R) and equity (RE), compared to the real interest rate (IR)**

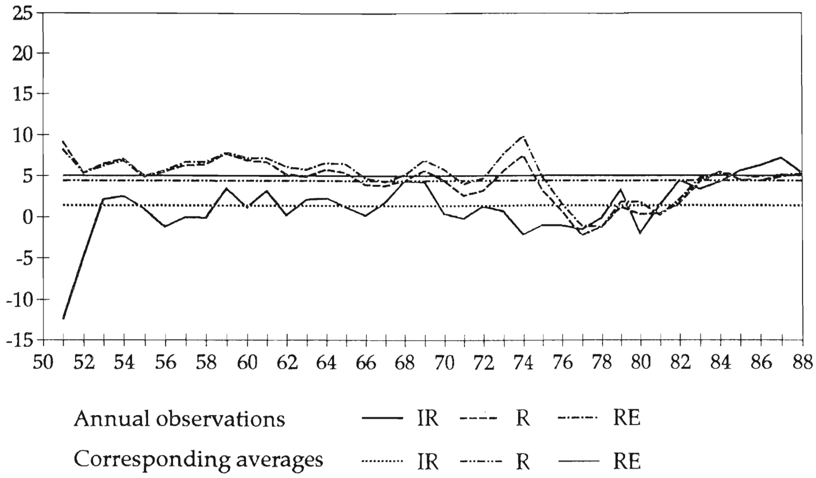
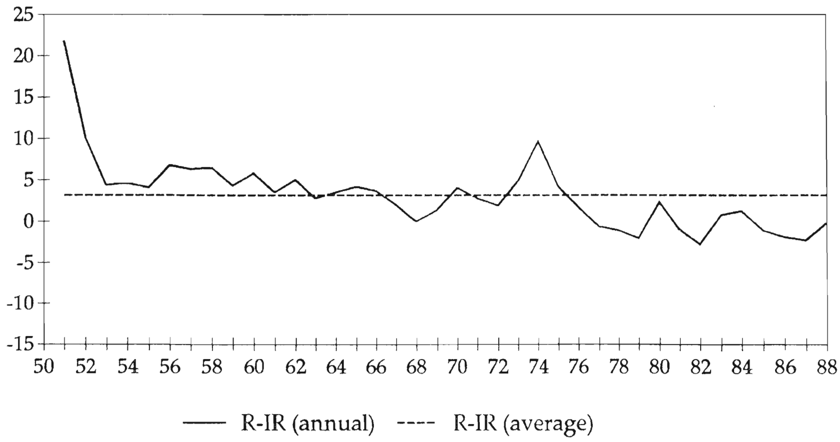


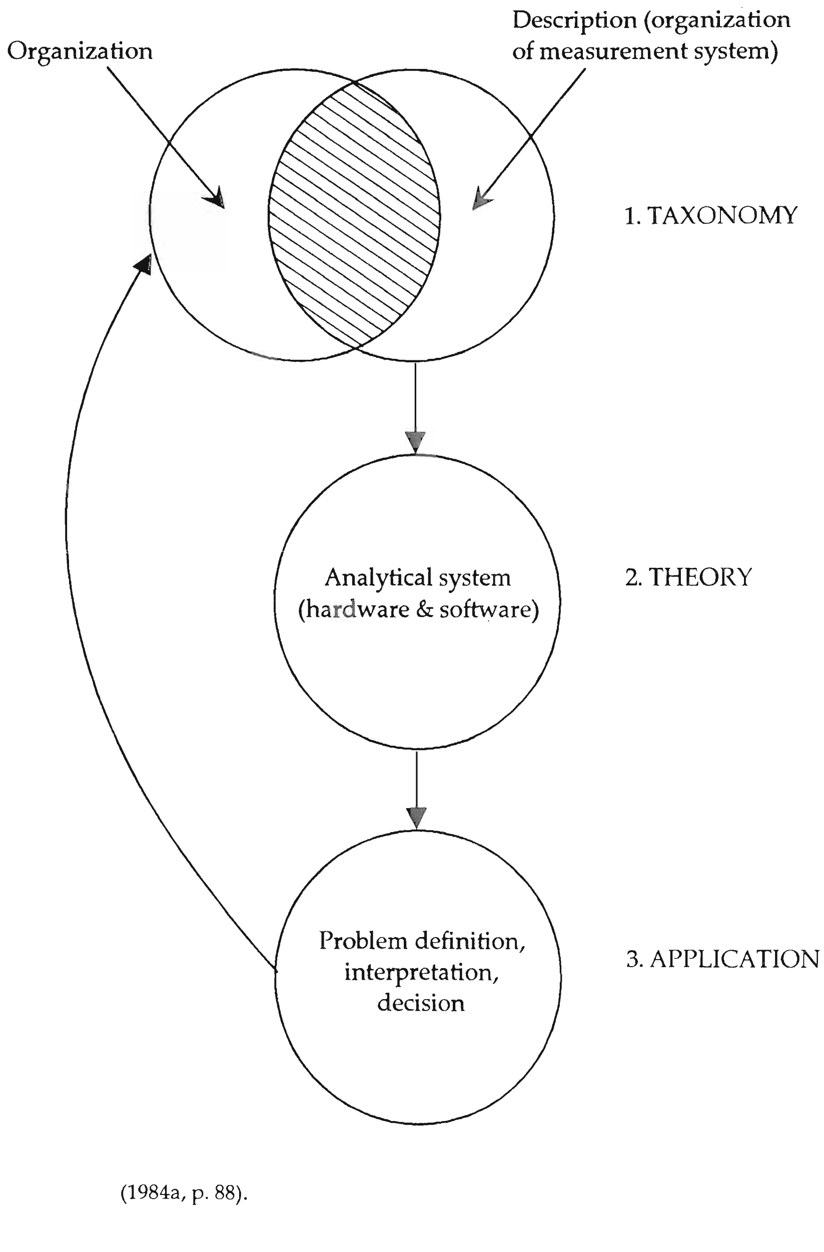
Figure 9C **Rate of return on total assets over the interest rate and equity (epsilon=R-IR)**



Note: Horizontal lines indicate corresponding averages. The real rate of return (R) is the nominal rate of return in Section 3.1 minus the rate of change in the capital goods price index. The real interest rate (IR) is the nominal interest in industrial loans minus the rate of change in the consumer price index.

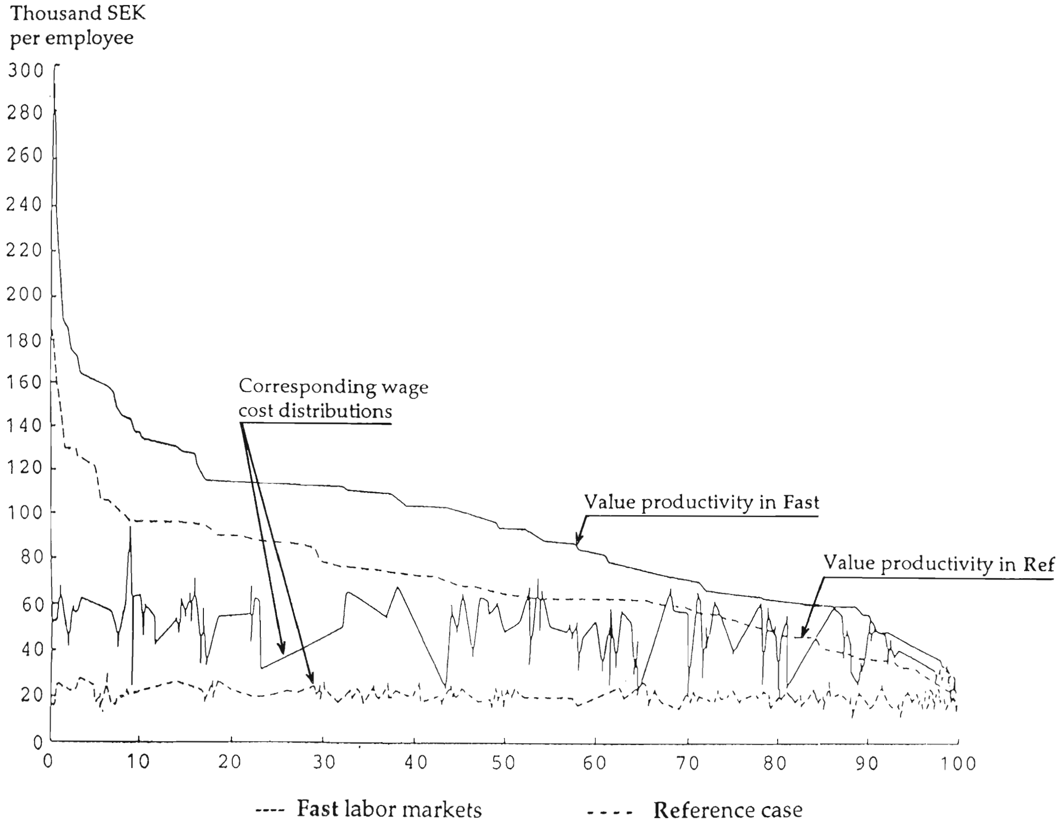
Source: See Tables 6A and B.

Figure 10 Integrated information and control system of a firm



(1984a, p. 88).

Figure 11 **Wage cost and value productivity distributions 1992 in reference case and in fast market experiment**



Source: Eliasson and Lindberg (1986).

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CHAPTER II

A Description of the Initial 1982 and the Synthetic 1990 Databases

Erol Taymaz

CONTENTS

Introduction

This chapter describes the initial 1982 and the synthetic 1990 databases (R1982.91 and R1990.10, respectively). The synthetic database has been prepared for external use. The MOSES model uses and generates a large number of micro and macro variables. It is almost impossible to describe and analyze all these variables. Therefore, only a small part of the variables is exhibited in this presentation. (For standard output tables and the variables saved in those tables, see the manual for the PC version, *MOSES on PC.*[1])

The R1990.10 database was prepared by using the model version 2.0 with the MSTART900 modification function and the dataset R1982.91.[2] The calibration process is explained in detail in *MOSES on PC.* The model is simulated 8 years and the output workspace is saved by using the function SAVE OUTPUT. Although the micro data of about 130 firms in this dataset is a simulated extension of the real firms' data, it is not possible to get specific information about real firms from this dataset which is based completely on simulation results.

Comparing actual and simulated macro data

Figures 1a-e compare real and simulated macro variables used in the calibration process for 1983-1988. (Solid lines are simulated data, broken lines real data.) As shown in these figures, the model mimics pretty well the *trends* in the real data. The performance of variables on the manufacturing sectors (Figures 1a-c) which are defined explicitly on the basis of micro data in the model is particularly good. In the case of annual growth rates of GNP, simulated results are higher than real changes. However, as shown in Figure 5f, the explicitly defined sectors comprise only a (small) part of total GNP. Thus, the discrepancy between the simulated and real variables is mainly due to the specification of the implicitly defined sectors (services, agriculture,

1. Taymaz, E. (1991), *MOSES on PC: Manual, Initialization, Calibration.* IUI Research Report No. 39, Stockholm.

2. The MSTART900 function uses calibrated parameters. The simulation results after 1990 are exactly the same for R1982.91 (used with the MSTART900 function) and R1990.10 (no modification function) datasets when the version 2.0 is used.

etc.).

Comparing actual and simulated micro data

Figures 2a-d compare actual and simulated micro data. There are more than 70 firms/divisions used in the MOSES model whose actual data are available for 1988. Sales, employment, labor productivity, and the share of exports in total sales of these firms in 1988 are plotted against the simulated results in Figures 2a-d. The sales and labor productivity figures are based on current prices. The solid line in these figures is the 45° line, i.e., those firms whose simulated and actual figures are same are shown *on* this line. Apparently, there are strong correlations between simulated and actual figures even for the micro data.[3] Recall that calibration so far has not been made against micro data.

To test more rigorously the relation between the simulated and actual variables, we can use the distribution of the log of simulated/actual values. If, for example, the model did generate the same employment levels for real firms in 1988, then

$$LEMP_i = ln(EMP_i^{sim} / EMP_i^{act}),$$

would be equal to zero for all firms where EMP_i^{sim} and EMP_i^{act} are the simulated and actual employment level of the i^{th} real firm in 1988. It is, of course, impossible for the model to simulate exact values on micro variables. However, if the model mimics the micro variables *on average*, then we expect that the $LEMP_i$ is distributed as $d(\mu,\sigma)$ where d is any (likely a normal) distribution with mean $\mu=0$.

The histograms of the distributions of (log) sales (LSALE), exports ratios (LXRAT), labor productivity (LPROD), and employment (LEMP) variables for those firms with actual data available for 1988 are shown in Figures 2e-f. The dotted lines on these figures represent the normal distributions that have the same mean and standard deviation.

3. We expect that the simulated value of a micro variable will be distributed around the actual value of that variable if the model generates good results. In other words, the *expected values* of micro variables should be equal to their actual values. Note that there is also another reason for the differences between simulated and actual values. The Planning Survey data cover divisions of firms. Data on these divisions can show differences from one survey to another due to changes in the boundaries of a division. We assume that the effects of these changes are also randomly distributed.

Table 1 Kolmogorov-Smirnov tests for normality

	Variables			
	LPROD	LEMP	LSALE	LXRAT
Mean	-.112	-.065	-.176	.095
Standard deviation	.370	.538	.502	.499
Mean/standard deviation	-.303	-.121	-.350	.190
K-S statistic	.595	.942	.798	1.880*
2-tailed probability	.870	.338	.548	.002

Note: * means statistically significant at the 1% level. There are 74 observations.

The results of K-S tests (see Table 1) show that we cannot reject the hypothesis that the LPROD, LSALE and LEMP variables are normally distributed. Moreover, their mean values are not statistically different from zero. Although the LXRAT variable is /not normally distributed (a large number of observations are concentrated around the mean value), its mean value is also not statistically different from zero. In other words, the simulated micro data are, on average, equal to the actual data.

Presenting the micro-structures: Salter curves

The main advantage of microsimulation models lies in the fact that they capture the effects of distributional characteristics by allowing micro-heterogeneity. The so-called Salter curve is a nice graphical representation of the distributional characteristics on which a specific firm's relative position can also be shown.

Figures 3a-e exhibit the Salter curves for actual and potential labor productivities, epsila (rates of return over the interest rate), capital/output ratios and wage rates superimposed on the actual labor productivity in 1983. The epsilon variable is equal to the difference between the rate of return and the interest rate.

The solid lines in these figures represent those firms nullified during the simulation period, 1983-1990. As may be expected, the nullified firms have generally lower initial actual and potential labor productivities in 1983. Moreover, all but two of them have negative initial epsilon values. Figure 3e reveals that more productive firms are more likely to pay higher wages. The correlation between these two variables are statistically significant at the 1% level.

Figures 4a-e present the same Salter curves for 1990. The solid lines on these figures represent those firms that entered into the model during the period of 1982-1990. A comparison of Figures 3 and 4 reveals that not much structural change has occurred in this period. The most notable difference is a slight improvement in the rates of return in 1990. Moreover, it seems that new firms generally perform better than incumbent firms. Note, however, that this better performance in terms of rates of return does not generally mean a relatively better productivity performance. The rate of return is affected by financial ratios, stock behavior, etc.

Firms in the MOSES model have over a hundred attributes (employment level, desired level of input and output inventories, expectations, capital structure, etc.). All of these attributes can be presented in various ways, e.g., Salter curves, Lorenz curves, etc. Thus it is possible to analyze any type of structural change in an economy.

Evolution of the economy: Aggregate time series data

During an experiment, the model stores a large number of aggregated time-series data for all sectors including the financial accounts of each sector, banking and government. Variables are saved in standard output tables for each category so that the data in those tables can be easily accessed by the graphics functions in the MOSES.GRAPH workspace (for details, see *MOSES on PC*).[4]

Figures 5a-h show some time series data. The rates of return in four explicit sectors (RAW: raw materials, INTER: intermediate goods, CAPG: capital goods and consumer durables, and CONG: consumer nondurables) are shown in Figure 5a. (These variables are stored in the output table, YEARLY PRICES.) Figure 5b shows firms' expenditures by categories (INTPY: interest payments, TAXES: corporate taxes, DIVID: dividends, INVST: investment spending, and CURRT: change in current assets). Note

4. All figures except 2e and 2f in this chapter were created by the MOSES.GRAPH functions, usually from the standard output tables.

that this figure shows aggregate values for the manufacturing industry. The same variables are also stored for each explicit sector separately. The composition of firms' assets is shown in Figure 5c (FIXED: physical capital, CURRT: current assets, INPIN: input goods inventories, and OUTIN: output goods inventories). The model also simulates complete financial life histories of individual firms on the same format that can be obtained if requested.

Figures 5d and 5e compares the distribution of *state revenue and expenditures* in 1983 and 1990. (In Figure 5d, WAGE: wage payments to government employees, PURCH: purchase of goods, SUBS: subsidies, TRANS: transfer payments, INVST: government investment, and INTPY: interest payments. In Figure 5e, ITAX: income tax, WTAX: wage tax, VATAX: value-added tax, CTAX: corporate tax, and DEFIT: government deficit.) Recall that a significant portion of government expenditures (number of employees, level of government purchasing, etc.) are exogenously determined in the model.

Figure 5f shows the *components of GNP* over the simulation period. Note that only four sectors of the economy (raw materials, intermediate goods, capital goods, and consumer goods) are specified on the basis of micro-data. Finally, Figures 5g and 5h present two scatter-charts for those firms who remained in the model during the entire period of 1983-1990. Figure 5g shows that there is a close correlation between the rates of return in different years. Those firms who were highly profitable in 1983 tend to be more profitable in 1990, as well. However, as shown in Figure 5h, the correlation between rates of return and the growth rate, although statistically significant at the 5% level, is weaker.

Evolution of individual firms: Micro time series data

The MOSES model enables us to follow the changes in specific firms in the model. By using the transcription functions of the model, firm-specific time series data can be saved during a simulation. (The Y R FIRM and Y R FIRM FINANCE functions prepare YEARLY FIRM *xx* and YEARLY FIRM FINANCE *xx* tables where *xx* is the firm code.) The format of standard firm-specific data tables are almost the same as the sector tables, YEARLY MARKET *yy* and YEARLY FINANCE *yy*, where *yy* is the sector number.

Figures 6a-g present data on two randomly selected real firms in the raw materials industry. Figures 6a and 6b depict the simulated and actual employment levels of both firms. Incidentally, the model simulates the employment levels of these firms pretty well. (Of course, this may not be the case for some other firms.)

Figure 6c shows the rate of returns in the raw materials industry in 1983. The solid bar on this figure represents Firm A (MOSES firm code: 1.11), and the shadowed bar Firm B (MOSES firm code: 1.15). Recall that the thickness of these bars is equal to firm's share in total capital stock. Labor productivity in the raw materials industry in 1983 is presented in Figure 6d. As shown in Figures 6c and 6d, both firms had over average rates of return and labor productivities at the initial year. Firm A's performance was particularly good.

Figure 6e shows annual output growth rates of both firms and the raw materials industry average. Firm B had relatively lower and declining growth rates during the simulation period. Firm A had growth rates higher than the industry average in all but one year. As may be expected, Firm A's relative rate of return performance was improved in the final year (see Figure 6f). Although Firm B had increased its rate of return as almost all other existing firms, its relative position detoriated. Finally, Figure 6g shows the level of labor productivity in 1990. Firm A's relative position was improved slightly whereas Firm B's relative position declined somewhat.

Summary

A (very) small part of the data produced by the MOSES model is presented in this chapter. The model generates almost all (aggregate) national accounts as well as a large number of data on each firm in manufacturing industry. It seems that the model tracks pretty well the historical data for the period of 1983–1989 which is used for the calibration of the model. The synthetic database, R1990.10 was prepared for external use by using the calibrated parameter set. (See section 3.4 in *MOSES on PC*.)

Figure 1a **Growth rate of manufacturing employment**

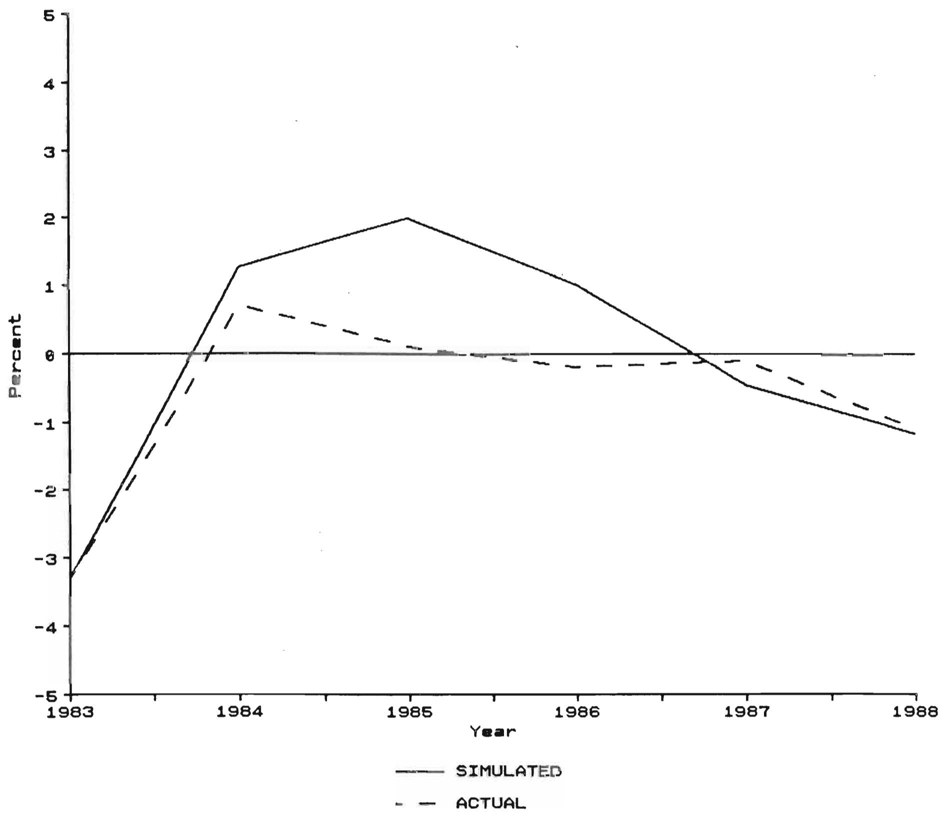


Figure 1b Growth rate of manufacturing output

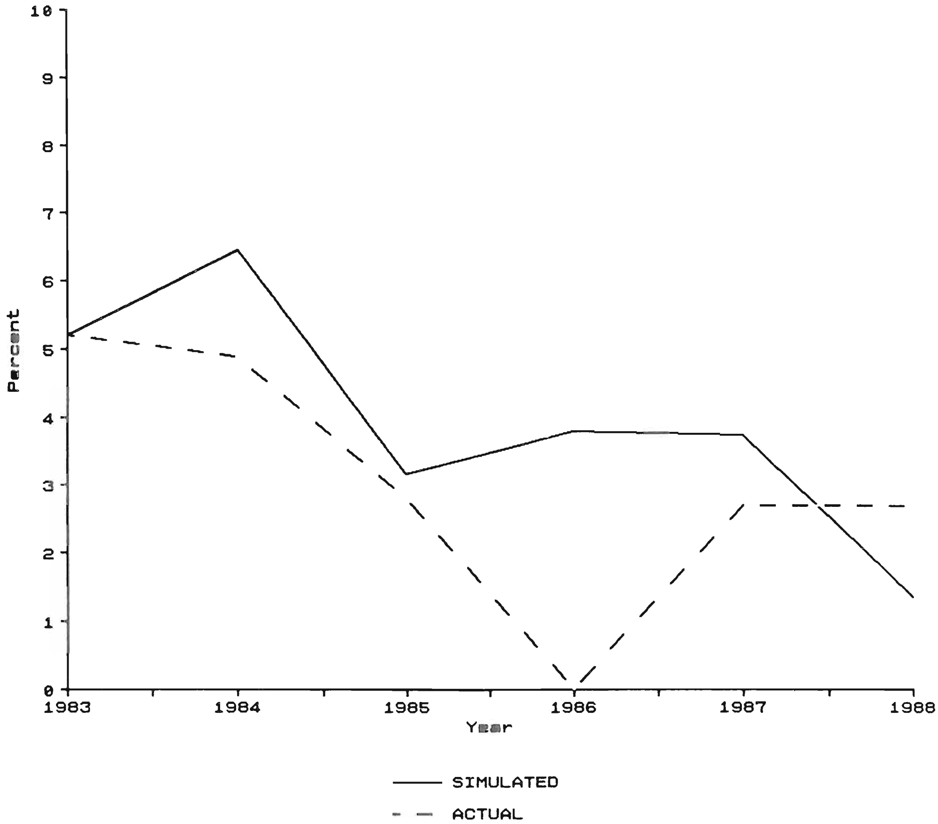


Figure 1c Growth rate of manufacturing prices

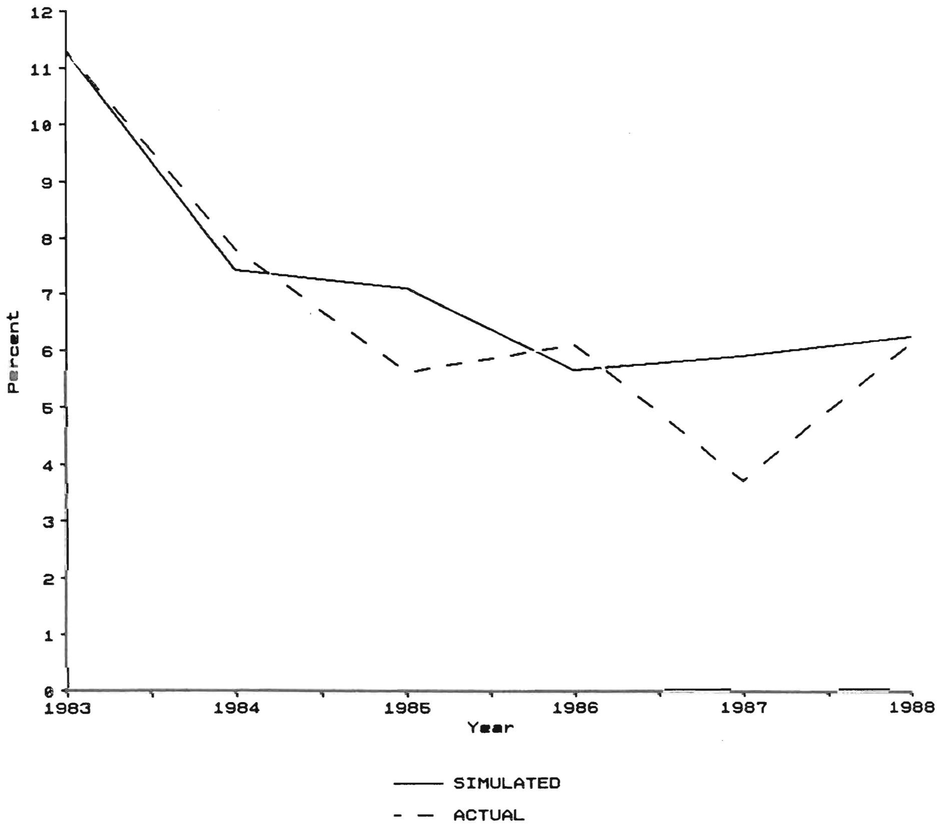


Figure 1d **Growth rate of GNP**

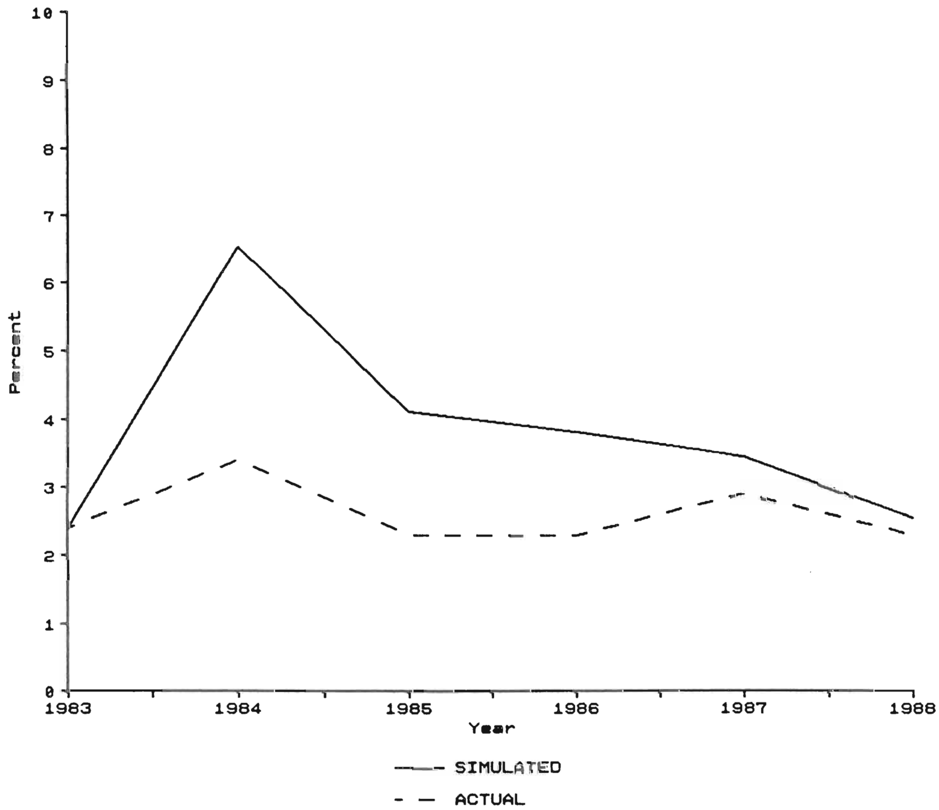


Figure 1e **Interest rates**

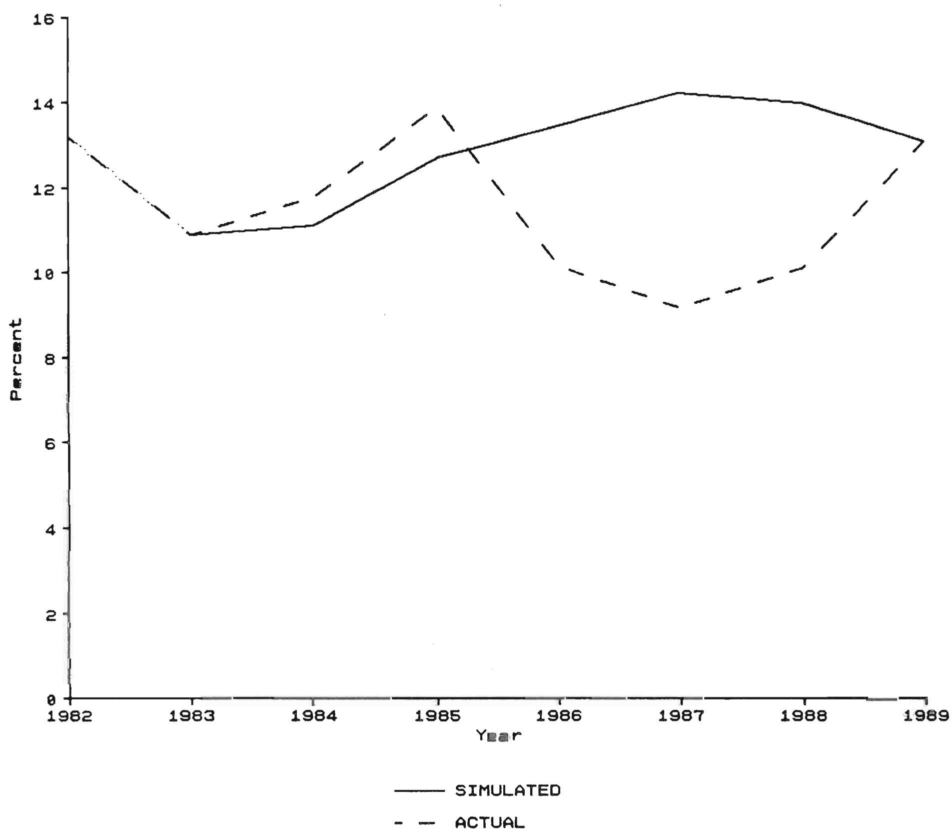


Figure 2a **Micro data comparisons**
Sales

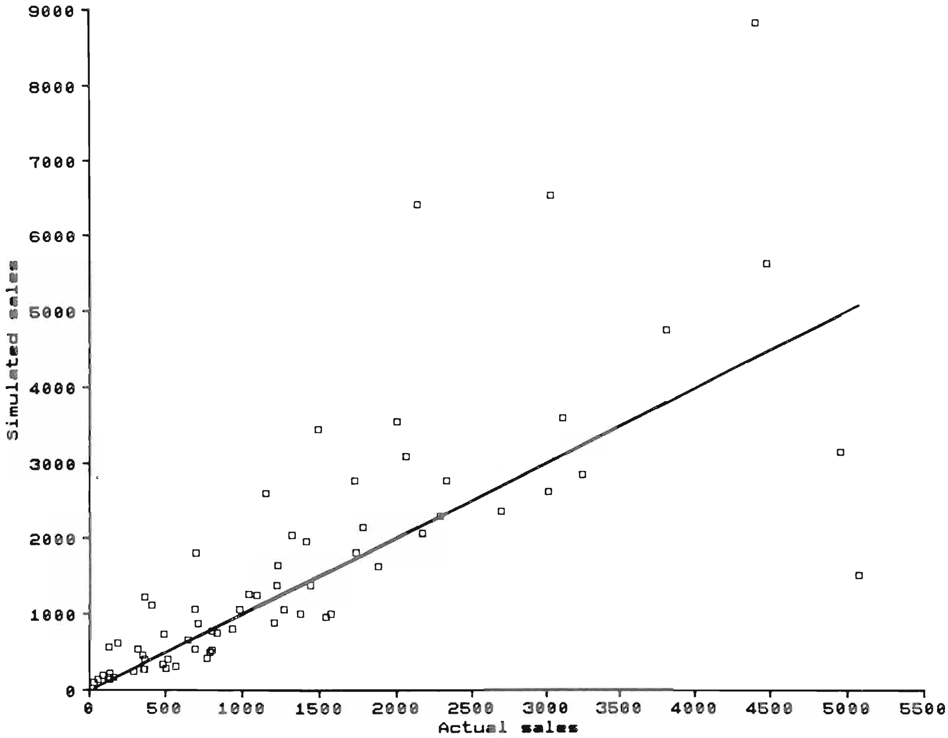


Figure 2b **Micro data comparisons**
Employent

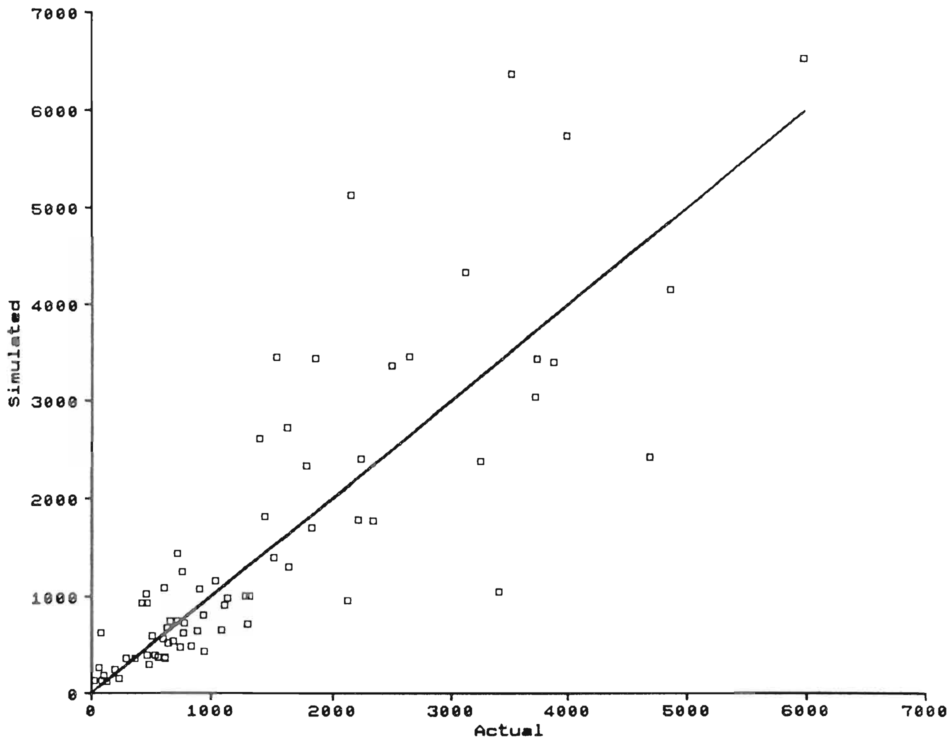


Figure 2c **Micro data comparisons**
Labor productivity

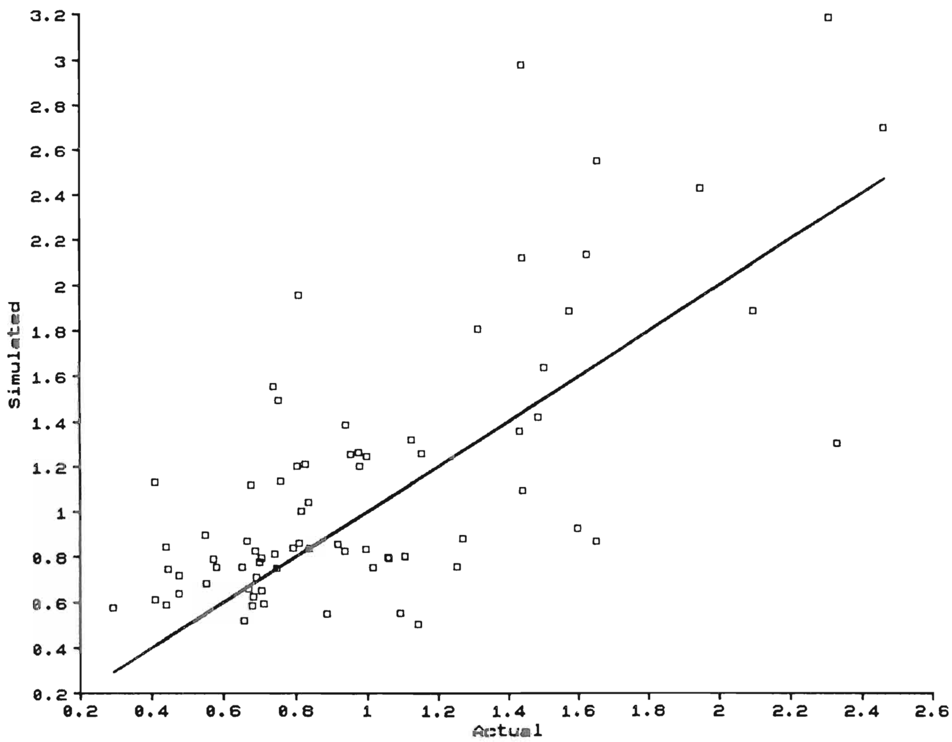


Figure 2d **Micro data comparisons**
Export shares

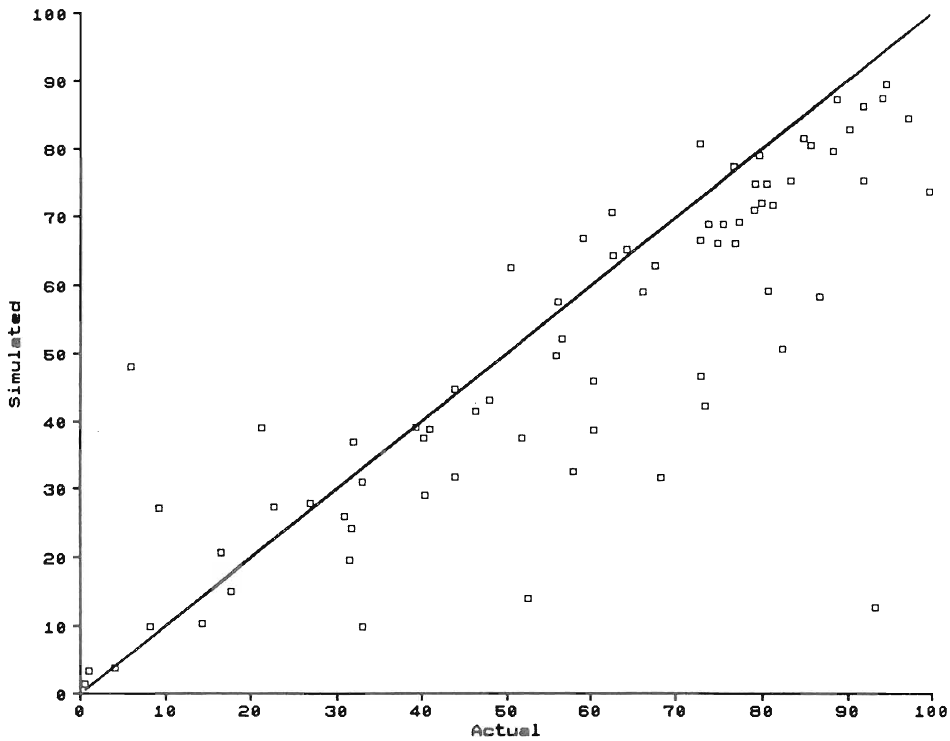
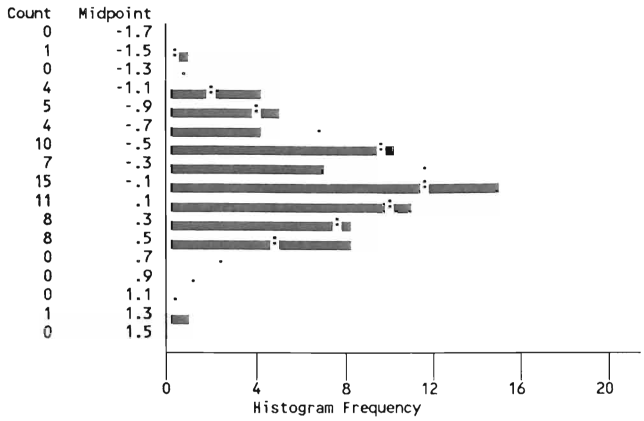


Figure 2e Frequency distributions of LSALE and LEMP

LSALE



LEMP

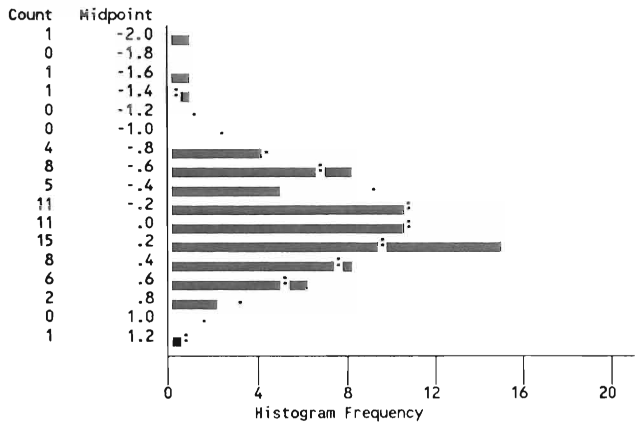
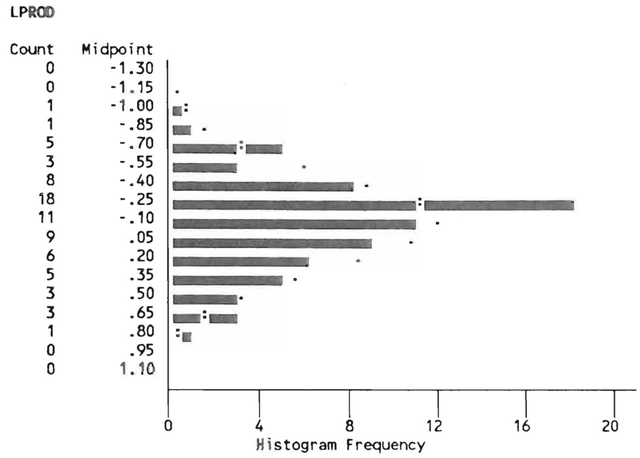


Figure 2f **Frequency distributions of LPROD and LXRAT**



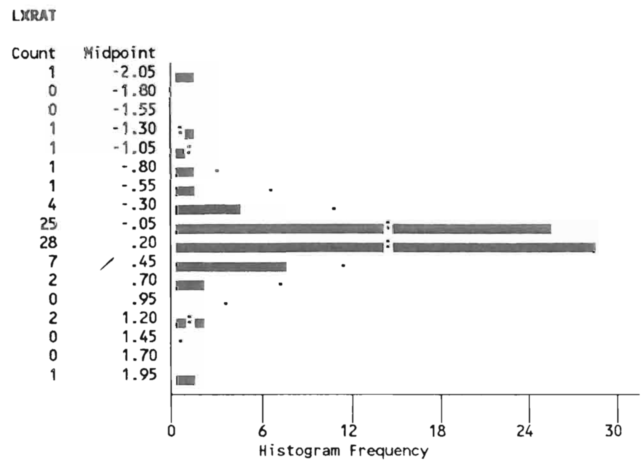


Figure 3a Actual labor productivity, 1983

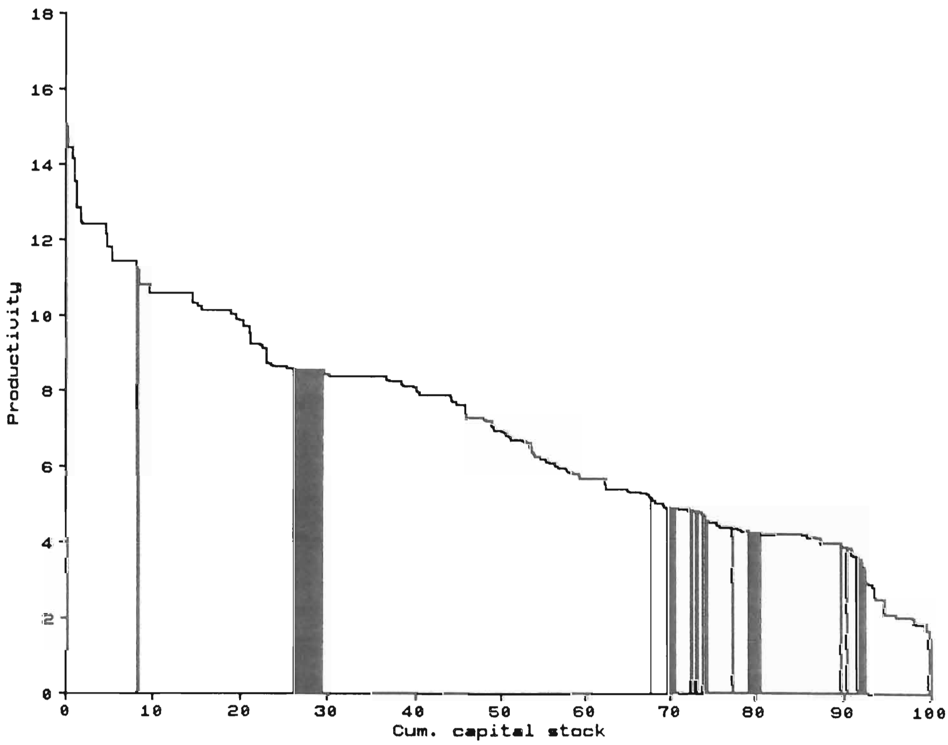


Figure 3b Potential labor productivity, 1983

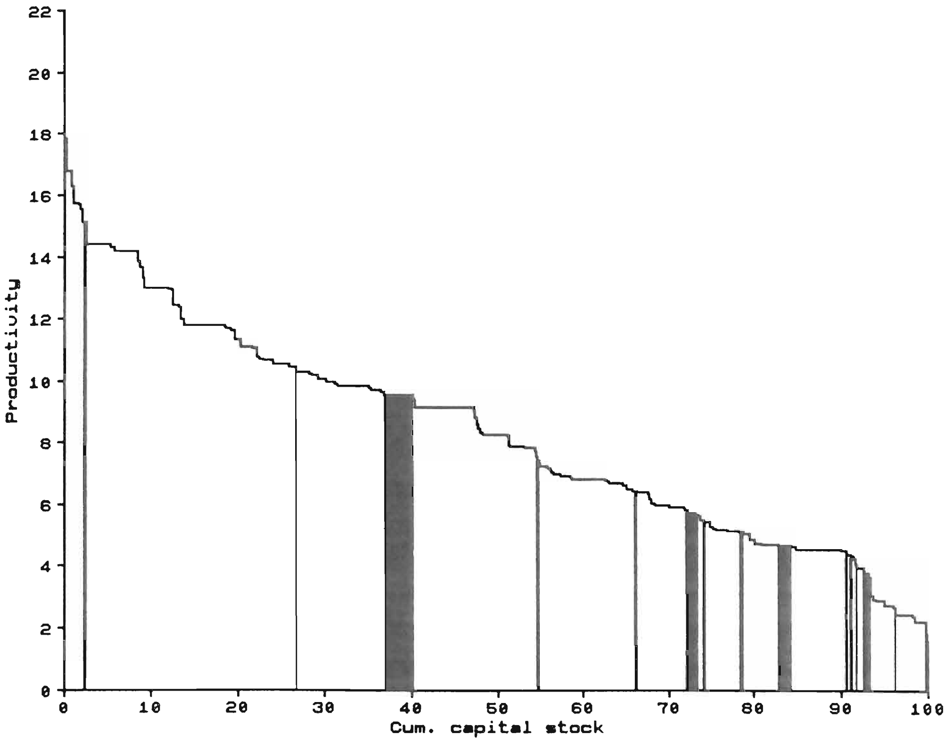


Figure 3c Epsila, 1983

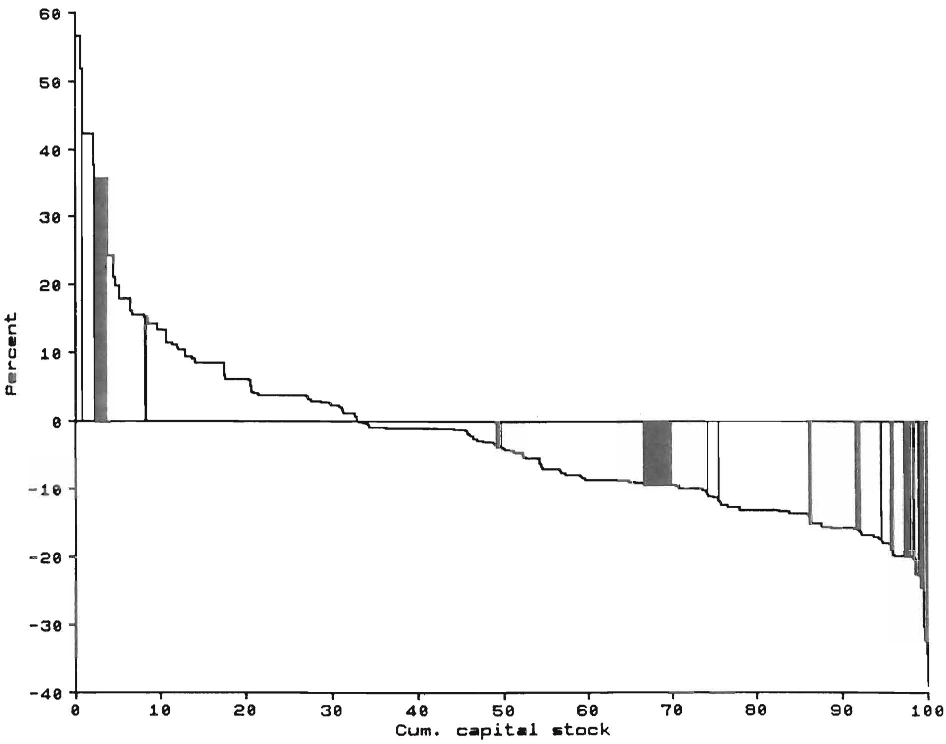


Figure 3d Capital output ratio

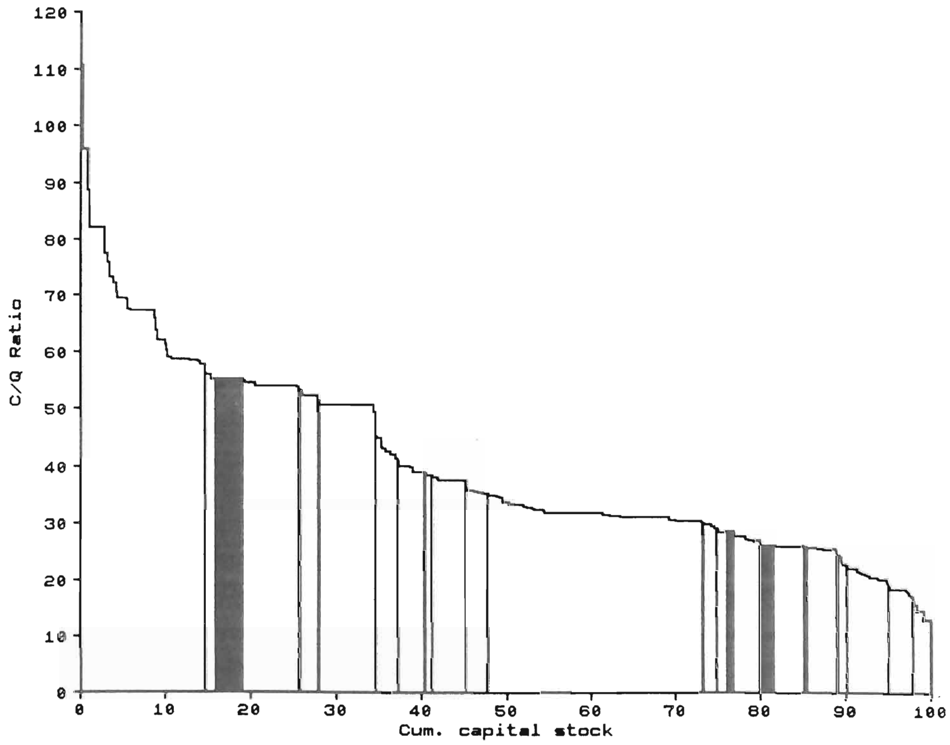
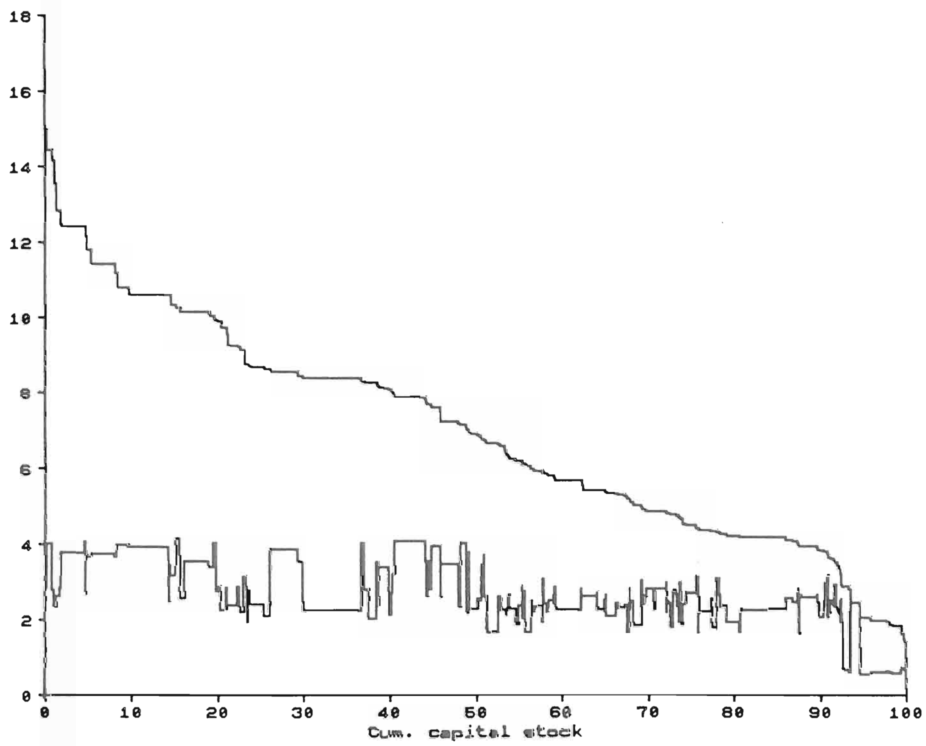


Figure 3e Actual labor productivity and wages, 1983

Hundred thousand SEK
current price/employee



Actual lab prod = 59,140 + 04.38 wages
(1.018) (9.81)

R^2 = 30.9
n = 217

Figure 4a Actual labor productivity, 1990

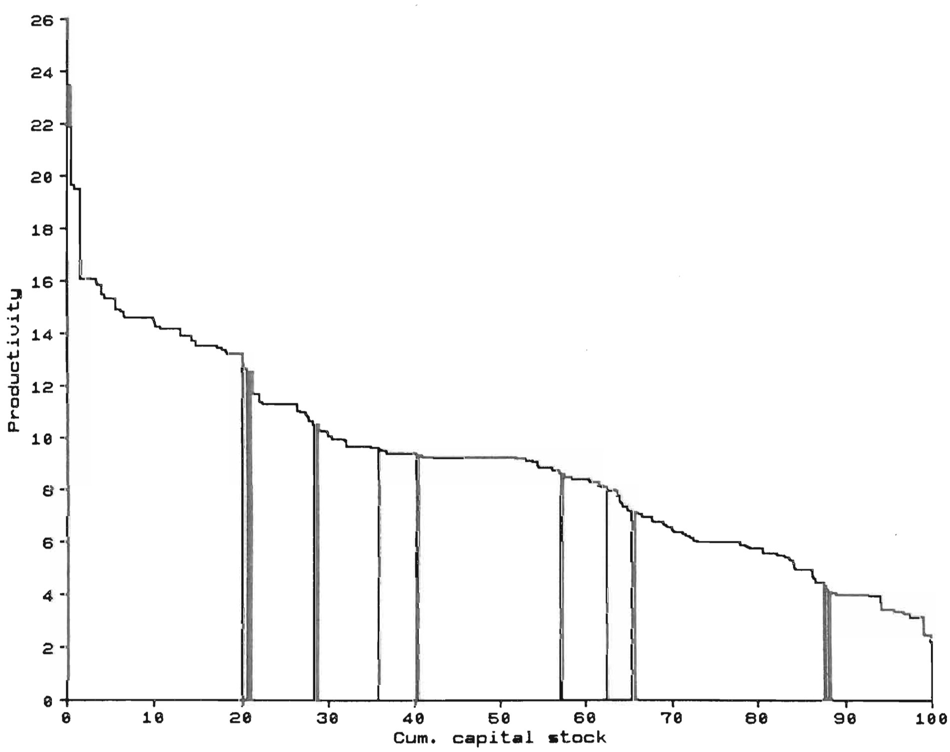


Figure 4b Potential labor productivity, 1990

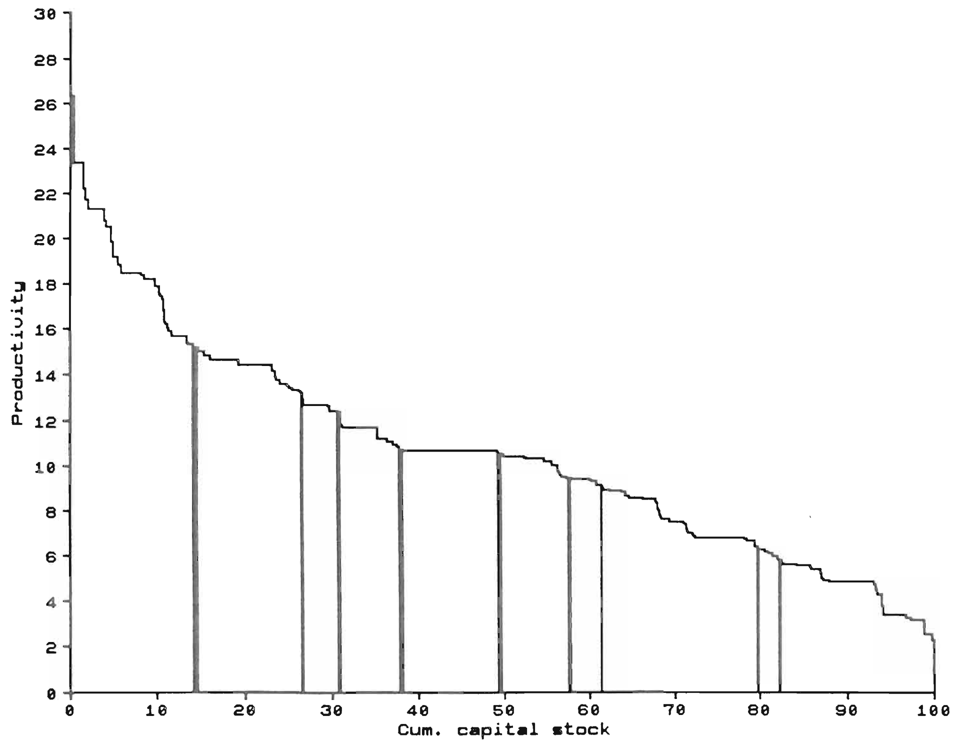


Figure 4c Epsila, 1990

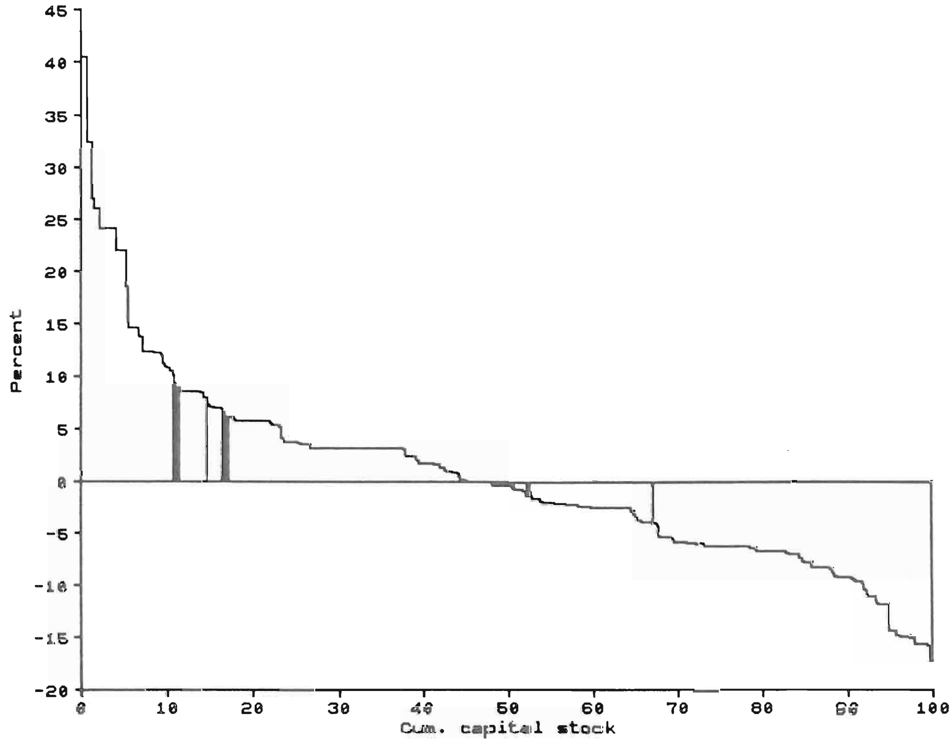


Figure 4d Capital output ratio, 1990

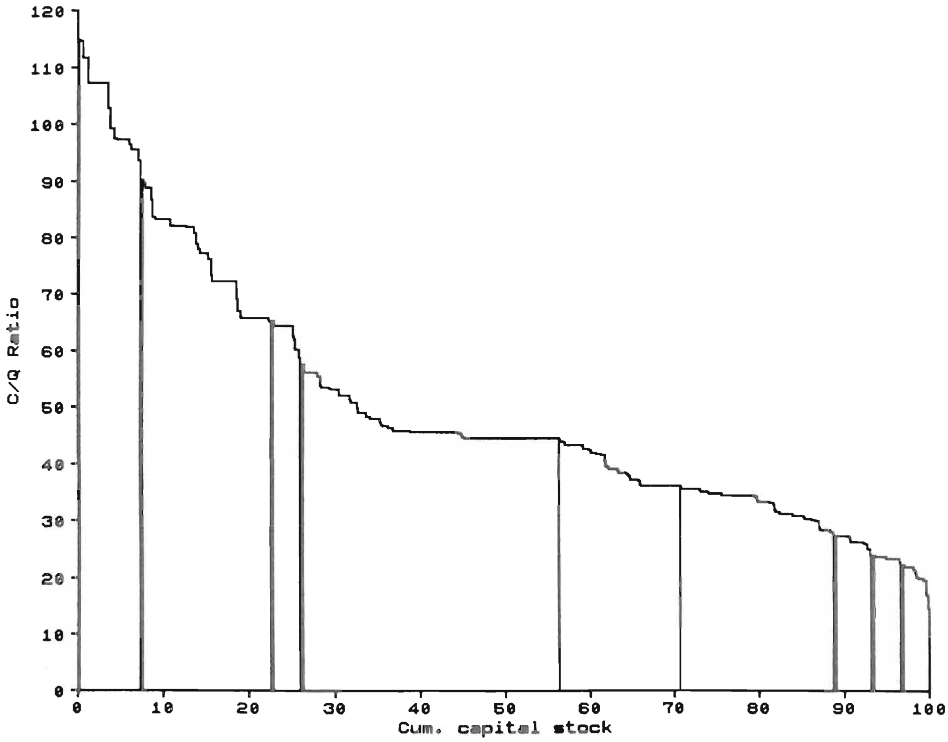
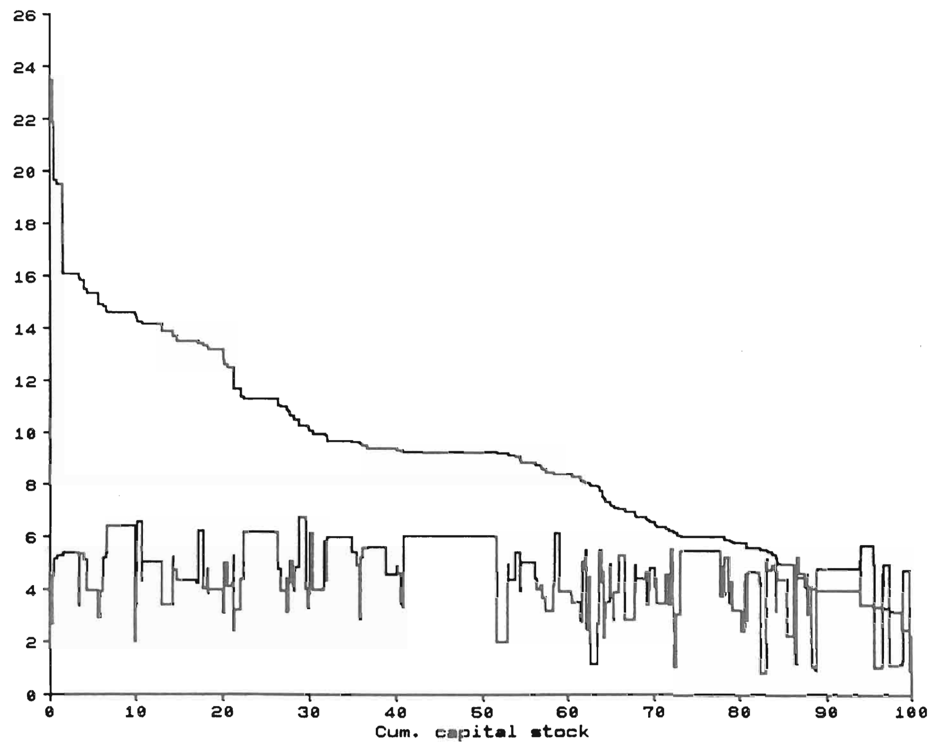


Figure 4e Actual labor productivity (1000 units of output; or output in 1982 prices) and wages (50000 SEK/employee), 1990



Actual labor productivity = 5,107.16 + .0166 wages
(5.00) (3.45)

R^2 = 5.6

n = 201

Figure 5a **Rates of return**

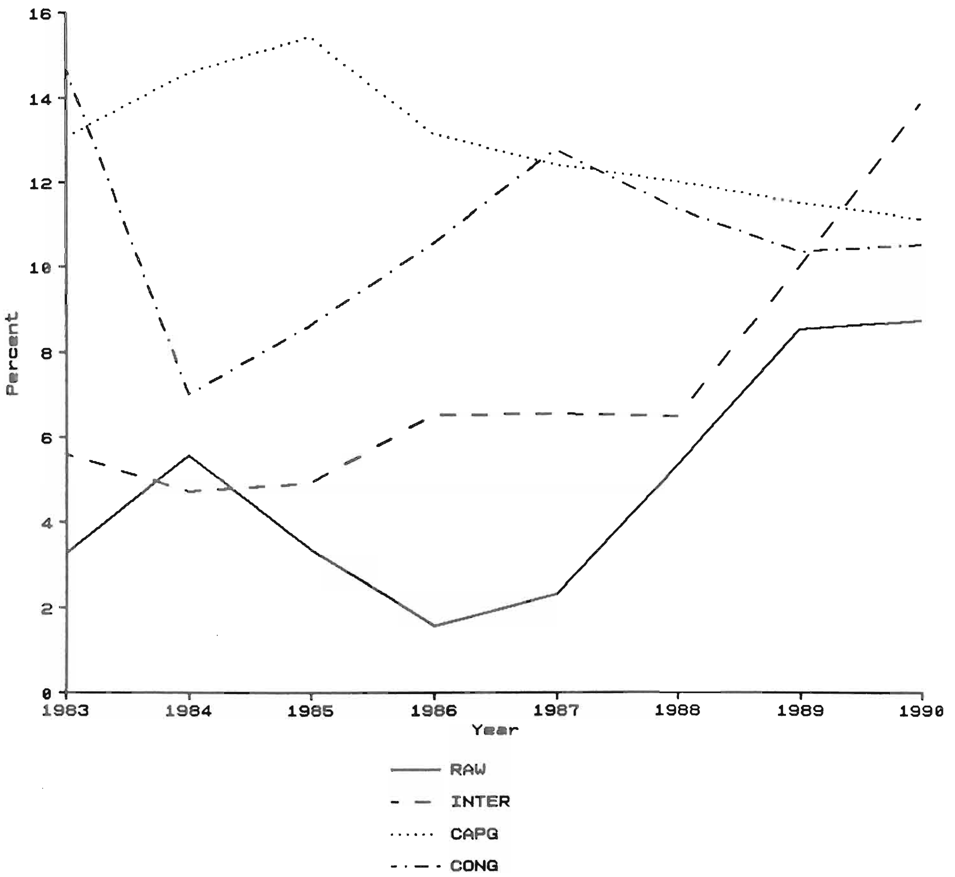


Figure 5b **Firms' expenses**
(10^9 SEK, current prices)

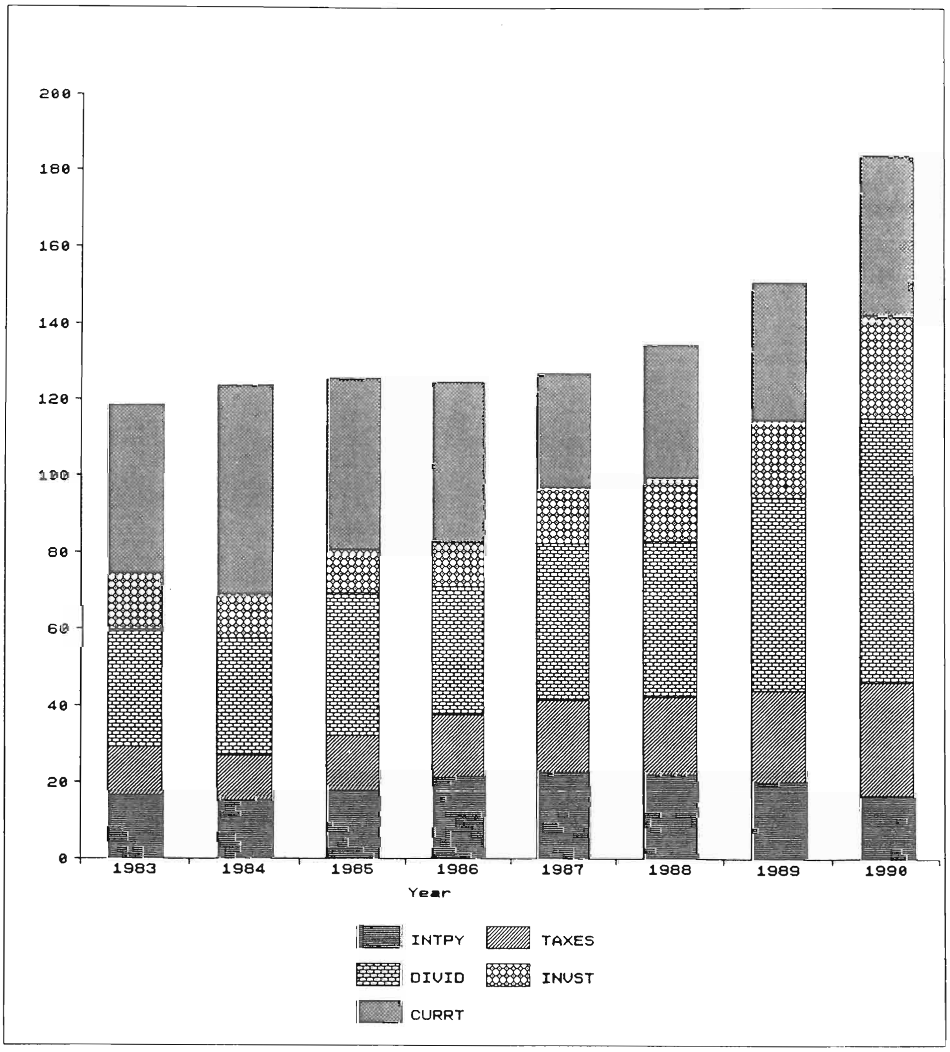


Figure 5c **Firms' assets**
(10^9 SEK, current prices)

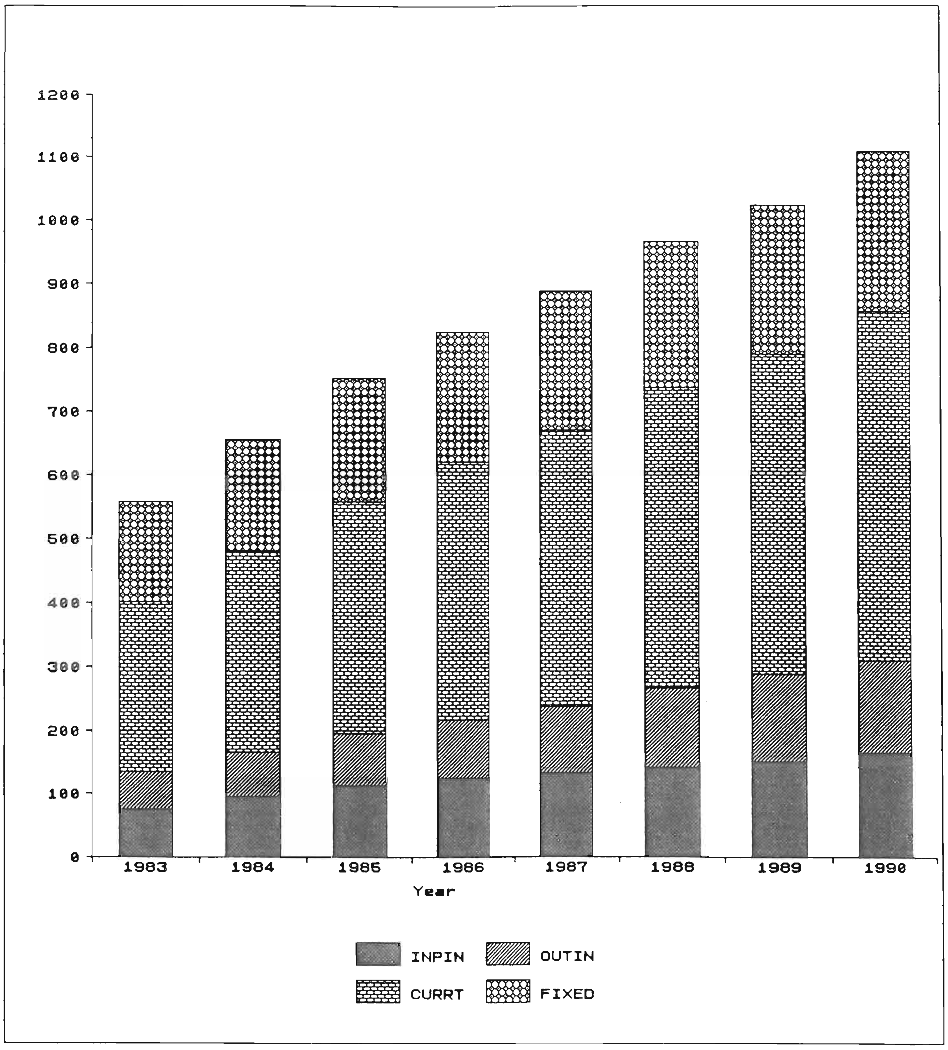


Figure 5d State expenditures

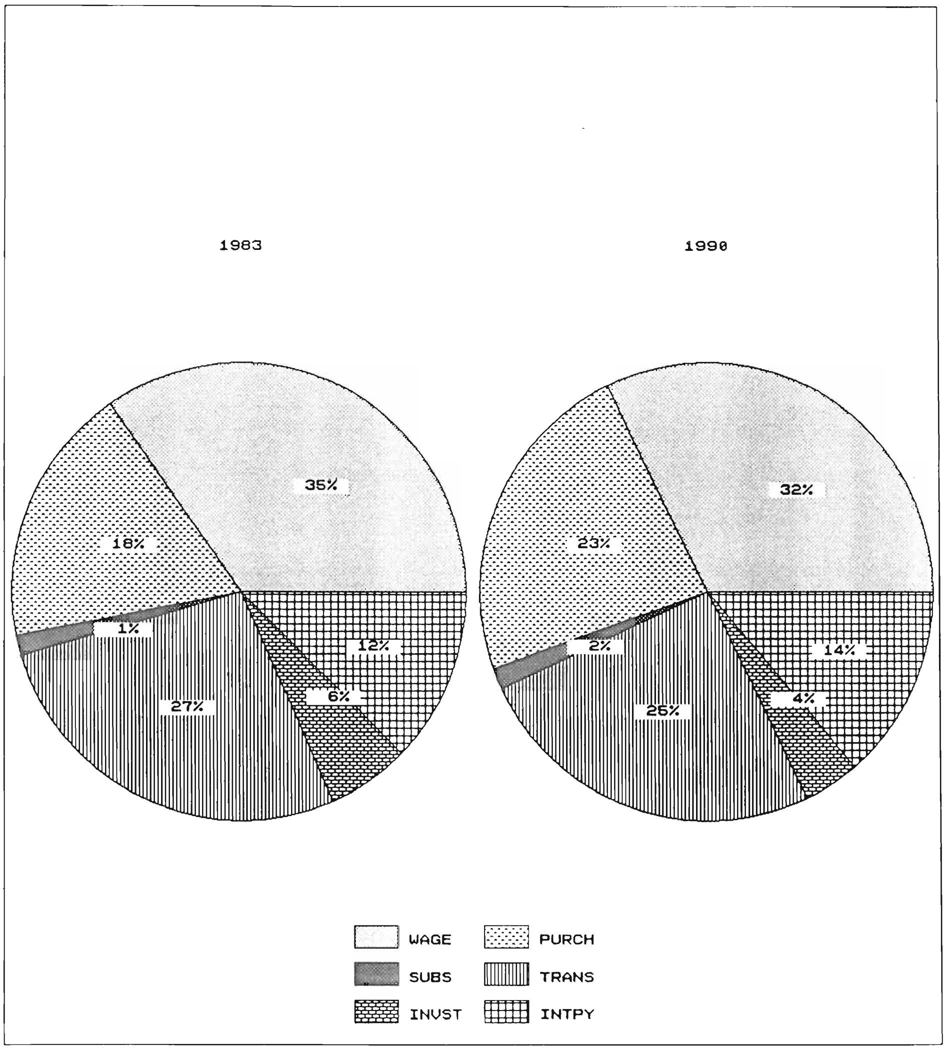


Figure 5e State revenue

Figure 5f **GNP components (10⁹ SEK, current prices)**

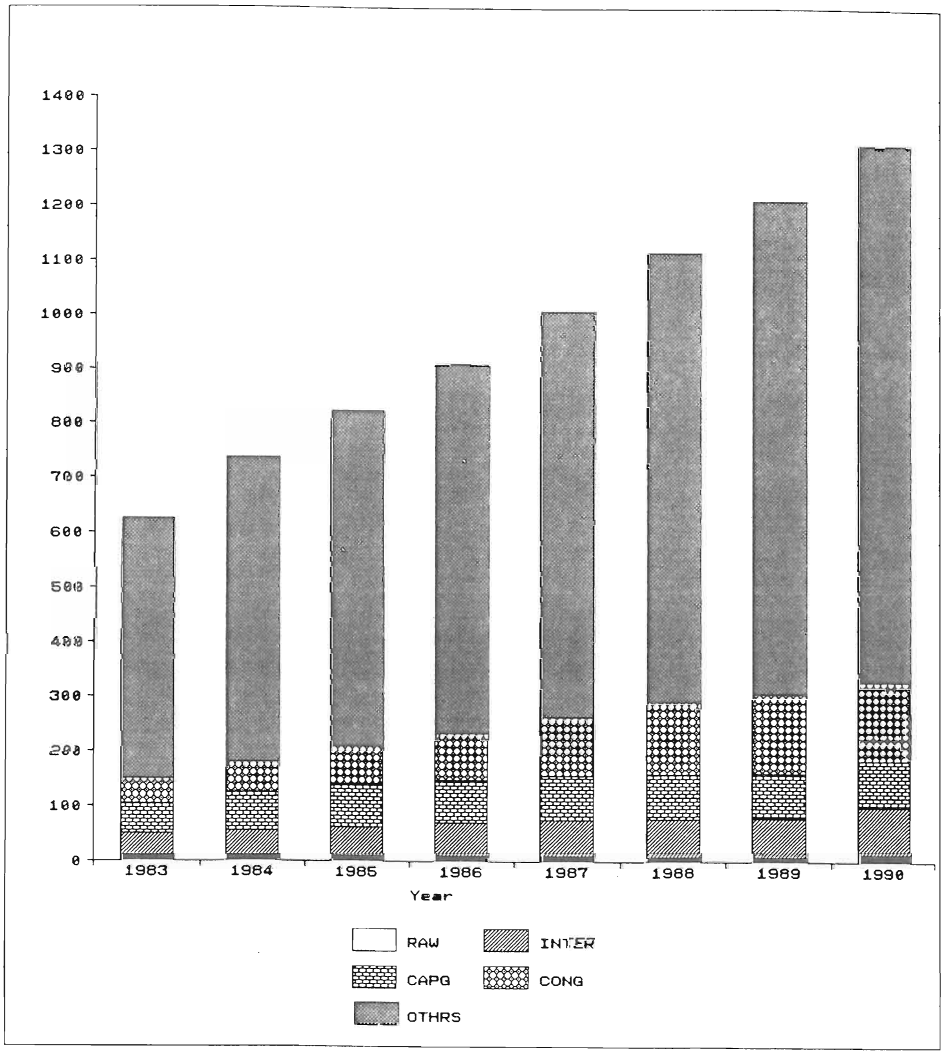
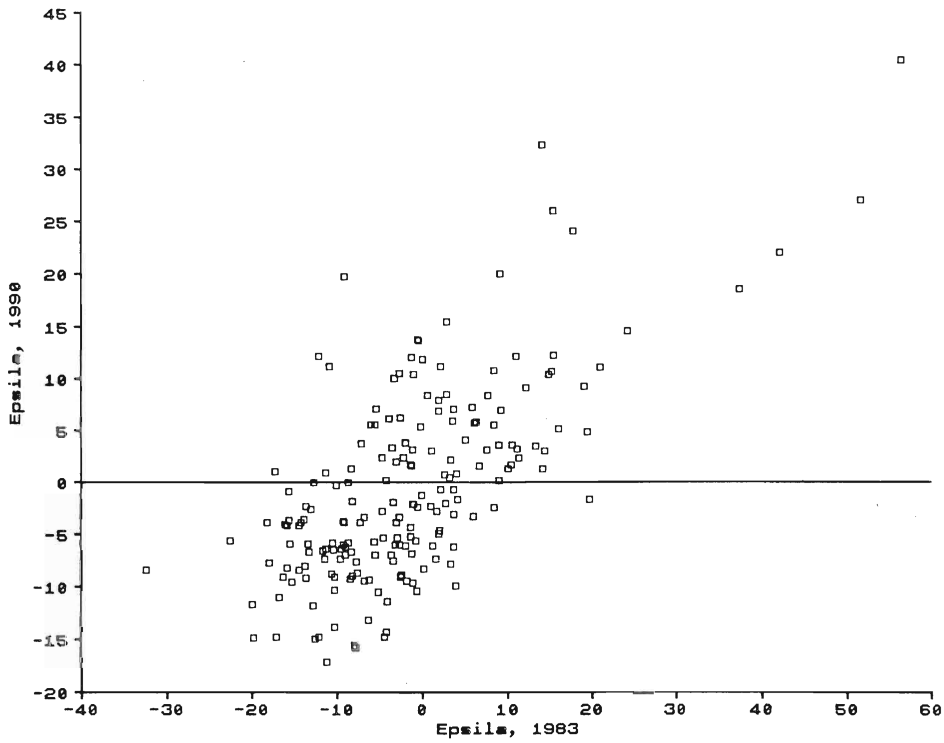


Figure 5g Correlation between profitability in 1983 and 1990

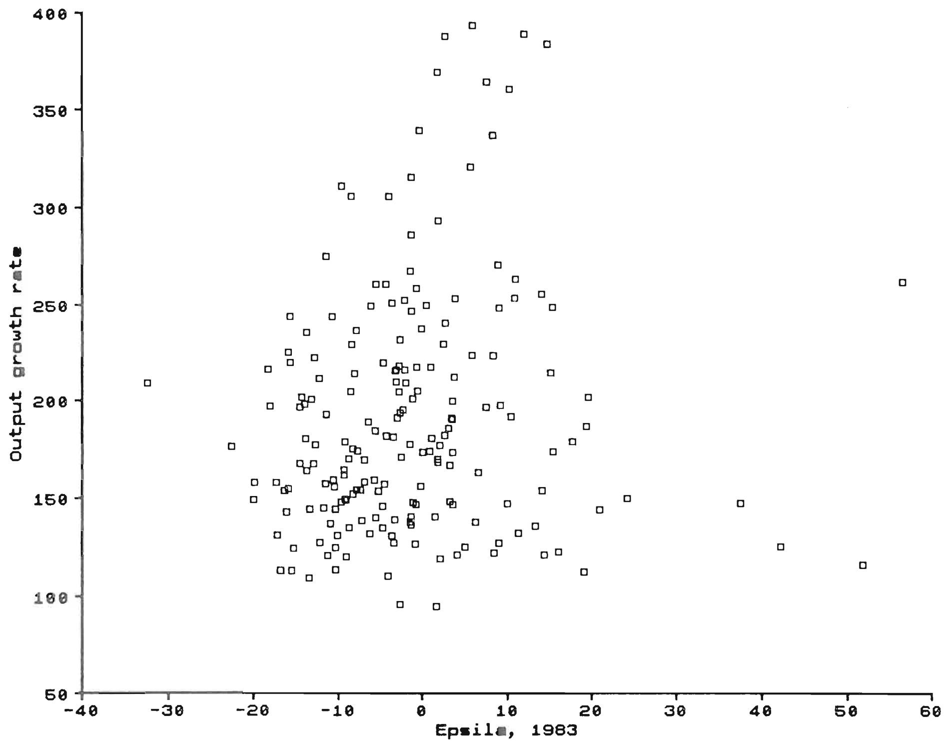


$$\text{Epsila 1990} = \underset{(.75)}{.38} + \underset{(12.88)}{.53}\ \text{Epsila 83}$$

$R^2 = 46.8$

$n = 191$

Figure 5h Correlation between epsila and growth rate



Output growth rate = 1.93 + .65 Epsila 83
(42.55) (1.72)

R^2 = 3.4

n = 191

Figure 6a **Employment level of firm 1.11 (equivalent of full-time employees)**

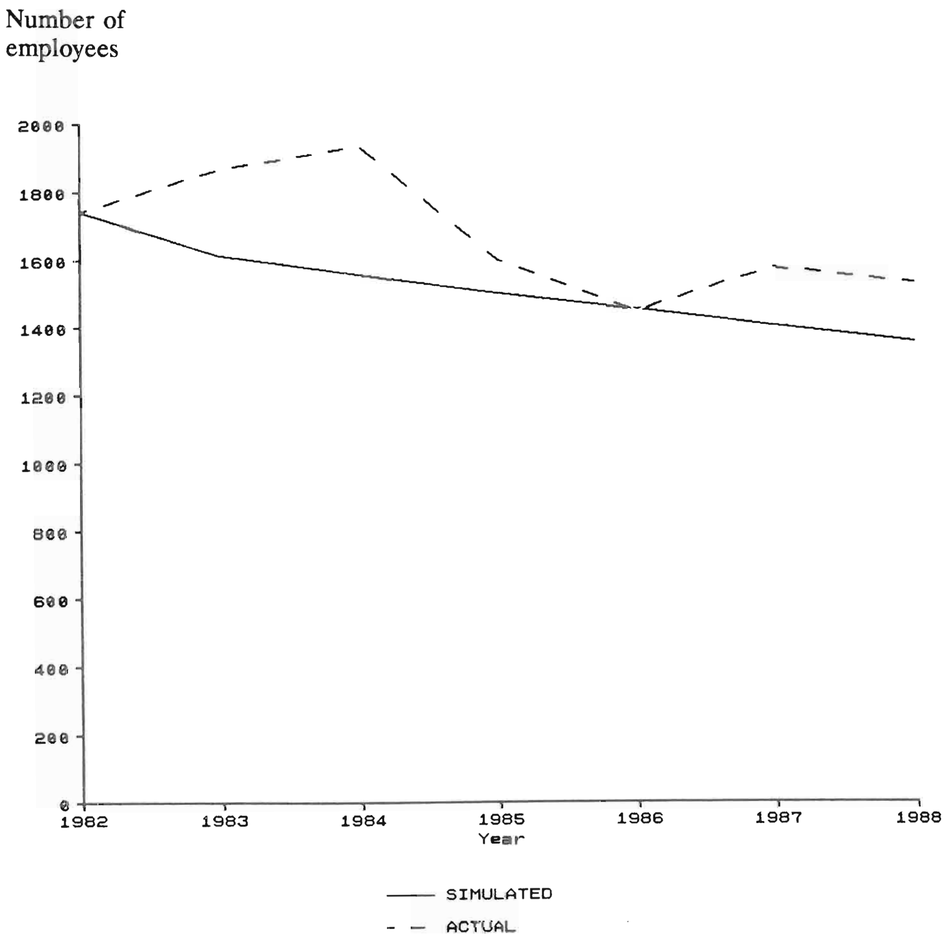


Figure 6b Employment level of firm 1.15 (equivalent of full-time employees)

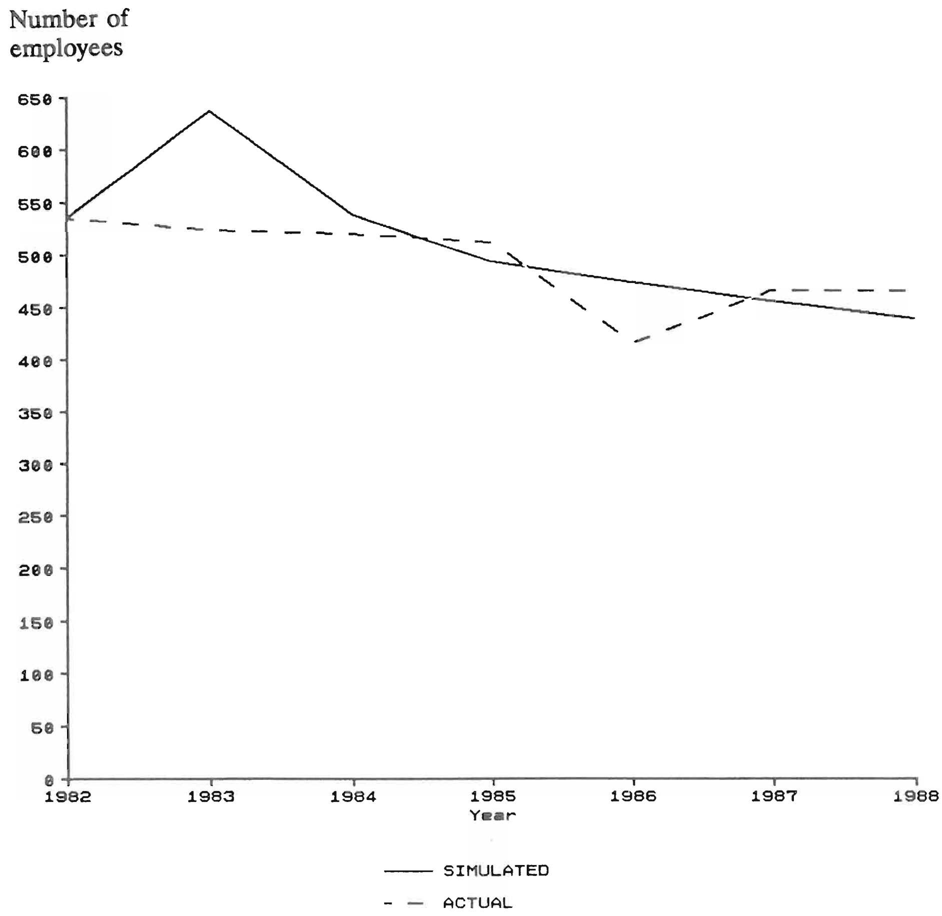


Figure 6c **Rates of return in raw materials industry, 1983**

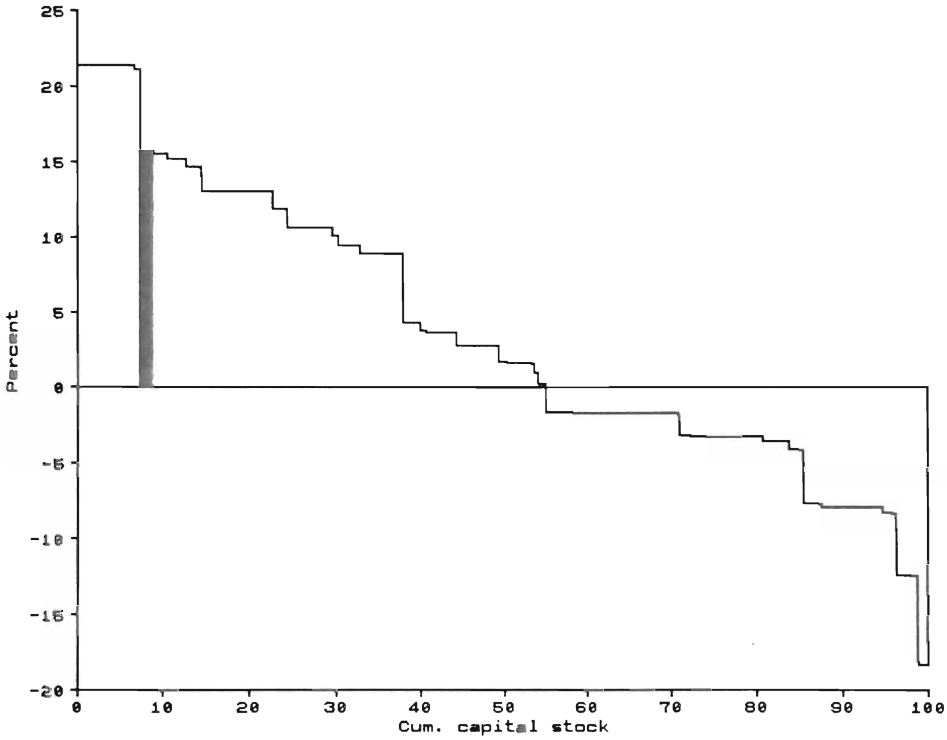


Figure 6d **Labor productivity in raw materials industry, 1983 (1000 units of output)**

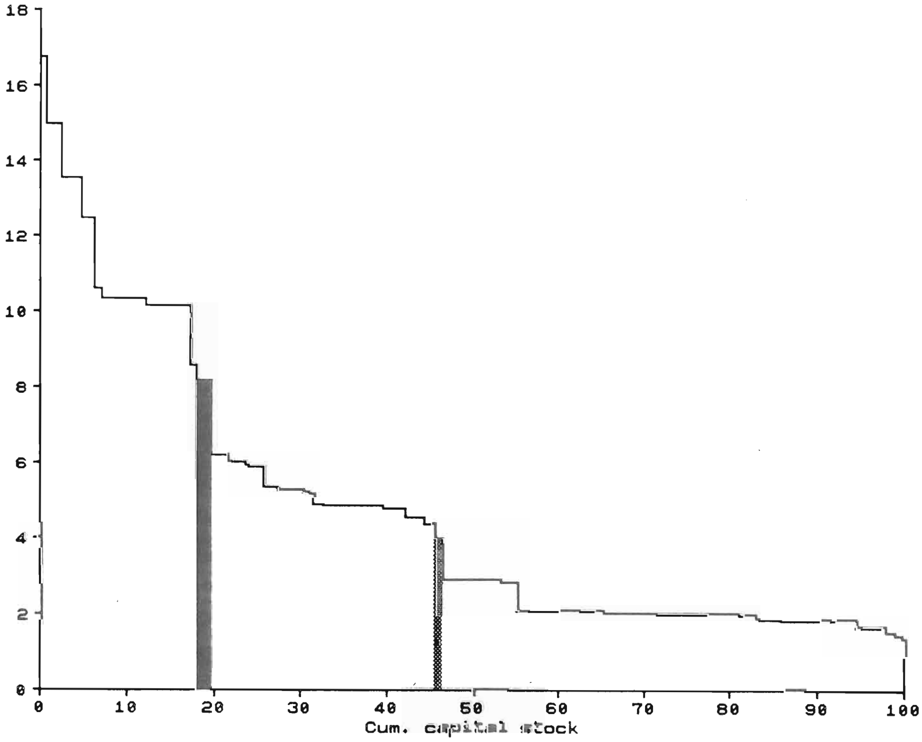


Figure 6e Annual growth rates of output

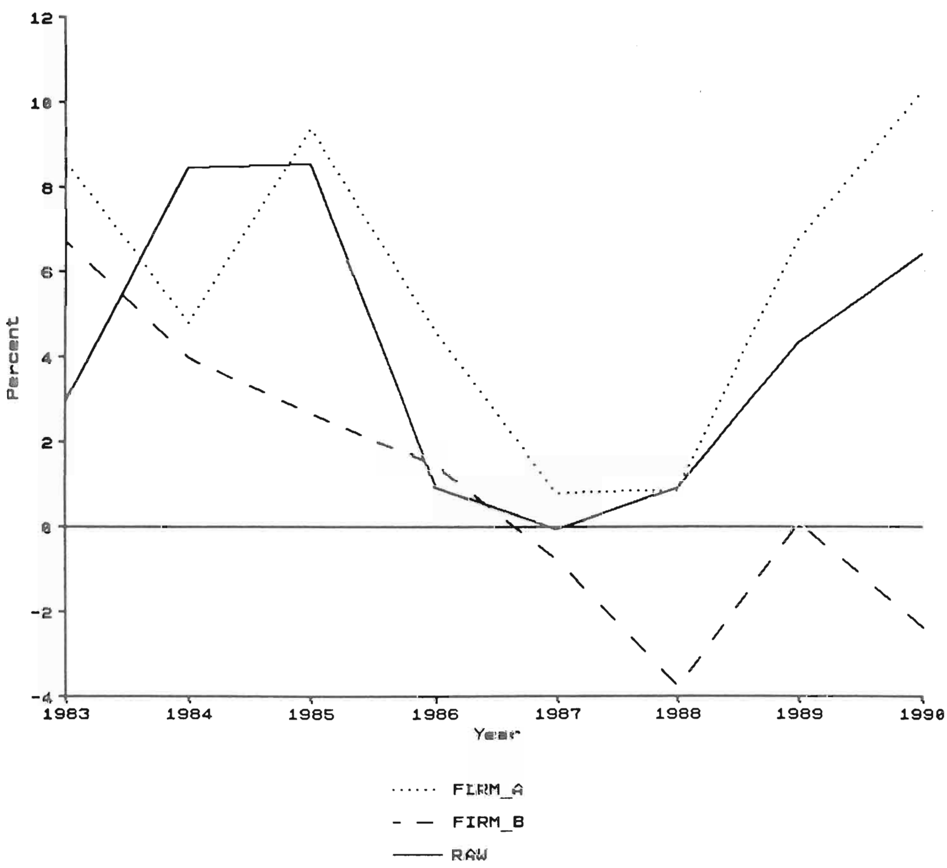


Figure 6f Rates of returns in raw materials industry, 1990

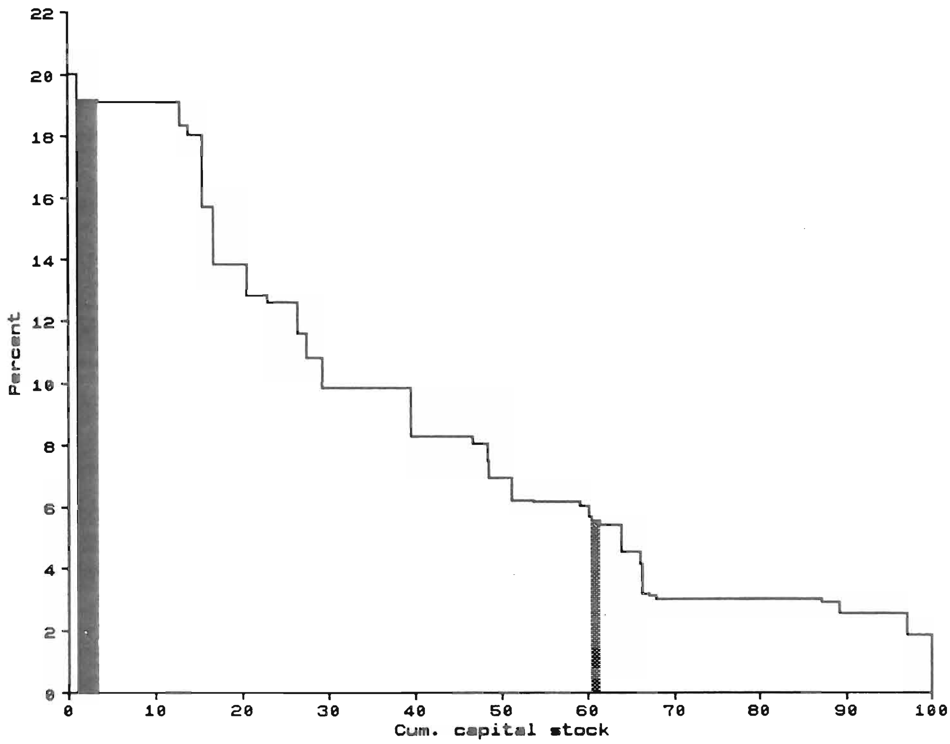
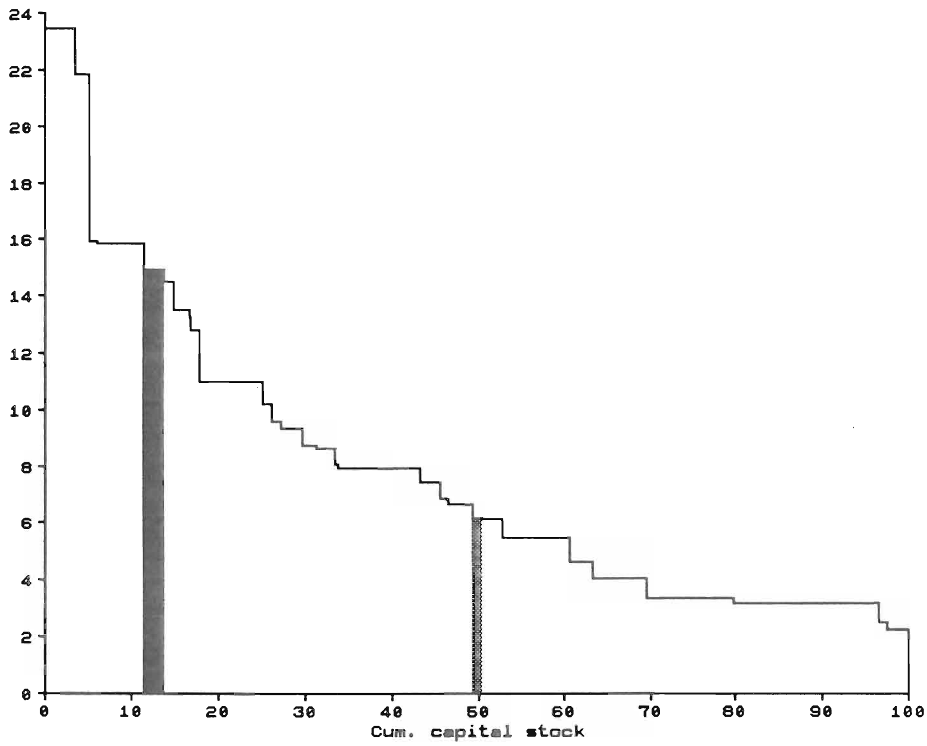


Figure 6g **Labor productivity in raw materials industry, 1990 (1000 units of output)**



CHAPTER III

Documentation of the Planning Survey Data: Cross-Section and Panel

James W. Albrecht

CONTENTS

Figure

1. Introduction[1]

Since 1975 the Federation of Swedish Industries has collected data from Swedish production units through an annual Planning Survey. These data are available both as unlinked annual cross–sections for the years 1975–86 and as a pooled panel for that period. The cross–sections are available at IUI as APL–workspaces; the pooled panel is available as a SAS–dataset.[2]

My purpose in this paper is to provide a general description and documentation of these data. The Planning Survey data have been used at IUI in connection with the MOSES modeling project, and my primary aim here is to provide documentary background for this project.[3] In addition, I hope to make these data more accessible to other potential users and to provide a general reference source for papers based on the Planning Survey.

My presentation of this material will be straightforward. In the next section I give the basics: how the data are collected, the nature of the respondents, comparability with other data sources, etc. In Section 3 I go through the Planning Survey questionnaire. Then in Section 4 I provide information about how the panel dataset was created. Finally, the appendices provide (i) the basic questionnaires for the cross–sectional data and (ii) a listing of variables for the panel dataset.

2. Nature of the Sample

The Planning Survey questionnaires are distributed each year around February 1 to

[1]My work on this project and the work of several research assistants have been supported by IUI over a long period. Among those who helped with the programming and data manipulation, Tom Cunningham, Mercedes Grácia–Díez, and Hans–Erik Persson deserve particular thanks. I also thank Ola Virin and Kerstin Wallmark. They were responsible for the actual data collection at the Federation of Swedish Industries, and both provided encouragement and very helpful advice.

[2]Kent–Rune Sjöholm, formerly at the Federation of Swedish Industries and now at IUI, has done similar work with the Planning Survey. He has independently constructed a panel for the period 1980–88. A useful exercise would be to check the two panels for consistency; eventually, the two datasets could be merged.

[3]A general description of the model is given in Eliasson [1989], and Albrecht and Lindberg [1989] explain how the model is initialized using the Planning Survey data.

the largest firms in Swedish manufacturing.[4] Responses come back on a "product line basis." Thus, firms producing a single product or a single line of related products return a single questionnaire, whereas other, more complicated firms may return as many as ten responses. The basic unit of response should be regarded as an establishment or division or "production unit."

Respondents are classified into 5 sectors by the Federation: (i) Raw Materials Processing (R), (ii) Intermediate Goods (INS), (iii) Investment Goods (INV), (iv) Consumption Goods (K), and (v) Building Materials (B). The respondent units comprising a single firm are often classified into different sectors. The Planning Survey sectoral classification conforms with the grouping based on the end use of products suggested by the OECD and is based on the concept of a "product chain." (Raw Materials Processing is an input to Intermediate Goods production which is in turn an input to the production of finished goods.) This end use classification differs from the Standard Industrial Classification used by the Statistics Sweden (SCB) and by the Business Cycle Institute (KI) in connection with their "barometer data."

The coverage of the Planning Survey is quite extensive. Approximately 40–50% of all employment in Swedish manufacturing takes place in establishments covered by the Planning Survey. Significant differences in sectoral coverage reflect the greater importance of larger firms in the Raw Materials Processing and Investment Goods sectors and of smaller firms in Consumption Goods and Building Materials.

There are senses in which Planning Survey respondents are not typical of Swedish manufacturing. One problem is that the survey has a "large firm bias" since firm size is the criterion for inclusion. (All companies with at least 500 employees are included in the survey plus some smaller companies in the Building Materials sectors and a few others of "special interest.") However, the basic units of response are establishments, and some of the production units comprising "large" firms are quite "small." Another problem is that over the sample period (especially during the late 1970's) some operations that might otherwise have been shut down have been taken over by state holding companies. To the extent that these operations are then excluded from the

[4]The Federation of Swedish Industries refers to the surveys in their publications according to the year in which the questionnaires were sent to the respondent firms. Since the first two surveys were sent in December 1975 and December 1976 and the third survey was sent in February 1978, there is no 1977 Planning Survey according the the Federation's dating scheme. I will use the convention of dating the various Planning Surveys according to the year's operations to which they refer. Thus, the survey sent in February 1978 is the 1977 Planning Survey according to my nomenclature.

sample, there is a bias in the sample away from failing enterprises. However, I find it difficult to imagine that either of these potential biases is quantitatively very important in a sample that covers close to 50% of total employment in Swedish manufacturing.

3. Planning Survey Questionnaire

The Planning Survey questionnaire basically consists of a set of core questions that have been repeated each year plus a small number of extra questions that change from year to year. There are, however, two important caveats to the notion of an unchanging set of core questions. The first is that some core questions were not asked in 1975, the first survey year, and the second is that some core questions have been modified and extended in the later years of the survey.

The core questions cover eight areas:

a. Employment and Compensation
b. Sales
c. Purchases of Raw Materials and Input Goods
d. Investment Goods
e. Annual Percentage Change in Production Volume
f. Capacity Utilization
g. Orders
h. Inventories.

Questions for the first four categories are expressed in quantitative terms (number of employees, annual sales in million SEK, etc) and are generally asked both for the survey year and retrospectively for the preceding year. Questions for the last four categories are expressed in qualitative terms (eg, responses are to be given in percentage ranges) and are not asked retrospectively. All data refer exclusively to the domestic operations of the respondent.

I now summarize the information available for each of these eight core areas. For a complete specification, see Appendix 1.

a. *Employment and Compensation*
Information is available on the total number of employees and on total compensation (in million SEK, including social fees) both for the year of the survey and retrospectively for the preceding year. Important exceptions to this pattern are (i) no

data are available in 1975 on compensation and (ii) total manhours of work are given starting in 1980 in addition to total employment.

My experience has been that some caution must be used in comparing employment figures from two different surveys for the same respondent. The problem is that within firms there may be employees who can plausibly be associated with more than one production unit. However, the survey year and retrospective employment and/or manhour figures within a single survey generally are comparable.

b. *Sales*

Information is available on total sales (more precisely, total invoicing) in current prices (million SEK) broken down into exports and domestic sales for the year of the survey, retrospectively for the preceding year, and expected (planned) for the year following the survey. Sales to subsidiaries at home and abroad are included.

c. *Purchases of Raw Materials and Input Goods*

Information is available on raw material and input goods purchases divided into purchases of (i) electricity, (ii) fuels (oil, coal, etc) and (iii) other raw materials and intermediate goods for the year of the survey, retrospectively for the preceding year, and expected (planned) for the year after the survey. Important exceptions are (i) no information is available for 1975 and (ii) in 1976 and 1977 data are available for total purchases only, rather than for the three components. Starting in 1984, information is also available on "total costs," ie, labor costs plus raw material/input goods costs plus any other costs that fall into neither of the first two categories.

Purchases of raw materials and input goods seem to be systematically understated in these data due to the non–inclusion of the service component (eg, transport services) of such purchases in the survey responses. (A limited corrective based on a supplementary question in the 1981 survey is available. See p 10 below.) Another possible source of measurement error in these data is the existence of unrecorded intra–firm transfers of raw materials and input goods.

d. *Investment*

Information is available on total investment (million SEK, current prices) divided into expenditures on plant and equipment for the survey year, retrospectively for the preceding year, and expected (planned) for the year following the survey.

e. *Production Volume*

Information is available on production volume for the survey year as compared with the preceding year and for the year following the survey (expected or planned) as compared with the survey year. The answers are expressed in percent ranges. That is, the possible answers are "approximately unchanged" (change between + or – 5%), "increased by more than x percent (x = 5, 10, 15, 20, 25) or "decreased by more than x percent" (again, x = 5, 10, 15, 20, 25). If an increase or decrease of more than 25% is indicated, then the respondent is asked to provide a precise percentage figure.

f. *Capacity Utilization*

A spectacular amount of information about capacity utilization is available from the various surveys: eight different capacity utilization questions have been asked at different times over the sample period. Two questions have been asked each year and are particularly important:[5]

(i) "By what percent could production volume have been increased during the survey year (as compared with the preceding year) had sufficient product demand and supply of labor been available?"

(ii) "By what percent could production volume have been increased during the survey year (as compared with the preceding year) had sufficient product demand existed but with the workforce actually employed?"

The answers to these questions take the form of "It could have been increased by more than x percent (x = 5, 10, 15, 20, 25) or "not at all" (0–5%). If an increase exceeding 25% is indicated, then the respondent is asked to specify a precise percentage figure. Note that to derive utilization figures the actual percent change in production volume needs to be subtracted from the answers to these questions.

The answer to the first question can be used to derive the usual capacity utilization figure, the ratio of actual output to capacity. The answer to the second can be used to derive the ratio of actual output to "potential output conditional on

[5]These two questions were created with the data needs of MOSES in mind and are referred to as SUM and A21, respectively, in the model. Since 1980 Statistics Sweden has published directly analogous figures on "actual utilization" (FU) and "possible utilization" (MU) on a quarterly basis. The series are related as follows:

$$FU = \frac{1}{1 + SUM} \quad \text{and} \quad MU = \frac{1}{1 + A21}$$

the existing workforce," ie, a measure of labor utilization. The ratio of capacity utilization to labor utilization, ie, the ratio of "potential output conditional on the existing workforce" to capacity, can be interpreted as a measure of the degree to which capital is utilized.

My experience with these data has been very encouraging. First, there seems to be much to be learned from how these utilization figures vary over establishments in the cross section and within establishments over the cycle. (I have made some first steps in this direction in Albrecht [1979].) Second, the obvious inconsistency that one would fear in such data, that the actual expansion in production volume would exceed what respondents reported as possible, almost never occurs.

Among the other capacity utilization information that is available, two questions that have been asked since 1980 are of particular interest:

(iii) "Could the survey year's output have been produced with a smaller workforce? If so, by how much could the workforce have been reduced as compared with actual employment?"

The answer is again of the form "It could have been reduced by more than x percent" (x = 5, 10, 15, 20, 25) with a precise percentage figure called for if a reduction exceeding 25% is indicated. The answer to this question gives a measure of labor redundancy.

(iv) "What increase in employment in the survey year (in percentage terms with actual employment that year as the base) would have been required to reach full capacity?"

The answer to this question, which is of the usual form, gives a measure of "marginal labor requirements."

An interesting exercise (which I haven't yet attempted) would be to use these utilization data to trace out *ex post* relationships between output and labor input at the establishment level. The accompanying figure shows how this could be done.

Data on actual output and labor input in the survey year provide a base point (A), and the first utilization question (SUM) locates the capacity level of output. The remaining three utilization questions then locate points on the *ex post* frontier. The second utilization question (A21) locates point B; the third utilization question (labor redundancy) locates point C; and the fourth utilization question (marginal labor requirements) together with knowledge of the level of capacity locates point D. These three points (B, C, and D) along with the origin suffice to sketch out the *ex post* frontier.

g. *Orders*

The same three orders questions have been asked in all three survey years. The questions refer to the "order situation" at the end of the survey year as compared with the end of the preceding year. I have no experience with these data.

h. *Inventories*

Information is available on (i) the stock of product inventories as of the end of the survey year as a percent of survey year sales, (ii) the "normal" ratio of the stock of product inventories to yearly sales, (iii) the stock of raw material and input good inventories as of the end of the survey year as a percent of survey year purchases, and (iv) the "normal" ratio of the stock of raw material and input good inventories to yearly purchases. Information is available for all years except 1975, and responses are given in percentage range terms.

The inventory data are probably the weakest link in the Planning Survey. A first problem is simply that the inventory measures are rather crude, being based on stock–to–flow ratios that are expressed in broad percentage ranges. A second problem has to do with the prices associated with the inventory stocks. Product inventories can be valued at the current price, at the price that is expected to prevail when the goods are to be sold, or at some other price that is advantageous for tax reasons. Likewise, raw material/input good inventories can be valued at purchase price or current price, a particular problem since raw materials prices, especially fuel prices, moved substantially over the sample period. Third, no information on inventories of "goods in process" is explicitly asked for in the Planning Survey. Some respondents may include these inventories in their answers to the questions about finished goods inventories; others probably do not. Fourth, although I have no evidence to support this suspicion, there may be incompletely recorded intra–firm transfers of stocks in these data. Finally, even if the data were completely free of measurement error, there still would not be sufficient information to precisely compute changes in inventory stocks from year to year. To compute the change in product inventories using data from one questionnaire, the best one can do is to multiply current sales by the difference between the actual and "normal" ratios of product inventories to sales (divided by 100). This, of course, requires that the stock–to–flow ratio in the preceding year was "normal," an assumption that does not seem consonant with the significant movements in average stock–to–flow ratios over the sample period.

Supplementary Questions

Finally, some of the supplementary (non–core) questions are also worth discussing. First, it is possible to use supplementary questions to construct a capital stock time series for some respondents. In the 1979 survey respondents were asked to give the replacement value of their capital stocks broken down into plant and equipment as of the end of 1979, and in both the 1977 and 1986 surveys respondents were asked to give an economic life expectancy (in years) both for buildings and for the most recently installed piece of important machinery. For respondents with complete records we thus have a base capital stock figure from 1979, the means to estimate economic rates of depreciation from the 1977 and/or 1986 surveys[6], and annual gross investment series. Note, of course, that the possibility of constructing a capital stock series applies only to those units that can be linked with a respondent from the 1979 survey.[7]

The second set of supplementary questions of particular interest come from the 1981 survey. In that survey respondents were asked to provide information about the

[6]Alternatively, one can use external estimates of depreciation, eg, those given in Södersten and Lindberg [1984].

[7]The gross investment series are expressed in current prices. To convert investments to current prices the following implicit price deflators can be used (source: Kerstin Wallmark, 7 May 1984):

	Buildings	Machinery	Total
1973	46.8	47.7	47.5
1974	54.1	55.5	55.1
1975	59.3	63.4	62.1
1976	66.7	69.5	68.7
1977	75.7	76.2	76.1
1978	81.8	85.4	84.4
1979	90.5	92.1	91.7
1980	100.0	100.0	100.0
1981	109.0	108.6	108.7
1982	117.2	124.7	123.3
1983	124.0	141.1	138.1
1984	132.7	145.5	142.8
1985	138.8	150.9	148.3
1986	145.1	158.8	155.4

Note also that I am implicitly assuming in this discussion that investments "enter into" the capital stock in the same year as the investment expenditures are made.

service component of total sales and of total raw material/input good purchases. Information about the service component of purchases is particularly important. Respondents were specifically asked to provide a figure for total purchases of services, including transport, and to indicate approximately what fraction of these purchases were reflected in their response to the core questions on raw material and input good purchases. Thus, the responses to the 1981 supplementary questions might be used to derive a correction factor that could then be applied to other years' data on purchases.

4. Creation of the Panel Dataset

The ability to follow individual production units through time, ie, to exploit the panel nature of the data, is an important feature of the Planning Survey. In this section I outline the procedure used to convert the data from a series of unlinked cross sections into a panel.

There are three basic steps to this procedure. First, I took data from the cross–sectional APL matrices (these are the "inputs" to the procedure) and re–organized these data into "variable matrices." Second, I "expanded" these variable matrices to take into account those instances in which respondents with the same identification code are not comparable across years. Finally, I converted these expanded variable matrices from APL workspaces to ASCII files (these are the "outputs" from the procedure). I will discuss the re–organization and expansion steps in detail below; the conversion step, however, is straightforward.

Re-organization of the Data

The APL matrices R75, INS75, ... ,B86 are the input to this first stage. (R75 is the matrix with data from 1975's Raw Material Processing sector's respondents, etc.) Vectors C75, C76, ... , C86 are specified, where C75 gives the columns in the 1975 matrices (ie, R75, INS75, etc) corresponding to the variables of interest, C76 gives the columns in the 1976 matrices corresponding to variables of interest, etc. To carry out the procedures described below, the respondent identification codes (ID's) are required, so 1 (the column corresponding to the respondent ID) is the first element in all the C–vectors. In addition, despite the fact that some information is not available in all survey years (eg, manhour figures are available only from 1980 onwards), the procedure requires that all of the C–vectors have the same number of elements. A solution, explained in the next paragraph, is to set elements of the C–vectors equal to

1 for those cases in which a variable is not included in the survey year in question.[8]

The vectors C75, C76, etc are used to select columns from the basic data matrices. Define X75 as the columns C75 of R75 stacked on top of the columns C75 of INS75, ... , stacked on top of the columns C75 of B75; likewise X76 consists of the columns C76 of R76 stacked on top of the columns C76 of INS76, ... , stacked on top of the columns C76 of B76; and so forth through X86. The various X–matrices need to be fixed to take missing variables into account. I adopt ¯99 as the *missing data code*. The columns of X75 corresponding to C75 = 1 (excepting the first column, ie, the respondent ID) are set equal to ¯99; likewise, the columns of X76 corresponding to C76 = 1 (excepting the first column) are set equal to ¯99; and so forth through X86. In addition, "check columns" are included in the C–vectors. These "check columns" correspond to "check variables" in the data matrices, ie, to variables indicating whether the respondent answered a particular question. At this point, these columns are used for an "APL compression" and then discarded.[9]

The final step in re–organizing the data is to combine the first columns of X75, X76, ... , X86 into a first variable matrix, the second columns of X75, X76, ... , X86 into a second variable matrix, etc. Using the first variable matrix as an example, this combination essentially results in a matrix the first column of which is the first column of X75, the second column of which is the first column of X76, etc. The only caveat is that not all respondent ID's occur in all years (so the X–matrices have different numbers of rows). To deal with this, define ID as the union of respondent ID's occurring in all years; ie, ID is the union of the first columns of X75, X76, ..., X86. Then define the "selection index" S75 as the position of the ID codes appearing in the 1975 matrices in the vector ID, similarly for selection indices S76, S77, ... ,S86. Each variable matrix is of dimension (# of elements in ID) by 12 (ie, the number of years in the cross–sections), and initially each element in each matrix is set to ¯99.

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[8]Example: C75 = 1 2 3 1 1 8 9 10 12 14 15 1 1 1 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 1 1 1 1 1 1 42 43 1 1 1 1 1 1 1 1 1 1 1 1 1

[9]Example: There is a check variable for "Production Volume — percent change in real terms" in each of the data matrices. This variable takes on the value one if the respondent answered the production volume question and the value zero if not. In the 1975 matrices the check variable is found in column 24 and the answer to the production volume question itself is found in column 25. The vector C75 thus includes the entries 24 and 25. These correspond in turn to columns 21 and 22 in X75. If an element of column 21 in X75 equals 0, then the corresponding element of column 22 X75 is set equal to –99; if an element of column 21 in X75 equals 1, then the corresponding element of column 22 in X75 is left as is. Once this compression is carried out, column 21 of X75 is discarded.

In the first column of the first variable matrix in the rows indicated by S75, ¯99 is then replaced by the first column of X75; in the second column of the first variable matrix in the rows indicated by S76, ¯99 is replaced by the first column of X76, and so forth.

Expansion of the Variable Matrices

The output of the above data re–organization is a collection of variable matrices. A row in a particular variable matrix gives a time series of responses on one variable for a single respondent ID. However, the problem with using the Planning Survey data as a time series is that, due to definitional changes, respondents with the same ID codes may not be comparable across years. The solution I have adopted is to treat definitionally different respondents with the same ID codes as separate entities. To do this "index matrices" identifying definitional changes are used. These index matrices are based on coding sheets constructed under Kerstin Wallmark's direction at the Federation of Swedish Industries.

The procedure can be illustrated by example. Consider the "respondent" with the APL identification code 1.01 in the cross–sectional data. (The code 1.01 means that this is the first respondent in Raw Materials Processing, the first sector.) There should be 12 years of data for this respondent; however, the unit is not comparable across the sample period. In particular, the unit was re–defined as of the beginning of 1979 to reflect organizational changes within the parent firm; that is, survey responses for respondent 1.01 before 1979 and after 1979 refer to fundamentally different entities, despite the common identification code. Another re–organization took place at the beginning of 1981. In this case the responses given in the 1981 survey to questions about 1981's operations of course refer to the new, re–defined entity; however, the responses to retrospective questions refer to the entity as it existed in 1980. This same type of re–definition, with a discrepancy between survey year and retrospective responses, also took place at the beginning of 1982 and then again at the beginning of 1983. Finally, in 1984 this "respondent" dropped out of the survey altogether.

Employment from 1975 to 1986 for respondent 1.01 (the first row of the third variable matrix – note the missing data entries for the years 1984–86) is given by

1872 1812 1571 1476 12607 12728 3851 3336 2206 ¯99 ¯99 ¯99.

To accommodate definitional inconsistencies, this single time series of responses is expanded into five separate time series:

```
1872 1812 1571 1476  ¯99  ¯99  ¯99  ¯99  ¯99 ¯99 ¯99 ¯99
 ¯99  ¯99  ¯99  ¯99 12607 12728 ¯99  ¯99  ¯99 ¯99 ¯99 ¯99
 ¯99  ¯99  ¯99  ¯99  ¯99  ¯99 3851 ¯99  ¯99 ¯99 ¯99 ¯99
 ¯99  ¯99  ¯99  ¯99  ¯99  ¯99  ¯99 3336 ¯99 ¯99 ¯99 ¯99
 ¯99  ¯99  ¯99  ¯99  ¯99  ¯99  ¯99  ¯99 2206 ¯99 ¯99 ¯99
```

To carry out this expansion the index matrix

```
1.01 1 1 1 1 0 0 0 0 0 0 0 0
1.01 0 0 0 0 1 1 0 0 0 0 0 0
1.01 0 0 0 0 0 0 1 0 0 0 0 0
1.01 0 0 0 0 0 0 0 1 0 0 0 0
1.01 0 0 0 0 0 0 0 0 1 0 0 0
```

is used. If the raw data to be expanded were retrospective employment (or, in general, any lagged variable) a different index matrix would need to be used. For respondent 1.01 this would be

```
1.01 1 1 1 1 0 0 0 0 0 0 0 0
1.01 0 0 0 0 1 1 1 0 0 0 0 0
1.01 0 0 0 0 0 0 0 1 0 0 0 0
1.01 0 0 0 0 0 0 0 0 1 0 0 0
1.01 0 0 0 0 0 0 0 0 0 0 0 0
```

(Note that the last row of this matrix consists entirely of zeroes. The interpretation is that there is no Planning Survey that gives retrospective information valid for the "fifth respondent" with ID 1.01.)

The index matrices for all respondents taken together (ie, not just respondent 1.01) are denoted by IMAT and ILAG. IMAT, or ILAG in the case of retrospective data, are used together with any pre-expansion variable matrix in a simple APL program to produce an expanded variable matrix. Although not all respondents are as chaotic as 1.01, this expansion process changes the nature of the data to a considerable degree. The number of "respondents" after expansion is approximately 3 times the number of respondent ID's.

5. Conclusion

The panel dataset described above should be used with caution. Despite our best efforts, there are doubtless instances in which noncomparable entities are incorrectly linked through time in the panel. Further, as I indicated in my discussion of the questionnaires, there are some variables that should be regarded with skepticism.

Having expressed these caveats, I nonetheless feel that this is a very rich and interesting dataset. The panel could provide useful information about productivity and technological change; and, as I suggested above, these data could shed considerable light on patterns of capacity utilization over the cycle. In addition, the Planning Survey data could be linked profitably with other datasets available at IUI, eg, with firm–level financial data. In short, this is a dataset that is ripe for exploitation.

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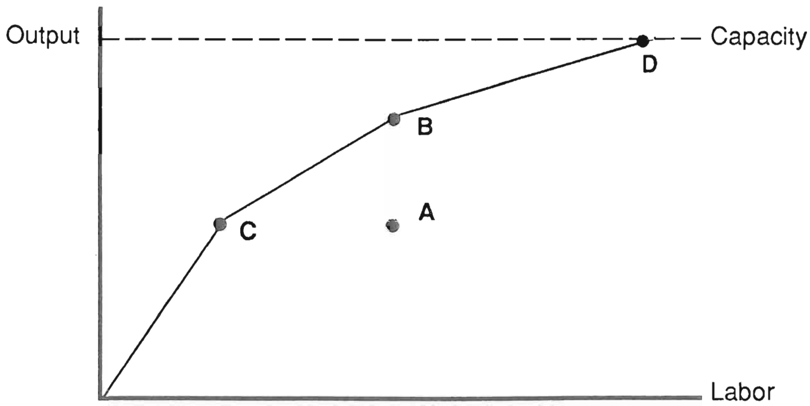
Figure 1 Ex post relationships between output and labor input



Appendix 1: Cross–section Data — Storage and Coding

The Planning Survey data in cross sections are stored as APL workspaces. There is one workspace per year of data with PD75 containing the 1975 data, PD76 containing the 1976 data, etc. Within each PD workspace the data are stored in 5 matrices. These matrices are identified by a prefix (R = Raw Materials Processing,INS = Intermediate Goods, INV = Investment Goods, K = Consumption Goods, B = Building Materials) and by suffix according to the year. Thus, for example, the workspace PD76 contains the 5 variables (matrices) R76, INS76, INV76, K76, and B76.

Each matrix is of dimension (# of respondents) x (# of variables). With the exception of the 1975 matrices a standard format has been preserved for the first 50 columns of all matrices; that is, in each of the years 1976–86 one can find the respondent ID in column 1, data on employment and wages in columns 2–5, etc. This has been done to make it possible to write standardized programs to analyze data across different years. (The functions used to rearrange the data into this standard format can be found in some of the later PD–workspaces.) Columns 1–50 correspond to what I call the "core variables" in Section 3 of the main text. For columns 51 and beyond what can be found in any given column differs from year–to–year, reflecting additions to the questionnaire and special questions.

Presented below are the codes for each year of data. In reading these codes one finds the expression "check on xx." This variables takes on a value of 1 or 0 according to whether or not the respondent gave an answer to the question called for in column xx; ie, the check is for missing data.

<u>1975 Planning Survey</u>

1. <u>ID</u>

<u>Number of Employees</u>

2. 1974
3. 1975
4. 1976 (plan)

<u>Number of production workers</u>

5. 1974
6. 1975
7. 1976 (plan)

<u>Sales</u> (million SEK, current prices, excluding indirect taxes)

Abroad, including to affiliates

8. 1974

1975 Planning Survey, continued

9. 1975
10. 1976 (plan)
11. check on 12
12. percent change per year 1975–80 (plan), constant prices

Domestic, including to affiliates

13. 1974
14. 1975
15. 1976 (plan)
16. check on 17
17. percent change per year 1975–80 (plan), constant prices

<u>Investment</u> (million SEK, current prices)

Building and plant, including air conditioning, sanitation, etc

18. 1974
19. 1975
20. 1976 (plan)

Machinery and equipment, including transport equipment

21. 1974
22. 1975
23. 1976 (plan)

<u>Production volume</u> (percent change, real terms)

24. check on 25
25. 1974–75
26. check on 27
27. 1975–76 (plan)

<u>Capacity utilization</u>

28. check on 29
29. "By what percent could 1975's production volume have increased (as compared with 1974), assuming labor supply and product demand imposed no restraint?"
30. check on 31
31. "By what percent could 1975's production volume have increased (as compared with 1974), assuming product demand available but with the existing labor force?"
32. check on 33
33. "By what percent can 1976 production volume increase (as compared with 1975), given the already decided–upon capacity increases and with labor supply and product demand imposing no restraint?"

<u>Orders</u>

34. check on 35
35. Percent increase or decrease in total volume of orders as compared with this time last year.
36. check on 37
37. Percent of planned 1976 production covered by existing orders.
38. check on 39–41

Order coverage for 1976 is

39. greater than normal
40. normal
41. less than normal

<u>Inventories</u>

42. check on 43
43. How much do product inventories as a percent of sales diverge fromnormal?

<u>Supplementary Questions</u>

Impediments to investment

44. check on 45–50

1975 Planning Survey, continued

45. Already have sufficient capacity relative to product demand
46. Insufficient internal finance
47. Insufficient external finance
48. Lack of profitable investments
49. Lack of labor
50. Other, namely...

1976 Planning Survey

1. ID

Number of Employees
2. 1975
3. 1976

Total Wage Bill, including social fees
4. 1975
5. 1976

Sales (million SEK, current prices, excluding indirect taxes)
Abroad, including to affiliates
6. 1975
7. 1976
8. 1977 (plan)
9. check on 12
10. percent change per year 1975–80 (plan), constant prices

Domestic, including to affiliates
11. 1975
12. 1976
13. 1977 (plan)
14. check on 17
15. percent change per year 1975–80 (plan), constant prices

Raw Materials Costs, including fuels, million SEK, current prices
16. 1975
17. 1976
18. 1977 (plan)

Investment (million SEK, current prices)
Building and plant, including air conditioning, sanitation, etc
19. 1975
20. 1976
21. 1977 (plan)

Machinery and equipment, including transport equipment
22. 1975
23. 1976
24. 1977 (plan)

Production volume (percent change, real terms)
25. check on 26
26. 1975–76
27. check on 28
28. 1976–77 (plan)

Capacity utilization
29. check on 30
30. "By what percent could 1976's production volume have increased (as compared with 1975), assuming labor supply and product demand imposed no restraint?"
31. check on 32

1976 Planning Survey, continued

32. "By what percent could 1976's production volume have increased (as compared with 1975), assuming product demand available but with the existing labor force?"
33. check on 34
34. "By what percent can 1977 production volume increase (as compared with 1976), given the already decided–upon capacity increases and with labor supply and product demand imposing no restraint?"

Orders

35. check on 36
36. Percent increase or decrease in total volume of orders as compared with this time last year.
37. check on 38
38. Percent of planned 1977 production covered by existing orders.
39. check on 40–42

Order coverage for 1977 is

40. greater than normal
41. normal
42. less than normal

Inventories

43. check on 44
44. Raw material inventories as of 76–12–31 as a percent of total purchases of raw materials (including fuels) in 1976.
45. check on 46
46. Normal ratio of raw material inventories to purchases
47. check on 48
48. Product inventories as of 76–12–31 as a percent of total 1976 sales volume
49. check on 50
50. Normal ratio of product inventories to sales volume

Supplementary Questions

Impediments to investment

44. check on 45–50
45. Already have sufficient capacity relative to product demand
46. Insufficient internal finance
47. Insufficient external finance
48. Lack of profitable investments
49. Lack of labor
50. Other, namely...

1977 Planning Survey

1. ID

Number of Employees

2. 1976
3. 1977

Total Wage Bill, including social fees

4. 1976
5. 1977

Sales (million SEK, current prices, excluding indirect taxes)

Abroad, including to affiliates

6. 1976
7. 1977
8. 1978 (plan)
9. check on 10

1977 Planning Survey, continued

10. percent change per year 1975–80 (plan), constant prices
Domestic, including to affiliates
11. 1976
12. 1977
13. 1978 (plan)
14. check on 15
15. percent change per year 1975–80 (plan), constant prices
Raw Materials Costs, including fuels, million SEK, current prices
16. 1976
17. 1977
18. 1978 (plan)
Investment (million SEK, current prices)
Building and plant, including air conditioning, sanitation, etc
19. 1976
20. 1977
21. 1978 (plan)
Machinery and equipment, including transport equipment
22. 1976
23. 1977
24. 1978 (plan)
Production volume (percent change, real terms)
25. check on 26
26. 1976–77
27. check on 28
28. 1977–78 (plan)
Capacity utilization
29. check on 30
30. "By what percent could 1977's production volume have increased (as compared with 1976), assuming labor supply and product demand imposed no restraint?"
31. check on 32
32. "By what percent could 1977's production volume have increased (as compared with 1976), assuming product demand available but with the existing labor force?"
33. check on 34
34. "By what percent can 1978 production volume increase (as compared with 1977), given the already decided–upon capacity increases and with labor supply and product demand imposing no restraint?"
Orders
35. check on 36
36. Percent increase or decrease in total volume of orders as compared with this time last year.
37. check on 38
38. Percent of planned 1978 production covered by existing orders.
39. check on 40–42
Order coverage for 1978 is
40. greater than normal
41. normal
42. less than normal
Inventories
43. check on 44
44. Raw material inventories as of 77–12–31 as a percent of total purchases of raw materials (including fuels) in 1977.
45. check on 46

1977 Planning Survey, continued

46. Normal ratio of raw material inventories to purchases
47. check on 48
48. Product inventories as of 77–12–31 as a percent of total 1977 sales volume
49. check on 50
50. Normal ratio of product inventories to sales volume

Supplementary Questions

51. check on 52
52. Economic life expectancy (in years) of the most recently installed piece of important machinery
53. check on 54
54. Economic life expectancy (in years) for buildings
55. check on 56
56. Machinery as a percent of fixed capital assets (fire insurance value)
57. check on 58
58. How much investment (current prices) would be required to increase capacity by at least 25%?
59. check on 60
60. How many people would be required to man this new capacity?

1978 Planning Survey

1. ID

Number of Employees

2. 1977
3. 1978

Total Wage Bill, including social fees

4. 1977
5. 1978

Sales (million SEK, current prices, excluding indirect taxes)

Abroad, including to affiliates

6. 1977
7. 1978
8. 1979 (plan)
9. check on 10
10. percent change per year 1977–83 (plan), constant prices

Domestic, including to affiliates

11. 1977
12. 1978
13. 1979 (plan)
14. check on 15
15. percent change per year 1977–83 (plan), constant prices

Raw Materials Costs, including fuels, million SEK, current prices

16. 1977
17. 1978
18. 1979 (plan)

Investment (million SEK, current prices)

Building and plant, including air conditioning, sanitation, etc

19. 1977
20. 1978
21. 1979 (plan)

Machinery and equipment, including transport equipment

22. 1977
23. 1978

1978 Planning Survey, continued

24. 1979 (plan)

<u>Production volume</u> (percent change, real terms)

25. check on 26
26. 1977–78
27. check on 28
28. 1978–79 (plan)

<u>Capacity utilization</u>

29. check on 30
30. "By what percent could 1978's production volume have increased (as compared with 1977), assuming labor supply and product demand imposed no restraint?"
31. check on 32
32. "By what percent could 1978's production volume have increased (as compared with 1977), assuming product demand available but with the existing labor force?"
33. check on 34
34. "By what percent can 1979 production volume increase (as compared with 1978), given the already decided–upon capacity increases and with labor supply and product demand imposing no restraint?"

<u>Orders</u>

35. check on 36
36. Percent increase or decrease in total volume of orders as compared with this time last year.
37. check on 38
38. Percent of planned 1979 production covered by existing orders.
39. check on 40–42

Order coverage for 1979 is

40. greater than normal
41. normal
42. less than normal

<u>Inventories</u>

43. check on 44
44. Raw material inventories as of 78–12–31 as a percent of total purchases of raw materials (including fuels) in 1978.
45. check on 46
46. Normal ratio of raw material inventories to purchases
47. check on 48
48. Product inventories as of 78–12–31 as a percent of total 1978 sales volume
49. check on 50
50. Normal ratio of product inventories to sales volume

<u>Supplementary Questions</u>

<u>Energy and Fuel Costs</u>

Electrical Energy, including internally generated

51. 1977
52. 1978
53. 1979 (plan)

Fuel (oil, coal, etc)

54. 1977
55. 1978
56. 1979 (plan)

<u>More Capacity Utilization Questions</u>

57. check on 58
58. Expected capacity utilization rate in first quarter 1979
59. check on 60

1978 Planning Survey, continued

60. About how many months would it take to reach a preferred operating rate?
61. check on 62
62. What percent increase in employment is implicit in the answer to question 60?

New or Modernized Facilities

63. Have any new or modernized facilities been acquired in the last 5 years?
64. check on 65
65. What percent of total employment is working with these facilities?
66. check on 67
67. What percent of total production volume derives from these facilities?
68. check on 69
69. By what percent could output from these new facilities have been increased (relative to 1977), assuming product demand and labor supply imposed no constraint?
70. check on 71
71. By what percent could output from these new facilities have been increased (relative to 1977), assuming product demand imposed no constraint but with the existing workforce?
72. check on 73
73. What percent of total electrical energy consumption was used by these new facilities?
74. check on 75
75. What percent of total fuel consumption was used by these new facilities?

1979 Planning Survey

1. ID

Number of Employees

2. 1978
3. 1979

Total Wage Bill, including social fees

4. 1978
5. 1979

Sales (million SEK, current prices, excluding indirect taxes)

Abroad, including to affiliates

6. 1978
7. 1979
8. 1980 (plan)
9. coded as zero
10. coded as zero

Domestic, including to affiliates

11. 1978
12. 1979
13. 1980 (plan)
14. coded as zero
15. coded as zero

Raw Material and Input Goods Purchases, total

16. 1978
17. 1979
18. 1980 (plan)

Investment (million SEK, current prices)

Building and plant, including air conditioning, sanitation, etc

19. 1978
20. 1979

1979 Planning Survey, continued

21. 1980 (plan)

Machinery and equipment, including transport equipment

22. 1978
23. 1979
24. 1980 (plan)

Production volume (percent change, real terms)

25. check on 26
26. 1978–79
27. check on 28
28. 1979–80 (plan)

Capacity utilization

29. check on 30
30. "By what percent could 1979's production volume have increased (as compared with 1978), assuming labor supply and product demand imposed no restraint?"
31. check on 32
32. "By what percent could 1979's production volume have increased (as compared with 1978), assuming product demand available but with the existing labor force?"
33. check on 34
34. "By what percent can 1980 production volume increase (as compared with 1979), given the already decided–upon capacity increases and with labor supply and product demand imposing no restraint?"

Orders

35. check on 36
36. Percent increase or decrease in total volume of orders as compared with this time last year.
37. check on 38
38. Percent of planned 1980 production covered by existing orders.
39. check on 40–42

Order coverage for 1980 is

40. greater than normal
41. normal
42. less than normal

Inventories

43. check on 44
44. Raw material inventories as of 79–12–31 as a percent of total purchases of raw materials (including fuels) in 1979.
45. check on 46
46. Normal ratio of raw material inventories to purchases
47. check on 48
48. Product inventories as of 79–12–31 as a percent of total 1979 sales volume
49. check on 50
50. Normal ratio of product inventories to sales volume

Supplementary Questions

Energy and Fuel Costs

Electrical Energy, including internally generated

51. 1978
52. 1979
53. 1980 (plan)

Fuel (oil, coal, etc)

54. 1978
55. 1979
56. 1980 (plan)

1979 Planning Survey, continued

More Capacity Utilization Questions
57. check on 58
58. Expected capacity utilization rate in first quarter 1980
59. check on 60
60. About how many months would it take to reach a preferred operating rate?
61. check on 62
62. What percent increase in employment is implicit in the answer to question 60?
Capital Stock
Replacement value of capital stock as of 79–12–31
63. check on 64
64. Building and plant
65. check on 66
66. Machinery and equipment

1980 Planning Survey

1. ID
Number of Employees
2. 1979
3. 1980
Total Wage Bill, including social fees
4. 1979
5. 1980
Sales (million SEK, current prices, excluding indirect taxes)
Abroad, including to affiliates
6. 1979
7. 1980
8. 1981 (plan)
9. coded as zero
10. coded as zero
Domestic, including to affiliates
11. 1979
12. 1980
13. 1981 (plan)
14. coded as zero
15. coded as zero
Raw Material and Input Goods Purchases, total
16. 1979
17. 1980
18. 1981 (plan)
Investment (million SEK, current prices)
Building and plant, including air conditioning, sanitation, etc
19. 1979
20. 1980
21. 1981 (plan)
Machinery and equipment, including transport equipment
22. 1979
23. 1980
24. 1981 (plan)
Production volume (percent change, real terms)
25. check on 26
26. 1979–80
27. check on 28

1980 Planning Survey, continued

28. 1980–81 (plan)

Capacity utilization

29. check on 30
30. "By what percent could 1980's production volume have increased (as compared with 1979), assuming labor supply and product demand imposed no restraint?"
31. check on 32
32. "By what percent could 1980's production volume have increased (as compared with 1979), assuming product demand available but with the existing labor force?"
33. check on 34
34. "By what percent can 1981 production volume increase (as compared with 1980), given the already decided–upon capacity increases and with labor supply and product demand imposing no restraint?"

Orders

35. check on 36
36. Percent increase or decrease in total volume of orders as compared with this time last year.
37. check on 38
38. Percent of planned 1981 production covered by existing orders.
39. check on 40–42

Order coverage for 1981 is

40. greater than normal
41. normal
42. less than normal

Inventories

43. check on 44
44. Raw material inventories as of 80–12–31 as a percent of total purchases of raw materials (including fuels) in 1980 .
45. check on 46
46. Normal ratio of raw material inventories to purchases
47. check on 48
48. Product inventories as of 80–12–31 as a percent of total 1980 sales volume
49. check on 50
50. Normal ratio of product inventories to sales volume

Supplementary Questions

Total Manhours (1000's)

51. 1979
52. 1980

Energy and Fuel Costs

Electrical Energy, including internally generated

53. 1979
54. 1980
55. 1981 (plan)

Fuel (oil, coal, etc)

56. 1979
57. 1980
58. 1981 (plan)

More Capacity Utilization Questions

59. check on 60
60. What percent increase in employment (using 1980's actual employment as base) would have been required to reach full capacity in 1980?
61. check on 62

1980 Planning Survey, continued

62. Could 1980's production level have been achieved with less employment? If so, by how much less compared with actual employment?
63. check on 64
64. How high is production activity now (first quarter 1981) as a percent of practically achievable capacity?
65. check on 66
66. How many months would be required (for technical or labor market reasons) to increase capacity utilization to 100%?
67. check on 68
68. How large an increase in employment would be required to reach full capacity utilization?

1981 Planning Survey

1. ID

Number of Employees

2. 1980
3. 1981

Total Wage Bill, including social fees

4. 1980
5. 1981

Sales (million SEK, current prices, excluding indirect taxes)
Abroad, including to affiliates

6. 1980
7. 1981
8. 1982 (plan)
9. coded as zero
10. coded as zero

Domestic, including to affiliates

11. 1980
12. 1981
13. 1982 (plan)
14. coded as zero
15. coded as zero

Raw Material and Input Goods Purchases, total

16. 1980
17. 1981
18. 1982 (plan)

Investment (million SEK, current prices)
Building and plant, including air conditioning, sanitation, etc

19. 1980
20. 1981
21. 1982 (plan)

Machinery and equipment, including transport equipment

22. 1980
23. 1981
24. 1982 (plan)

Production volume (percent change, real terms)

25. check on 26
26. 1980–81
27. check on 28
28. 1981–82 (plan)

1981 Planning Survey, continued

Capacity utilization
29. check on 30
30. "By what percent could 1981's production volume have increased (as compared with 1980), assuming labor supply and product demand imposed no restraint?"
31. check on 32
32. "By what percent could 1981's production volume have increased (as compared with 1980), assuming product demand available but with the existing labor force?"
33. check on 34
34. "By what percent can 1982 production volume increase (as compared with 1981), given the already decided–upon capacity increases and with labor supply and product demand imposing no restraint?"

Orders
35. check on 36
36. Percent increase or decrease in total volume of orders as compared with this time last year.
37. check on 38
38. Percent of planned 1982 production covered by existing orders.
39. check on 40–42

Order coverage for 1982 is
40. greater than normal
41. normal
42. less than normal

Inventories
43. check on 44
44. Raw material inventories as of 81–12–31 as a percent of total purchases of raw materials (including fuels) in 1981.
45. check on 46
46. Normal ratio of raw material inventories to purchases
47. check on 48
48. Product inventories as of 81–12–31 as a percent of total 1981 sales volume
49. check on 50
50. Normal ratio of product inventories to sales volume

Supplementary Questions
51. Number of employees 1982 (plan)

Total Manhours (1000's)
52. 1980
53. 1981
54. 1982 (plan)
55. Expected Wage Bill, including social fees, 1982

Energy and Fuel Costs

Electrical Energy, including internally generated
56. 1980
57. 1981
58. 1982 (plan)

Fuel (oil, coal, etc)
59. 1980
60. 1981
61. 1982 (plan)

More Capacity Utilization Questions
62. check on 63
63. What percent increase in employment (using 1981's actual employment as base) would have been required to reach full capacity in 1981?

1981 Planning Survey, continued

64. check on 66
65. Could 1981's production level have been achieved with less employment? If so, by how much less compared with actual employment?
66. check on 67
67. How high is production activity now (first quarter 1982) as a percent of practically achievable capacity?
68. check on 69
69. How many months would be required (for technical or labor market reasons) to increase capacity utilization to 100%?
70. check on 71
71. How large an increase in employment would be required to reach full capacity utilization?

Purchases of Raw Materials/Input Goods Abroad

72. check on 73–75

Has the fraction of input goods and raw materials purchased abroad changed from 1980 to 1981?

73. Increased
74. Unchanged
75. Decreased
76. check on 77–79

Do you expect the fraction of input goods and raw materials purchased abroad to change from 1981 to 1982?

77. Increase
78. Not change
79. Decrease

Service components

80. check on 81
81. What fraction of total sales consists of a service component (including transport)?
82. Total purchases of services (including transport), million SEK
83. check on 84
84. Approximately what fraction of service purchases is reflected in your answers to questions 16–18 above?

1982 Planning Survey

1. ID

Number of Employees

2. 1981
3. 1982

Total Wage Bill, including social fees

4. 1981
5. 1982

Sales (million SEK, current prices, excluding indirect taxes)

Abroad, including to affiliates

6. 1981
7. 1982
8. 1983 (plan)
9. coded as zero
10. coded as zero

Domestic, including to affiliates

11. 1981
12. 1982

1982 Planning Survey, continued

13. 1983 (plan)
14. coded as zero
15. coded as zero

Raw Material and Input Goods Purchases, total

16. 1981
17. 1982
18. 1983 (plan)

Investment (million SEK, current prices)

Building and plant, including air conditioning, sanitation, etc

19. 1981
20. 1982
21. 1983 (plan)

Machinery and equipment, including transport equipment

22. 1981
23. 1982
24. 1983 (plan)

Production volume (percent change, real terms)

25. check on 26
26. 1981–82
27. check on 28
28. 1982–83 (plan)

Capacity utilization

29. check on 30
30. "By what percent could 1982's production volume have increased (as compared with 1981), assuming labor supply and product demand imposed no restraint?"
31. check on 32
32. "By what percent could 1982's production volume have increased (as compared with 1981), assuming product demand available but with the existing labor force?"
33. check on 34
34. "By what percent can 1983 production volume increase (as compared with 1982), given the already decided–upon capacity increases and with labor supply and product demand imposing no restraint?"

Orders

35. check on 36
36. Percent increase or decrease in total volume of orders as compared with this time last year.
37. check on 38
38. Percent of planned 1983 production covered by existing orders.
39. check on 40–42

Order coverage for 1983 is

40. greater than normal
41. normal
42. less than normal

Inventories

43. check on 44
44. Raw material inventories as of 82–12–31 as a percent of total purchases of raw materials (including fuels) in 1982.
45. check on 46
46. Normal ratio of raw material inventories to purchases
47. check on 48
48. Product inventories as of 82–12–31 as a percent of total 1982 sales volume

1982 Planning Survey, continued

49. check on 50
50. Normal ratio of product inventories to sales volume

Supplementary Questions

51. Number of employees 1983 (plan)

Total Manhours (1000's)

52. 1981
53. 1982
54. 1983 (plan)
55. Expected Wage Bill, including social fees, 1983

Wage costs attributable to R&D work

56. 1981
57. 1982
58. 1983 (plan)

Wage costs attributable to marketing

59. 1981
60. 1982
61. 1983

Energy and Fuel Costs

Electrical Energy, including internally generated

62. 1981
63. 1982
64. 1983 (plan)

Fuel (oil, coal, etc)

65. 1981
66. 1982
67. 1983 (plan)

More Capacity Utilization Questions

68. check on 69
69. What percent increase in employment (using 1982's actual employment as base) would have been required to reach full capacity in 1982?
70. check on 71
71. Could 1982's production level have been achieved with less employment? If so, by how much less compared with actual employment?
72. check on 73
73. How high is production activity now (first quarter 1983) as a percent of practically achievable capacity?
74. check on 75
75. How many months would be required (for technical or labor market reasons) to increase capacity utilization to 100%?
76. check on 77
77. How large an increase in employment would be required to reach full capacity utilization?

Prices

Expected percent change in average product price 1982–83

78. check on 79
79. Domestic sales
80. check on 81
81. Exports

More Questions on Input Purchases

82. check on 83–85

Has the percent of input purchases coming from abroad (1982 vs 1981)

83. Increased

1982 Planning Survey, continued

84. Been approximately unchanged
85. Decreased
86. check on 87–89

Will the percent of planned input purchases from abroad (1983 vs 1982)

87. Increase
88. Be approximately unchanged
89. Decrease

<u>Effects of Devaluation</u>

90. check on 91
91. By what percent do you estimate the average selling price (in SEK) for your product would have changed on foreign markets between 1982 and 1983 had there been no devaluation?
92. check on 93
93. By what percent do you estimate your average sales (in SEK) would have changed on foreign markets between 1982 and 1983 had there been no devaluation?
94. check on 95
95. By what percent do you estimate that international demand (in volume) for the type of goods you produce will change on avreage between 1982 and 1983?

About how large a percentage cost savings do you think the devaluation (19% reduction in production cost increases as a result of the devaluation in October 1982) will imply for your firm?

96. check on 97
97. By the beginning of 1983?
98. check on 99.
99. By mid–1983?
100. check on 101.
101. By the beginning of 1984?
102. check on 103
103. By mid–1984?

<u>1983 Planning Survey</u>

1. <u>ID</u>

<u>Number of Employees</u>

2. 1982
3. 1983

<u>Total Wage Bill</u>, including social fees

4. 1982
5. 1983

<u>Sales</u> (million SEK, current prices, excluding indirect taxes)
Abroad, including to affiliates

6. 1982
7. 1983
8. 1984 (plan)
9. coded as zero
10. coded as zero

Domestic, including to affiliates

11. 1982
12. 1983
13. 1984 (plan)
14. coded as zero
15. coded as zero

1983 Planning Survey, continued

Raw Material and Input Goods Purchases, total
16. 1982
17. 1983
18. 1984 (plan)

Investment (million SEK, current prices)
Building and plant, including air conditioning, sanitation, etc
19. 1982
20. 1983
21. 1984 (plan)

Machinery and equipment, including transport equipment
22. 1982
23. 1983
24. 1984 (plan)

Production volume (percent change, real terms)
25. check on 26
26. 1982–83
27. check on 28
28. 1983–84 (plan)

Capacity utilization
29. check on 30
30. "By what percent could 1983's production volume have increased (as compared with 1982), assuming labor supply and product demand imposed no restraint?"
31. check on 32
32. "By what percent could 1983's production volume have increased (as compared with 1982), assuming product demand available but with the existing labor force?"
33. check on 34
34. "By what percent can 1984 production volume increase (as compared with 1983), given the already decided–upon capacity increases and with labor supply and product demand imposing no restraint?"

Orders
35. check on 36
36. Percent increase or decrease in total volume of orders as compared with this time last year.
37. check on 38
38. Percent of planned 1983 production covered by existing orders.
39. check on 40–42

Order coverage for 1984 is
40. greater than normal
41. normal
42. less than normal

Inventories
43. check on 44
44. Raw material inventories as of 83–12–31 as a percent of total purchases of raw materials (including fuels) in 1983.
45. check on 46
46. Normal ratio of raw material inventories to purchases
47. check on 48
48. Product inventories as of 83–12–31 as a percent of total 1983 sales volume
49. check on 50
50. Normal ratio of product inventories to sales volume

Supplementary Questions
51. Number of employees 1984 (plan)

1983 Planning Survey, continued

Total Manhours (1000's)
52. 1982
53. 1983
54. 1984 (plan)
55. Expected Wage Bill, including social fees, 1984
Energy and Fuel Costs
Electrical Energy, including internally generated
56. 1982
57. 1983
58. 1984 (plan)
Fuel (oil, coal, etc)
59. 1982
60. 1983
61. 1984 (plan)
More Capacity Utilization Questions
62. check on 63
63. What percent increase in employment (using 1983's actual employment as base) would have been required to reach full capacity in 1983?
64. check on 65
65. Could 1983's production level have been achieved with less employment? If so, by how much less compared with actual employment?
66. check on 67
67. How high is production activity now (first quarter 1984) as a percent of practically achievable capacity?
68. check on 69
69. How many months would be required (for technical or labor market reasons) to increase capacity utilization to 100%?
70. check on 71
71. How large an increase in employment would be required to reach full capacity utilization?
Prices
Expected percent change in average product price 1983–84
72. check on 73
73. Domestic sales
74. check on 75
75. Exports
More Questions on Input Purchases
76. check on 77–79
Has the percent of input purchases coming from abroad (1983 vs 1982)
77. Increased
78. Been approximately unchanged
79. Decreased
80. check on 81–83
Will the percent of planned input purchases from abroad (1984 vs 1983)
81. Increase
82. Be approximately unchanged
83. Decrease
Labor Shortages
84. check on 85
85. Do you currently have a shortage of labor in any occupational category?
86. check on 87–89
If so, is this shortage
87. Very large

88. Large
89. Moderate
Indicate occupational categories (yes/no)
90. Production worker
91. Other blue–collar worker
92. Technical white–collar worker
93. Other white–collar worker
<u>Training</u>
Does your firm give new employees any formal training or education?
94. check on 95
95. Blue–collar workers
96. check on 97
97. White–collar workers
If so, approximately how long does such training last for a typical new employee?
98. check on 99
99. Blue–collar worker
100. check on 101.
101. White–collar worker
<u>Service component of sales</u>
What percent of invoicing consists of services?
102. check on 103
103. 1983
104. check on 105
105. 1978
What percent of service invoicing was bought through other firms?
106. check on 107
107. 1983
108. check on 109
109. 1978.

<u>1984 Planning Survey</u>

1. <u>ID</u>
<u>Number of Employees</u>
2. 1983
3. 1984
<u>Total Wage Bill</u>, including social fees
4. 1983
5. 1984
<u>Sales</u> (million SEK, current prices, excluding indirect taxes)
Abroad, including to affiliates
6. 1983
7. 1984
8. 1985 (plan)
9. coded as zero
10. coded as zero
Domestic, including to affiliates
11. 1983
12. 1984
13. 1985 (plan)
14. coded as zero
15. coded as zero

1984 Planning Survey, continued

Raw Material and Input Goods Purchases, total
16. 1983
17. 1984
18. 1985 (plan)
Investment (million SEK, current prices)
Building and plant, including air conditioning, sanitation, etc
19. 1983
20. 1984
21. 1985 (plan)
Machinery and equipment, including transport equipment
22. 1983
23. 1984
24. 1985 (plan)
Production volume (percent change, real terms)
25. check on 26
26. 1983–84
27. check on 28
28. 1984–85 (plan)
Capacity utilization
29. check on 30
30. "By what percent could 1984's production volume have increased (as compared with 1983), assuming labor supply and product demand imposed no restraint?"
31. check on 32
32. "By what percent could 1984's production volume have increased (as compared with 1983), assuming product demand available but with the existing labor force?"
33. check on 34
34. "By what percent can 1985 production volume increase (as compared with 1984), given the already decided–upon capacity increases and with labor supply and product demand imposing no restraint?"
Orders
35. check on 36
36. Percent increase or decrease in total volume of orders as compared with this time last year.
37. check on 38
38. Percent of planned 1985 production covered by existing orders.
39. check on 40–42
Order coverage for 1985 is
40. greater than normal
41. normal
42. less than normal
Inventories
43. check on 44
44. Raw material inventories as of 84–12–31 as a percent of total purchases of raw materials (including fuels) in 1984.
45. check on 46
46. Normal ratio of raw material inventories to purchases
47. check on 48
48. Product inventories as of 84–12–31 as a percent of total 1984 sales volume
49. check on 50
50. Normal ratio of product inventories to sales volume
Supplementary Questions
51. Number of employees 1985 (plan)

1984 Planning Survey, continued

<u>Total Manhours</u> (1000's)
52. 1983
53. 1984
54. 1985 (plan)
55. Expected Wage Bill, including social fees, 1985
<u>Other costs</u>
56. 1983
57. 1984
<u>Energy and Fuel Costs</u>
Electrical Energy, including internally generated
58. 1983
59. 1984
60. 1985 (plan)
Fuel (oil, coal, etc)
61. 1983
62. 1984
63. 1985 (plan)
<u>More Capacity Utilization Questions</u>
64. check on 65
65. What percent increase in employment (using 1984's actual employment as base) would have been required to reach full capacity in 1984?
66. check on 67
67. Could 1984's production level have been achieved with less employment? If so, by how much less compared with actual employment?
68. check on 69
69. How high is production activity now (first quarter 1985) as a percent of practically achievable capacity?
70. check on 71
71. How many months would be required (for technical or labor market reasons) to increase capacity utilization to 100%?
72. check on 73
73. How large an increase in employment would be required to reach full capacity utilization?
<u>Prices</u>
Expected percent change in average product price 1984–85
74. check on 75
75. Domestic sales
76. check on 77
77. Exports
<u>More Questions on Input Goods Purchases</u>
78. check on 79–81
Has the percent of input purchases coming from abroad (1984 vs 1983)
79. Increased
80. Been approximately unchanged
81. Decreased
82. check on 83–85
Will the percent of planned input purchases from abroad (1985 vs 1984)
83. Increase
84. Be approximately unchanged
85. Decrease
<u>Labor Shortages</u>
86. check on 85

1984 Planning Survey, continued

87. Do you currently have a shortage of labor in any occupational category?
88. check on 89–91

If so, is this shortage

89. Very large
90. Large
91. Moderate

Indicate occupational categories (yes/no)

92. check on 93
93. Production worker
94. check on 95
95. Technical white–collar worker
96. check on 97
97. Other

<u>1985 Planning Survey</u>

1. <u>ID</u>

<u>Number of Employees</u>

2. 1984
3. 1985

<u>Total Wage Bill</u>, including social fees

4. 1984
5. 1985

<u>Sales</u> (million SEK, current prices, excluding indirect taxes)

Abroad, including to affiliates

6. 1984
7. 1985
8. 1986 (plan)
9. coded as zero
10. coded as zero

Domestic, including to affiliates

11. 1984
12. 1985
13. 1986 (plan)
14. coded as zero
15. coded as zero

<u>Raw Material and Input Goods Purchases</u>, total

16. 1984
17. 1985
18. 1986 (plan)

<u>Investment</u> (million SEK, current prices)

Building and plant, including air conditioning, sanitation, etc

19. 1984
20. 1985
21. 1986 (plan)

Machinery and equipment, including transport equipment

22. 1984
23. 1985
24. 1986 (plan)

<u>Production volume</u> (percent change, real terms)

25. check on 26
26. 1984–85

1985 Planning Survey, continued

27. check on 28
28. 1985–86 (plan)

<u>Capacity utilization</u>

29. check on 30
30. "By what percent could 1985's production volume have increased (as compared with 1984), assuming labor supply and product demand imposed no restraint?"
31. check on 32
32. "By what percent could 1985's production volume have increased (as compared with 1984), assuming product demand available but with the existing labor force?"
33. check on 34
34. "By what percent can 1986 production volume increase (as compared with 1985), given the already decided–upon capacity increases and with labor supply and product demand imposing no restraint?"

<u>Orders</u>

35. check on 36
36. Percent increase or decrease in total volume of orders as compared with this time last year.
37. check on 38
38. Percent of planned 1986 production covered by existing orders.
39. check on 40–42

Order coverage for 1986 is

40. greater than normal
41. normal
42. less than normal

<u>Inventories</u>

43. check on 44
44. Raw material inventories as of 85–12–31 as a percent of total purchases of raw materials (including fuels) in 1985.
45. check on 46
46. Normal ratio of raw material inventories to purchases
47. check on 48
48. Product inventories as of 85–12–31 as a percent of total 1985 sales volume
49. check on 50
50. Normal ratio of product inventories to sales volume

<u>Supplementary Questions</u>

51. Number of employees 1986 (plan)

<u>Total Manhours</u> (1000's)

52. 1984
53. 1985
54. 1986 (plan)
55. Expected Wage Bill, including social fees, 1986

<u>Other costs</u>

56. 1984
57. 1985

<u>Energy and Fuel Costs</u>

Electrical Energy, including internally generated

58. 1984
59. 1985
60. 1986 (plan)

Fuel (oil, coal, etc)

61. 1984

1985 Planning Survey, continued

62. 1985
63. 1986 (plan)

More Capacity Utilization Questions

64. check on 65
65. What percent increase in employment (using 1985's actual employment as base) would have been required to reach full capacity in 1985?
66. check on 67
67. Could 1985's production level have been achieved with less employment? If so, by how much less compared with actual employment?
68. check on 69
69. How high is production activity now (first quarter 1986) as a percent of practically achievable capacity?
70. check on 71
71. How many months would be required (for technical or labor market reasons) to increase capacity utilization to 100%?
72. check on 73
73. How large an increase in employment would be required to reach full capacity utilization?

Prices

Expected percent change in average product price 1985–86

74. check on 75
75. Domestic sales
76. check on 77
77. Exports

More Questions on Input Goods Purchases

78. check on 79–81

Has the percent of input purchases coming from abroad (1985 vs 1984)

79. Increased
80. Been approximately unchanged
81. Decreased
82. check on 83–85

Will the percent of planned input purchases from abroad (1986 vs 1985)

83. Increase
84. Be approximately unchanged
85. Decrease

How large a fraction of the cost of raw material and input goods purchases came from abroad?

86. check on 87
87. 1980
88. check on 89
89. 1985

1986 Planning Survey

1. ID

Number of Employees

2. 1985
3. 1986

Total Wage Bill, including social fees

4. 1985
5. 1986

1986 Planning Survey, continued

Sales (million SEK, current prices, excluding indirect taxes)
Abroad, including to affiliates
6. 1985
7. 1986
8. 1987 (plan)
9. coded as zero
10. coded as zero
Domestic, including to affiliates
11. 1985
12. 1986
13. 1987 (plan)
14. coded as zero
15. coded as zero
Raw Material and Input Goods Purchases, total
16. 1985
17. 1986
18. 1987 (plan)
Investment (million SEK, current prices)
Building and plant, including air conditioning, sanitation, etc
19. 1985
20. 1986
21. 1987 (plan)
Machinery and equipment, including transport equipment
22. 1985
23. 1986
24. 1987 (plan)
Production volume (percent change, real terms)
25. check on 26
26. 1985–86
27. check on 28
28. 1986–87 (plan)
Capacity utilization
29. check on 30
30. "By what percent could 1986's production volume have increased (as compared with 1985), assuming labor supply and product demand imposed no restraint?"
31. check on 32
32. "By what percent could 1986's production volume have increased (as compared with 1985), assuming product demand available but with the existing labor force?"
33. check on 34
34. "By what percent can 1987 production volume increase (as compared with 1986), given the already decided–upon capacity increases and with labor supply and product demand imposing no restraint?"
Orders
35. check on 36
36. Percent increase or decrease in total volume of orders as compared with this time last year.
37. check on 38
38. Percent of planned 1987 production covered by existing orders.
39. check on 40–42
Order coverage for 1987 is
40. greater than normal

1986 Planning Survey, continued

41. normal
42. less than normal

Inventories

43. check on 44
44. Raw material inventories as of 86–12–31 as a percent of total purchases of raw materials (including fuels) in 1986.
45. check on 46
46. Normal ratio of raw material inventories to purchases
47. check on 48
48. Product inventories as of 86–12–31 as a percent of total 1986 sales volume
49. check on 50
50. Normal ratio of product inventories to sales volume

Supplementary Questions

51. Number of employees 1987 (plan)

Total Manhours (1000's)

52. 1985
53. 1986
54. 1987 (plan)
55. Expected Wage Bill, including social fees, 1987

Other costs

56. 1985
57. 1986

Energy and Fuel Costs

Electrical Energy, including internally generated

58. 1985
59. 1986
60. 1987 (plan)

Fuel (oil, coal, etc)

61. 1985
62. 1986
63. 1987 (plan)

More Capacity Utilization Questions

64. check on 65
65. What percent increase in employment (using 1986's actual employment as base) would have been required to reach full capacity in 1986?
66. check on 67
67. Could 1986's production level have been achieved with less employment? If so, by how much less compared with actual employment?
68. check on 69
69. How high is production activity now (first quarter 1987) as a percent of practically achievable capacity?
70. check on 71
71. How many months would be required (for technical or labor market reasons) to increase capacity utilization to 100%?
72. check on 73
73. How large an increase in employment would be required to reach full capacity utilization?

Prices

Expected percent change in average product price 1986–87

74. check on 75
75. Domestic sales
76. check on 77
77. Exports

1986 Planning Survey, continued

More Questions on Input Goods Purchases
78. check on 79–81
Has the percent of input purchases coming from abroad (1986 vs 1985)
79. Increased
80. Been approximately unchanged
81. Decreased
82. check on 83–85
Will the percent of planned input purchases from abroad (1987 vs 1986)
83. Increase
84. Be approximately unchanged
85. Decrease
Service component of sales
What percent of sales in 1986 consisted of services
86. check on 87
87. Services sold in connection with goods (installation, maintenance)
88. check on 89
89. Services sold separtely (technical services, data services)
90. check on 91
91. Total services
Economic life length of capital equipment
92. check on 93
93. Expected economic life length of the most recently installed piece of important equipment (in years).
94. check on 95
95. Expected economic life length of recently constructed plant (years)
Depreciation
Which write–off method do you regard as the economically best way to depreciate machines?
96. check on 97–99.
97. straight–line
98. accelerated
99. other
Second–hand market
Is there a functioning second–hand market for your more important types of machines?
100. check on 101–103
101. Not at all
102. To some degree
103. Very much so.

Appendix 2: SAS Panel Dataset

The dataset consists of 46 SAS variables. Four of these variables are "index variables" — the observations are indexed by establishment, by year, by industry, and by their APL codes in the cross–sectional data.; 31 variables come from the core part of the Planning Survey ("core variables"); and 11 variables contain information from the supplementary part of the Planning Survey ("supplementary variables"). Missing data are coded as –99.

A. Index Variables

I: Establishment index
Takes on the values 1, 2,...,xx

T: Year index
Takes on the values 75, 76,...,86

IND: Industry code
Takes on the values 1.1, 1.2,...,5 as shown below.

1. Raw Materials Processing
   - 1.1 Iron and Steel
   - 1.2 Non–Ferrous Metals
   - 1.3 Saw Works
   - 1.4 Pulp
2. Intermediate Goods
   - 2.1 Chemicals
   - 2.2 Metal Working
   - 2.3 Paper
3. Investment Goods
   - 3.1 Machinery
   - 3.2 Electronics
   - 3.3 Office Furniture
   - 3.4 Shipbuilding
4. Consumption Goods
   - 4.1 Food–Tobacco–Beverages
   - 4.2 Textiles–Shoes–Leather
   - 4.3 Pharmecueticals
   - 4.4 Consumer Durables
   - 4.5 Graphics
   - 4.6 Furniture
5. Building Materials

APL: APL code in cross–sectional data
Takes on the values 1.01,..etc

B. Core Variables

These are the variables that are available for all years (with some exceptions in 1975).

LLAG: Number of Employees in T–1
L: Number of Employees in T

****The following variables are in current prices, million SEK****
WLAG: Total Wage Bill (including social fees) in T–1
W: Total Wage Bill (including social fees) in T
S1LAG: Sales Abroad (including to affiliates) in T–1
S1: Sales Abroad (including to affiliates) in T
S1EXP: Sales Abroad (including to affiliates) in T+1 (expected)
S2LAG: Sales Domestic (including to affiliates) in T–1
S2: Sales Domestic (including to affiliates) in T
S2LAG: Sales Domestic (including to affiliates) in T+1 (exp)
RLAG: Raw Material and Input Good Purchases in T–1
R: Raw Material and Input Good Purchases in T
REXP: Raw Material and Input Good Purchases in T+1 (expected)
I1LAG: Investment Expenditures, Plant and Building (including air conditioning, sanitation, etc) in T–1
I1: Investment Expenditures, Plant and Building (including air conditioning, sanitation, etc) in T
I1EXP: Investment Expenditures, Plant and Building (including air conditioning, sanitation, etc) in T+1 (expected)
I2LAG: Investment Expenditures, Machinery and Equipment, (including transport equipment) in T–1
I2: Investment Expenditures, Machinery and Equipment, (including transport equipment) in T
I2EXP Investment Expenditures, Machinery and Equipment, (including transport equipment) in T+1 (expected)
****Percents Expressed in Whole Numbers***
DQ: Production Volume — Percent Change from T–1 to T
DQEXP: Production Volume — Percent Change from T to T+1 (exp)
Note: To use A21 and SUM to compute utilization rates, one needs first to subtract off DQ*
SUM: "By what percent could year T's production volume have increased (as compared with T–1), assuming labor supply and product demand imposed no constraint?"
A21: "By what percent could year T's production volume have increased (as compared with T–1), assuming product demand available but with the existing labor force?"
DC: "By what percent can year T+1's production volume increase (as compared with T), given already decided–upon capacity increases and assuming labor supply and product demand impose no restraint?"
DORDER: Percent change in orders from T–1 to T
COVER1: Percent of planned production in T+1 covered by existing orders
COVER2: Order coverage for T+1 (–1 = less than normal; 0 = normal; 1 = greater than normal)
RSTO: Raw materials inventories as of the end of year T as a percent of total purchases of raw materials in T (including fuels)
NORMRS: Normal ratio of raw materials inventories to purchases

STO: Product inventories as of end of year T as a percent of total sales in year T

NORMST: Normal ratio of product inventories to sales volume

C. Supplementary Variables

COST: Total Costs (labor costs + raw material/input goods costs + "other costs")
(available from 1984–86)

ELAG: Electricity Costs in T–1 (including internally generated)
(available from 1978–86)

E: Electricity Costs in T (including internally generated)
(available from 1978–86)

FLAG: Fuel costs in T–1 (coal, oil, etc)
(available from 1978–86)

F: Fuel costs in T (coal, oil, etc)
(available from 1978–86)

HLAG: Total manhours (in 1000's) in T–1
(available from 1980–86)

H: Total manhours (in 1000's) in T
(available from 1980–86)

K1: Replacement value of capital stock (building and plant) as of 31 December 1979

K2: Replacement value of capital stock (machinery and equipment) as of 31 December 1979

MLR: "What increase in employment in year T (compared with actual employment that year) would have been required to reach full capacity?"
(available from 1980–86)

RED: "Could year T's production level have been achieved with less employment? If so, by how much less as compared with actual employment in T (in percentage terms)?"
(available from 1980–86)

CHAPTER IV

Competence, Capacity and Capital: A Description of a Complementary IUI Firm Survey of Small and Large Firms and of Subcontractors

Pontus Braunerhjelm

CONTENTS

Tables

1 Introduction

The Industrial Institute for Economic and Social Research (IUI) has a long tradition of working with data collected directly from firms, using their own definitions and interpreting the data in the light of the particular purposes for which such internal data have been put together (Eliasson 1985b). The advantage of gathering and processing information directly and independently is threefold: increased quality of data, a more relevant selection of data and comparability of data over time. IUI's good relations with the firms also make it relatively easy to gain access to otherwise confidential data.

The "traditional" databases of IUI are the yearly planning survey (see Albrecht's Chapter III in this volume) carried out jointly with the Federation of Swedish Industries, covering manufacturing *firms and/or divisions* in Sweden since 1975, and the large surveys on the *international operations of Swedish firms* (Swedenborg 1979, 1982, Swedenborg et al. 1988, Eliasson 1984b, Eliasson et al. 1985a. Sections 4 and 5 in this chapter give a brief description of the database and its connection to other IUI databases). Those databases have recently been complemented with two new sets of data *on firms*, collected in 1989 and 1990. The first data set covers medium and large sized firms, predominantly located in Sweden, whereas the latter comprises small Swedish firms and subcontractors.[1] The background of these surveys is the rapid transformation of Europe due to the EC 1992 program and the restructuring of East Europe (Braunerhjelm 1990, 1991a). All these data sets are now being consolidated within the context of the micro-to-macro model. (See Chapter I in this volume.)

This chapter focuses on the contents of the two special IUI "firm surveys". The data sets include information on the firms' degree of international operations, the quality of the labor force and the nature of capital employed in the firm (traditional

[1] The participating small firms—small being defined as having between 20 and 200 employees—make up a random sample from the firm register at the National Bureau of Statistics (SCB). Subcontractors make up a random sample from a population put together by IUI using different sources. At the time of the investigation there were no official statistics available on subcontractors. Subcontractors are defined as producers of intermediate products exposed to international competition—either through the internationalization of their customers or their international contacts—displaying a high degree of customer dependence (one customer should receive at least 20% of their production).

fixed capital complemented with more untraditional data on "soft" capital, such as investments in software, marketing, technical knowledge etc.). In addition to these "structural" data, the standard questions of the planning survey were asked (the questionnaire is found in Appendix 2). Altogether the data make possible an analysis of the sources of international competitiveness of firms, emphasizing the importance of human embodied team competence (Braunerhjelm–Eliasson 1991b).

Some questions asked in the new survey have been tested and asked in earlier special surveys, complementary to the planning survey. Special questions on the contents of manufacturing production, notably its service and information contents were added for 1976 and 1982–1985 in the planning survey. Furthermore, a special "service questionnaire" was designed in 1983. This database contains information on the degree and type of service production in different subindustries (see Deiaco and Pousette–Lindberg, pages 107 and 165 in Eliasson et al. 1986). In addition, a special questionnaire to private service producers, on the format of the planning survey, was designed and tested in 1989. Lack of funding, however, has prevented us from carrying it out so far.

This chapter divides naturally into two parts. The first part (section 2) presents the extension of the planning survey to small firms, subcontractors and foreign operations, using *the firm* rather than the division as observation unit. The second part (section 3) concentrates on the structural data. It particularly attempts to measure firm stocks of human-based knowledge. This study builds on earlier studies conducted at IUI (Eliasson et al. 1986, Eliasson 1990). The chapter includes a discussion of the problem of choosing the appropriate units of measurement and to whom the questions should be addressed. In other words, what data are available where in the firm? A plan for the organization of future data collection concludes the chapter.

2 Extension of the planning survey

Internationalization has become one of the key-perceived strategies for corporate success. Deregulation during the postwar period, the development of modern communications technologies and decreasing costs in transportation have prompted such development. The fact that some firms lacked competence to internationalize successfully and failed, has not changed the prevailing view that internationalization is necessary to stay competitive. Hence, the analysis of firms requires that foreign operations be incorporated. While the planning survey covers domestic activities only, the observation unit in the 1989 firm survey is the firm, globally defined.

The 1990 survey covers small firms and subcontractors and is designed to correspond with the regular planning survey. It continues the pilot surveys undertaken in 1986 and 1987 (Virin 1986, 1987).

The questionnaires sent out to firms in the 1989 and the 1990 surveys consist of two parts; the first part deals with information taken directly from the annual reports of firms and, in addition, structural factors (knowledge capital, internationalization, markets). The questionnaire naturally refers to the firm as the observation unit. The second set of questions is oriented towards expectations of firms with respect to the EC 1992, their main competitive advantages and alike information. The presentation below emphasizes the information gathered in the first part of the questionnaire. I will begin by describing the 1989 survey.

2.1 Description of the 1989 database

The sample of firms in the 1989 database follows the respondents of the planning survey as closely as possible. Whenever possible, divisions have been systematically consolidated. The observation year is 1988 except for gross investment where data were collected for 1986–1988 and a (by the firms) predicted figure for 1992.

Most of the data are reported on regions, notably Sweden, the EC and the rest of the world (RoW). Firms can also be identified with respect to subindustries, whether they belong to a Swedish firm or have a foreign affiliation etc. The database covers 140 firms.

2.1.1 Sales and cost data

The sales and cost data are from the profit and loss accounts of the annual reports. Data are matched with internal data on R&D, marketing, administration, wages, etc. Expenditure on the purchase of intermediate products and unprocessed goods is included as well as costs for external purchases of services. For practically all these data the location of production is regionally distributed on Sweden, the EC and the RoW (cf. the distribution of labor productivities and rates of return between Sweden and the EC in the machinery industry in Figures 1 and 2).

As in the regular planning survey, data on capacity utilization and the different restrictions that prevent operation at full capacity utilization are reported. Furthermore, data on firms' assets—as recorded in their balance sheets for fixed and current assets—as well as on how these are distributed between Sweden and foreign countries have been collected. This allows the comparison of rates of return in different regions (see Figure 2).

2.1.2 Internationalization and market

Structural data relate to the firms' specialization and their dependence on other firms, their internationalization and their competence level. These data make it possible to identify the source and origin of firm competitiveness (see Section 3).

The 1989 survey provides market data on specialization down to the three-digit level (when possible, down to the 6-digit level). A variety of additional market data have been collected in the 1990 survey to which I shall return in Section 2.2.

With regard to the degree of internationalization of firms, the data set contains information on exports from the Swedish units to the EC and the RoW. Moreover, exports to the EC are divided between intra-firm exports and other exports. Intra-firm exports are then classified with respect to their use; as investment goods, as intermediate products to be further processed and, finally, as goods for sale directly through the foreign subsidiary (Table 1).

Table 1 Intra-firm export to the EC as percentage of total export in different subindustries, large firms, 1988

	Percentage intra-firm export	of which for direct sale	of which are goods in process	of which are investment goods
Food industry	37	95	5	0
Paper and Pulp	26	86	14	0
Machinery	53	60	32	8

Source: Braunerhjelm 1990.

Import patterns of goods and services of individual firms have been collected, with imports divided on the EC and imports from the rest of the world. Whenever possible, imports from the EC have been shown as intra-firm and other imports. Thus, the firms' overall purchase of goods and services can be distributed on foreign and domestic sources. Intra-firm trade is one way to capture the dependence of Swedish firms of the EC market.

The regional distribution of investment and the allocation of firm assets —discussed in the previous section—constitute an additional measure of the degree of internationalization.

2.2 Small firms and subcontractors; the 1990 survey

The survey in 1990 to small firms and subcontractors is a follow-up of the 1989 survey. The questionnaire has been designed to make comparisons with the result of the 1986 and 1987 surveys to small firms possible. The 1990 survey is, however, much more detailed. In particular, more attention has been directed towards the firms' specialization in production (divided into 6 groups, Figures 3a,b), their dependence on different markets and customers (Figures 4a,b), links to the large Swedish multinationals, etc. Moreover, for some of the firms data on expectations (as well as on past performance) of sales, prices, and inventory stocks, have been included. Some of the expectations variables refer to both domestic and foreign markets.

The survey covers a sample of 115 firms, although non-response is high for some difficult questions. Firms are classified according to whether they are subcontractors, foreign or domestically owned subsidiaries, or whether they belong to a group of small, independent firms. All the accounting data of the 1989 survey are available (sales, costs, investment, etc.), as are data on foreign activities, exports, assets and expectations with regard to the EC 1992 program. Most of the accounting data have been collected for 1988–1989 and in some cases up to 1990. This time only data on labor, fixed assets, gross investment and exports are given on Sweden and foreign countries (foreign countries are divided into the Nordic countries, the EC and the RoW). No data are available (in the 1990 survey) on imports, purchases of services and intra-firm trade. Labor productivities and rates of return can be derived from the data set (as an example, consider the distribution of the real rate of return on firms of different sizes in Figure 5).

3 Firm competence

We have attempted to obtain measures on specific firm competence, by asking questions on the firms' internal education costs, the skill composition of its labor force, R&D and marketing expenditures. Firms have also provided estimates on their hidden, "soft", capital not reported in their balance sheet, defined to be comparable to recorded tangible assets. We have asked for data on all assets—tangible and non-tangible—expressed in repurchasing value, after appropriate depreciation charges. Since these data are not part of the standard information set available at the corporate headquarters (CHQ) we have encountered special difficulties. Our prior tests of questionnaires with firms, however, indicate that firms could supply meaningful data.

3.1 "Soft" capital

To bring together "soft" capital with the firms' tangible assets is not altogether uncontroversial. Economists are used to looking at standard balance sheets, but get confused when the new data show up, even though the definition and measurement problems are the same (see Eliasson's Chapter I, Section 4.4). Complementary interviews and other studies demonstrate, however, that investments in soft capital are becoming increasingly important for firm profit performance. From a macro perspective such capital also carries implications for an economy's flexibility and ability to adjust to external shocks. A global competitive edge requires unique skills in—and continuous upgrading of—organizational learning, internal communication, marketing, R&D, etc. However, investments in such "soft" capital are—for legal and traditional reasons—not shown on the balance sheet. As a consequence, assets are generally underestimated.

As an example, consider a firm's effort to capture a share of the market in a country formerly not penetrated by the firm. The firm allocates resources to different marketing activities, establishes contact with retail dealers etc. These are long-run investments and profit effects are expected to show only after many years. Still, such investments are charged as a whole as current costs in the profit and loss statement. Quite often this means that the division undertaking the investment is reporting a loss for several years.

Firms participating in the survey have calculated how much of their expenditure on computer software, marketing, education and R&D that should be regarded as an investment, the rest being charged to the current cost account. After depreciation, the repurchasing value of the stock of these assets has been calculated (Tables 2 and 3). For some of the categories, notably internal education, data were not available at CHQ, but had to be based on specifications from divisions and establishments.

Table 2 The composition of production capital in Swedish manufacturing firms

	9 largest firms		17 largest firms	Planning survey firms	Sample of subcontractors (ISIC 38)	Sample of small firms (ISIC 38)
	1985	1988	1988	1988	1989	1989
1 Machines and buildings	53	50	70	62	89	80
2 Software	n.a.	7	6	5	2	4
3 Technical know-how (R&D) capital	17	16	13	21	4	11
4 Marketing capital	20	19	6	10	3	3
5 Educational capital	10	8	5	2	2	2
6 Total (percent)	100	100	100	100	100	100

Source: Braunerhjelm 1990, 1991a. For the data from 1985, see Eliasson 1990.

Table 3 **The composition of production capital in different Swedish industries**
Percent

	Fixed capital	R&D capital	Marketing capital	Educational capital	Software capital
Food industry	90	4	3	2	1
Paper and Pulp	91	2	2	2	3
Machinery	62	21	10	2	5

Source: Braunerhjelm 1990.

Since information on "soft" capital is available only after special calculations based on the internal accounts of firms, some of the data for the firms in Table 2 have been estimated on the basis of subindustry averages, or the average for a similar group of firms. Some data have been collected through telephone interviews.[2]

The table reveals a number of interesting things. For instance, as the number of firms increases from 9 to 17, the share of fixed assets increases to 70 percent. The explanation is that the additional 8 firms belong to Swedish basic industries (forestry, steel), which are hardware production intensive and exhibit relatively low investments in "soft" capital. Furthermore, the figures suggest that the importance of traditional, fixed capital has diminished even in such a short time as 3 years.

3.2 Other competence variables

The distribution of cost variables measuring competence (the costs of R&D, marketing and education) in firms of different sizes is shown in Table 4. Apparently, small firms and subcontractors devote substantially less resources on competence account than do large firms.

[2] Obviously unrealistic values have been omitted from Tables 2 and 3, even though they are still kept in the database files to be checked in later surveys.

Table 4 R&D, marketing and education expenditures as percentage of the firms' total costs, 1989

	R&D	Marketing*	Education	Sum
Small firms	.8	4	.3	5.1
Subcontractors	1.5	3	2	6.5
Large firms	9	5	2	16

* The figures relate to the domestic parts of the firms which explains the low marketing figures for large firms.

Source: Braunerhjelm 1990, 1991a.

The data also allow the firms' labor force to be decomposed by educational level. As illustrated by Table 5, the structure of the labor force displays huge differences between firms of different sizes. This could significantly influence the firms' capability of adjustment to changing market conditions, as for instance in response to the restructuring of Europe.

Table 5 The skill composition of the labor force in firms of different sizes, 1982, 1988, 1990

<table>
<tr><th></th><th>Small firms 1990</th><th>Subcon-tractors 1990</th><th>Large firms 1988</th><th>Large firms 1982</th></tr>
<tr><td>Executive staff</td><td>5</td><td>3</td><td>2</td><td>4</td></tr>
<tr><td>Specialists, middle management</td><td>9</td><td>7</td><td>11</td><td>12</td></tr>
<tr><td>White collar</td><td>16</td><td>15</td><td>29</td><td>20</td></tr>
<tr><td>Skilled worker</td><td>46</td><td>35</td><td>25</td><td rowspan="2">64</td></tr>
<tr><td>Unskilled worker</td><td>24</td><td>40</td><td>33</td></tr>
<tr><td>Total</td><td>100</td><td>100</td><td>100</td><td>100</td></tr>
</table>

Source: Braunerhjelm 1990, 1991a.
The 1982 shares are estimates based on the IUI service survey in 1983 (see Eliasson et al. 1986).

4 The surveys of Swedish manufacturing multinationals

Over the years IUI has conducted 5 surveys on the entire population of Swedish multinationals, covering the years 1965, 1970, 1974, 1978 and 1986 (Swedenborg

1973, 1979, 1982, Swedenborg et al. 1988). There is an early and not as complete study with data for 1960 (Lund 1967). A new survey is planned for the year of 1990. These surveys have an exceptionally high response rate (approximately 95% of the firms have answered the questionnaire) which allows unique micro panel studies. The incidence of Swedish direct investment and production abroad over different regions and nations, as well as its extent, can thus be traced to the early 60s (Lund 1967). Data are available on employment, the relation between production and sales companies, sales and acquisitions of foreign subsidiaries etc. Information is also reported for the particular country in which the Multinational Firm (MNF) has its foreign operations. Hence, country and regional dimensions of MNF activity can be shown.

These surveys, except the last one, originally had nothing to do with the MOSES Database. Some work has, however, been done on integrating the MNF firm/group data with the matching planning survey data. (See Eliasson et al. 1985a, p. 30 ff. and Bergholm–Jagrén 1985, p. 110 ff.). This work will continue, with the ambition of completing a firm panel with domestic and foreign firm operations kept separate for the years covered in the surveys. This data set will constitute part of the MOSES Database.

5 Choice of observation unit—who knows what, where?

A major database problem in MOSES work has been to consolidate financial data in the firm with production data sets for the establishment or division levels. In modern manufacturing firms CHQ management is increasingly removing itself from operational responsibilities below the division level (Eliasson 1976, Eliasson et al. 1985a). This means that the "rich" databases on production available at CHQ level in centralized firms are increasingly being removed to division level. There is not even a guarantee that division production data will be consistent with overall firm financial data. The "firm planning surveys" reported on in this chapter, rather than the "establishment and division" planning surveys in Albrecht's Chapter III, were partly motivated by a desire to obtain the necessary data from *one* source only.

However, switching from one source of information to another raises new problems. The unit of measurement that is controlled and measured by division management may not be identical with the unit of account (the division) that CHQ controls and measures. These measurement problems are large and are subject to separate inquiries at IUI, not yet ready. For MOSES purposes we need the units that CHQ measures and controls. We do not yet know to what extent these units are the same as the planning survey units. The way the planning survey was designed, we believe, makes the matching effective. The large firm, however, runs a large number of units and subsidiaries, especially in the service area, that are not covered by the planning survey. It is even possible that significant foreign value added has been classified as domestic value added in previous surveys, due to the design of the questionnaire. Therefore, a questionnaire incorporating a conversion matrix (see Section 5.1 below) has been designed to be completed at CHQ, on the format of the MOSES model firm, later to be used to consolidate and check planning survey data.

This method saves survey time, but moves the cost of collecting the information on to the firm and creates a quality problem. Either CHQ of the large firm sends out an internal questionnaire to collect the data, which increases the probability of non-response, or completes the form on its own, with the risk of entering data of bad quality. On the latter score, which seems to be the common procedure, one could say that this is better for MOSES use, since we obtain the data available and used for decision making at CHQ. Furthermore, one would guess that CHQ data, even though of lower quality than the division and establishment data for operational use, exhibit better consistency with corporate financial accounts.

5.1 Conversion matrix between planning survey, multinational firms, and firm surveys

The planning survey units have been defined as the smallest, financially defined and reasonably stable decision units (see Eliasson 1985b, p. 363 ff.). This corresponds to the division concept, sometimes a small firm, sometimes an establishment. A division consists of a bunch of product groups. A product group is normally the smallest unit within a firm for which a complete profit and loss statement (not a balance sheet) can be composed. It is also referred to as profit centers for which single valued profit control can be defined (Eliasson 1976 Chapter 11; see also

Table 8 in Chapter I above). The division is the smallest unit for which a balance sheet can be naturally made up. A division almost always has a one to one interface with a well defined market. It is, however, also possible to ask division heads about production data.

Divisions are coordinated financially at CHQ. The point with the conversion matrix (Table 6) is to ask CHQ about data available for their coordination and control purposes and to check consistency with the data gathered in the regular planning surveys. Assuming the consistency to be good, the conversion matrix allows for the integrated use of all these databases at IUI that make up the MOSES Database. This would considerably enrich the potential for relevant empirical analysis.

Table 6 The conversion matrix

DIVISIONS		Division 1	Division 2	...	Division N	The rest	Value Added contribution
Percent Domestic Value Added contributions		Planning survey	Planning survey	...	Planning survey	CHQ	Total domestic division Value Added contribution y percent
Percent Foreign Value Added contributions		MNF survey	MNF survey	...	MNF survey	CHQ	Total foreign division Value Added production z percent
Total division	Percent	100	100		100	100	y+z = 100
Value Added contributions	Million SEK	x	x		x	x	Total firm Value Added million SEK

The CHQ of a large corporation coordinates and controls divisional activities. This requires time consistent measures of firm performance. Since the internal measurement system of a firm is designed to represent internal structures that are constantly changing, the reliable use of such information systems requires a long experience in their interpretation. CHQ management are therefore unwilling to change their internal principles of measurement, since it may seriously reduce the interpretability of internal data (Eliasson 1976).

The interpretation of internal accounts has been particularly difficult in conjunction with the classical problem of identifying the source of profits in an international firm. CHQ wants to understand and control the inner life of a complex organization through an information system designed to suit their problems. Tax literature has discussed the equitable distribution of profits in multinational firms for years, and much attention has been directed at how—and if—firms manipulate profits through their transfer pricing practices (see Eliasson 1972). Is the high rate of return in foreign subsidiaries compared to domestic operations wrong in Figure 2, because firms have charged too little for their R&D services to foreign subsidiaries?

The extension of the firm planning survey and the new survey to multinationals will shed empirical light on these questions. However, the argument for biased profit reporting is probably misleading for two reasons. First of all, although "R&D assets" reside in Sweden, even larger stocks of "marketing assets" reside in foreign subsidiaries. Secondly, if a Swedish production unit tries to sell its intangible goods to unrelated foreign firms (instead of their own foreign subsidiaries) they may have to be satisfied with even lower prices. Hence, while the parent may be charging too little for R&D services, the foreign subsidiary might be satisfied with a too small margin for their marketing services.[3] Consequently, it is decisive that the actual principles by which transfer prices are set within large business organizations are understood.

Transfer price systems incorporate certain basic principles. First of all, each transfer price system used generates its particular "profit incidence". Firms prefer to use rather simple and (internally) non-manipulatable transfer price systems that may appear arbitrarily designed to the outsider analyst or tax accountant, but allow CHQ to identify profits and losses properly and to exercise internal cost control accordingly. It is an important part of the firms' internal information system. As a consequence CHQ management does not want to change its transfer price principles since the loss of internal information quality and control probably overshadows by far the tax benefits that can be earned (Eliasson 1972, 1976). The

[3] The large overall profit contribution from international markets is illustrated for two East European firms in Eliasson (1991b). The East European firms obtain a very low sales price since they have to use a western agent to market and distribute their products.

transfer price system used, hence, always embodies an arbitrary, profit distribution bias with special characteristics for each firm.

According to Eliasson (1972) generous corporate tax advantages in Sweden may have induced firms in the 60s to exaggerate their profits in Sweden. There are no indications that a reversal of this bias should be expected for recent years. Under this presumption the rate of return difference between the foreign and domestic activities in Figure 2 may even be underestimated. This problem however, is a typical accounting problem that has to be addressed in the design of further firm planning surveys.

6 Final remarks

The two data sets—the EC survey and the survey on small firms and subcontractors—described above have been developed for their specific purposes; to investigate the effects of the EC 1992 program on the Swedish economy. An example is given in Figure 6 (see also Figure 2), where the vulnerability of subcontractors to increased costs (or to lower prices), i.e. intensified competition, is shown. In fact, the MOSES model will be used to systematically quantify the macro consequences of the EC 1992 on Sweden. This analysis requires structural data on competence attributes, such as internationalization, marketing, etc., which are not available on a routine basis from corporate accounts. The material is classified in such a way that both sector and firm data are readily accessible (Braunerhjelm 1990, 1991a). Altogether the two databases contain approximately 35 000 observations on 260 Swedish firms of different sizes in different sectors.

In the future the ambition is to repeat these surveys regularly, structural factors being an essential source of information. In 1991/92 IUI will undertake a new survey on Swedish multinational firms with links to earlier analyses (Swedenborg et al. 1988) and surveys (1965, 1970, 1974, 1978, 1986) in this area. The new survey will contain a large part of the structural questions. The idea is to make a direct integration of planning survey data and global firm data possible. Furthermore, a regular questionnaire on small firms and subcontractors will supplement the planning survey in the future.

APPENDIX 1

Formulas

The questionnaire sent out in the MNF survey and in the special surveys includes data on the firm or the group. The planning survey does the same for divisions. The conversion matrix allows us to consolidate the two sources. The conversion matrices allow the computation of profitabilities for the divisions and the whole firm. This is the way it can be done.

Assume that conversion matrices on value added, group operating profits and assets, replacement valuation are available.

Take the rate of return formula (4B) from Eliasson's Chapter I,

$$R^N = M \cdot \alpha - \rho + \frac{\Delta p^k}{pk}$$

$$M = \frac{\textit{gross operations profits}}{\textit{value added}}$$

$$\alpha = \frac{\textit{value added}}{\textit{assets}}$$

$$\rho = \textit{depreciation rate}$$

$$\frac{\Delta p^k}{p^k} = \textit{capital gains in percent of assets}$$

Disregard the capital gains item. Assume that information on the depreciation factor (ρ) is available from divisions (planning survey), or apply standard assumptions, as is currently done.

Then the three conversion matrices include all the information needed to compute R^N properly for each division and the entire firm.

APPENDIX 2

Questionnaire

STRICTLY CONFIDENTIAL

SWEDISH INDUSTRIAL COMPETENCE IN AN EC-PERSPECTIVE

SPECIAL ENQUIRY FOR THE INDUSTRIAL INSTITUTE FOR ECONOMIC AND SOCIAL RESEARCH

THE ENQUIRY SHOULD BE RETURNED AT THE LATEST MONDAY, JULY 3, 1989 TO THE FOLLOWING ADDRESS:

Industriens Utredningsinstitut
Box 5501
114 85 STOCKHOLM

Questions will be answered by:	Pontus Braunerhjelm, tel. 08-783 84 53 Jeannette Åkerman, tel. 08-783 84 59

The name and address of the firm if different than the above:

____

____

____

Contact person: ______________________________

Tel.: ____________________ Ext.: ____________

THE QUESTIONS REFER TO CALENDAR YEAR 1988 OR THE CORRESPONDING ACCOUNTING YEAR IF NOTHING ELSE IS SPECIFIED. THE QUESTIONS REFER TO THE PART OF THE FIRM (GROUP) WHICH HAS BEEN GIVEN AT THE TOP OF THE FORM. IF PREFERABLE, THE QUESTIONS CAN BE ANSWERED INDEPENDENTLY BY THE RESPECTIVE UNITS OF THE FIRM.

PART 1: FACTS ABOUT THE FIRM

---

1. The firm's (group's) external sales distributed on regions, mill. SEK.

   (Sales should be stated net, i.e., after deduction of indirect taxes and returns. Internal deliveries should also be eliminated. Sale per region refers to subsidiary sales from each respective area, i.e., not sales to receiving markets.)

Total	Sweden	EC	RoW
________	________	________	________

---

2. Total external sales according to question 1, distributed on product groups.

Products/product groups (see note 1)	Share of sales %
______________________________	______________
______________________________	______________
______________________________	______________
______________________________	______________
	100%

---

3. Total costs distributed on type of cost and region (i.e., costs before depreciation and financial result, mill. SEK).

	Total	Sweden	EC	RoW
a) R&D costs	_____	_____	_____	_____
b) Production	_____	_____	_____	_____
of which				
– purchases of raw materials and intermediate products	_____	_____	_____	_____
– energy costs	_____	_____	_____	_____
– purchases of services (see note 2)	_____	_____	_____	_____
– other production costs	_____	_____	_____	_____
c) Marketing	_____	_____	_____	_____
of which				
marketing investments (see note 3)	_____	_____	_____	_____
d) Administration	_____	_____	_____	_____
e) Other costs	_____	_____	_____	_____
Total costs	_____	_____	_____	_____

4. Gross profit, distributed by region, mill. SEK.

Total	Sweden	EC	RoW
________	________	________	________

5. How are educational and wage costs (incl. social charges) distributed on the following categories of profession?[note 4)] (Please estimate roughly if you don't have the appropriate statistics.)

	No. of employees	Salary cost	Educational cost
a) Executive functions, managers	________	________	________
b) Employees with qualified technical assignments or special competence	________	________	________
c) Other employees	________	________	________
d) Skilled workers, qualified maintenance personnel, supervisors etc.	________	________	________
e) Unskilled workers	________	________	________
Sum: Total sum of employees, total salary costs, total educational costs	________	________ (1000 SEK)	________ (1000 SEK)

6. Number of employees and salary costs (incl. social charges, 1000 SEK) distributed on regions

	Total	Sweden	EC	RoW
Employees (Average full time)	________	________	________	________
Salary costs	________	________	________	________

7. a) Total firm assets in each region, mill. SEK.
(**Note:** If possible, use replacement valuation. Please indicate which valuation method you have been using.)

Replacement value ☐ Fire insurance value ☐ Book value ☐

Total (mill. SEK)	of which Sweden	EC	RoW
______ mill. SEK	______ %	______ %	______ %

of which

b) Fixed assets, (property, machinery, inventories) total and per region

Total (mill. SEK)	of which Sweden	EC	RoW
______ mill. SEK	______ %	______ %	______ %

c) The firm has probably invested in other assets than those visible on the balance sheet. Most of these investments have been charged at current costs. Please try to estimate the value of such assets, distributed on the following categories (after depreciation).

Resources invested in	Estimated replacement value as percentage of total assets in (7a)
c1) Software	______________
c2) R&D	______________
c3) Marketing	______________
c4) Education	______________

8. Gross investments in fixed assets (property, machinery, inventories), mill. SEK.

	1986	1987	1988	1992 (plan)
Gross investment	______	______	______	______
of which				
a) in Sweden	______	______	______	______
b) in EC	______	______	______	______
c) in RoW	______	______	______	______

9. Total exports from domestic firm units ____________ mill. SEK

a) of which to EC ____________ mill. SEK

b) of which to EC subsidiaries ____________ mill. SEK

10. Intra-firm exports (9b) to EC intended for

a) direct sales ____________ mill. SEK

b) goods in process ____________ mill. SEK

c) investment goods ____________ mill. SEK

11. Purchases of raw-materials, intermediate products and services. (Please estimate if no direct statistics are available.)

	Raw materials and intermediate goods	Services
a) Imports from firm units within the EC	________	________
b) Other imports	________	________
(Percentage of all imports from EC-countries	________	________)
c) Domestic purchases	________	________
	100%	100%

PART 2: ESTIMATES

12. By what percent can the production volume increase in the survey year (as compared with the preceding year) with the current production capacity and already decided capacity expansions? (By assumption there is no restriction on demand and supply of labor.)

Total	Sweden	EC	RoW
_______%	_______%	_______%	_______%

13. Current production activity (the second quarter in the survey year) in percent of feasible production level.

Total	Sweden	EC	RoW
_______%	_______%	_______%	_______%

14. If below 100% (in 13) this is due to:

a) insufficient demand YES _______ NO _______
b) lack of labor YES _______ NO _______
c) other factors (itemize below):

....

....

15. What increase in employment in the survey year (in percentage of actual employment) is required to reach full production capacity?

Total	Sweden	EC	RoW
_______%	_______%	_______%	_______%

16. Has the "EC 1992 event" initiated restructuring of the firm in the following ways:

a) production earlier located in Sweden has been located to EC?[see note 5)] YES _______ NO _______

b) investments have been concentrated to EC and reduced in Sweden? YES _______ NO _______

c) if "YES", how many full-time jobs do you estimate have been transferred, so far, into the EC region due to this restructuring?

number of jobs: ________

d) what other effects do you expect of the "internal market" (itemize below)?

....

....

17. How many full-time jobs do you estimate will be transferred to the EC up to 1995, due to such restructuring effects mentioned in question 16?

	Number of jobs	Production
a) to EC	____________	____________
b) to RoW	____________	____________

18. Please identify among the alternatives the firm's relative competitive advantage.

	Very great advantage	Relatively great advantage	Some advantage	No advantage
a) product knowledge				
b) process knowledge				
c) commerciali-zation of available technique				
d) competent organization and management				
e) competent labor				
f) R&D				
g) product quality				
h) customized products, system solutions				
i) closeness to raw materials				

j) other

....

....

19. To what extent do you employ automated or computer monitored production processes?

product/product groups	percentage of total process automated or/and computer monitored
______________________	> 75%
______________________	75–50%
______________________	50–25%
______________________	25–10%
______________________	10–0%

20. If certain areas of factory production (< 10%) have not been automated, what are the reasons?

a) not (yet) profitable ____

b) initial investment too costly ____

c) lack of competence to automate ____

d) no time ____

e) not relevant in this production ____

f) firm is too small ____

g) automation is planned ____

h) other ____

....

....

21. Which are the main advantages of automation or computer monitored processes?

	Very great advantage	Relatively great advantage	Some advantage	No advantage
a) cost efficient production				
b) less dependence on labor				
c) improved monitoring of production				
d) more flexible production				
e) facilitates "just in time" etc.				
f) better and more even quality in production				
g) better product quality				
h) allows future competitive advantages				

i) other

....

....

22. Please indicate factors of importance for location of production to Sweden and the EC respectively.

		Sweden	EC
a)	the EC is expected to become a growth market	____	____
b)	communication between production and R&D	____	____
c)	competent organization and management	____	____
d)	competent labor	____	____
e)	easier to monitor production	____	____
f)	closeness to market	____	____
g)	uncertainty about future Swedish relations to the EC	____	____
h)	closeness to suppliers	____	____
i)	the Swedish labor market	____	____
j)	economies of scale in existing plants	____	____
k)	facilitates automation	____	____
l)	labor costs	____	____
m)	energy costs	____	____
n)	other	____	____
o)*	uncertainty about future Swedish relations to the EC even if an EES agreement is concluded	____	____
p)*	irrespective of other factors, it is natural that the firm's expansion takes place in	____	____
q)*	customers have their production abroad	____	____

* only in the survey to small firms and subcontractors

NOTES

note 1) Most companies divide their production or/and sales on divisions or product groups. It would be desirable if the division could be identified by SNI or SITC classification. Reasonable estimates are accepted.

note 2) Purchases of services include all externally bought services, such as consulting, legal services, freights, etc.

note 3) Market investment relates to periodical costs of long-run nature (goodwill, market penetration, buildings and inventories as sales offices are established, etc.).

note 4) Education is defined as courses and other education organized or paid for by the firm for their employees. It relates to firm individual as well as more general education. Both internal and external education costs should be included.

note 5) Location abroad refers to newly started operations in foreign countries or to the transfer of domestic operations to foreign countries.

ADDITIONAL QUESTIONS IN THE SURVEY OF SMALL FIRMS AND SUBCONTRACTORS

* Distribute production capacity on the following regions.

	1988	1989	1990 (plan)	1992 (plan)
a. Sweden	....	....	....	....
b. The Nordic countries (excl. Denmark)	....	....	....	....
c. EC	....	....	....	....
Total	.... 100%	.... 100%	.... 100%	.... 100%

---

* By December 31, 1989 incoming orders were

☐ larger than normal ☐ normal ☐ smaller than normal

---

* Sales prices (in Swedish crowns) of the firm's products are (between 1989 and 1990) expected to:

Market		Market		Market	
Sweden	Abroad	Sweden	Abroad	Sweden	Abroad
Increase up to		About unchanged		Decrease up to	
2.5% ☐	☐	±0% ☐	☐	2.5% ☐	☐
5% ☐	☐			5% ☐	☐
10% ☐	☐			10% ☐	☐
15% ☐	☐			15% ☐	☐
20% ☐	☐			20% ☐	☐
☐ ....%	☐ ....%			☐ ....%	☐ ....%

---

* Stock of raw materials and goods in process 1989-12-31 as percentage of total purchase 1989.

up to
☐ 5% ☐ 10% ☐ 15% ☐ 20% ☐ 25% ☐ 50% ☐ 75% ☐ 100%
☐ no stock at all

---

* What is the normal relation between the stock of raw material goods in process and yearly total purchases?

up to
☐ 5% ☐ 10% ☐ 15% ☐ 20% ☐ 25% ☐ 50% ☐ 75% ☐ 100%
☐ no stock at all

---

* How large was the stock of finished products in percentage of total sales 1989-12-31?

up to
☐ 5% ☐ 10% ☐ 15% ☐ 20% ☐ 25% ☐ 50% ☐ 75% ☐ 100%

---

* What is the normal relation between finished products and total sales?

up to
☐ 5% ☐ 10% ☐ 15% ☐ 20% ☐ 25% ☐ 50% ☐ 75% ☐ 100%

---

* Have you sold or acquired any firm (or part of firms) during 1989?

Sales	☐ Yes	☐ No
Acquisitions	☐ Yes	☐ No

---

* Is it probable that your firm will acquire or sell any firms (or part of firms) during the following 3 year period?

Sales	☐ Yes	☐ No
Acquisitions	☐ Yes	☐ No

---

* Will planned acquisitions take place within Sweden or abroad?

☐ Mainly in Sweden
☐ Mainly abroad
☐ Both in Sweden and abroad

* Distribute production on the following products groups.

a. Raw material	..... %
b. Simple intermediate products	..... %
c. Components	..... %
d. Sophisticated systems	..... %
e. Investment goods	..... %
f. Other	..... %

* List customers, using the classification below (1-6), that received more than 10% of your deliveries during 1989.

Type of customer
1. Swedish MNF
2. Swedish MNF abroad
3. Other Swedish firms
4. Foreign MNF in Sweden
5. Foreign MNF abroad
6. Other firms abroad

	Customer % of total sales	Type of customer (1–6 as above)	Product groups (acc. to questions above, a–f)
1	....	....	....
2	....	....	....
3	....	....	....
4	....	....	....
5	....	....	....
6	....	....	....
7	....	....	....
8	....	....	....
9	....	....	....
10	....	....	....

---

* Has the number of customers during the period 1987–89 decreased, remained constant or increased?

☐ fewer customers ☐ unchanged ☐ more customers

---

* Is your firm an affiliate of some other firm?

☐ No
☐ Yes, which is ....
☐ Owner share .... %

---

* Do you regard any other region than EC as more important for the location of a subsidiary?

☐ Yes ☐ No

---

* If the question above is answered in the affirmative, which region are you referring to?

☐ U.S. ☐ Japan ☐ Eastern Europe ☐ The Nordic countries ☐ Asia

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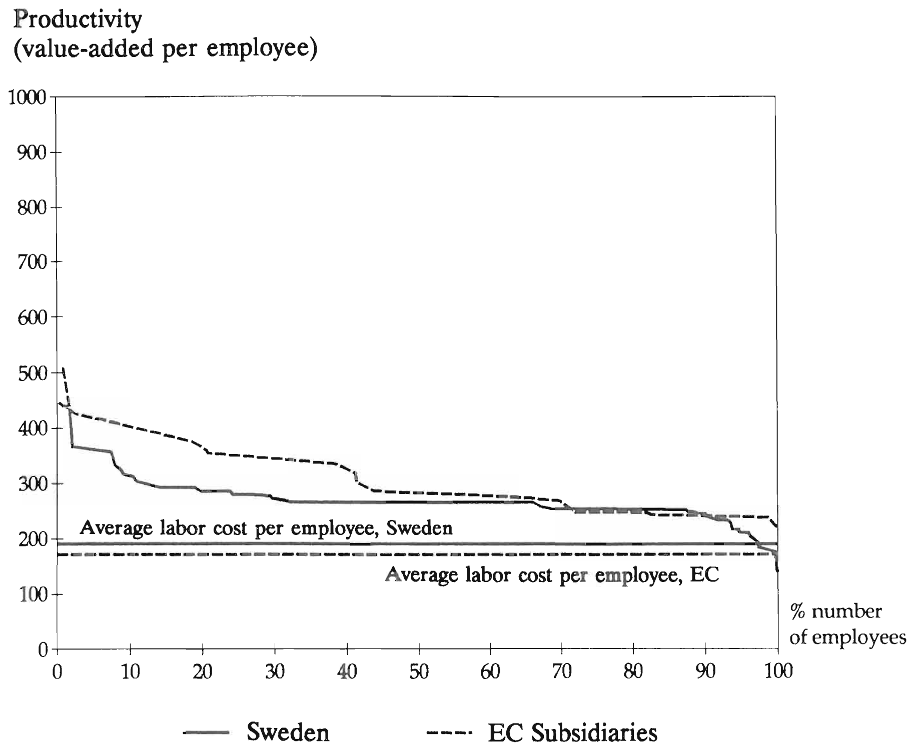
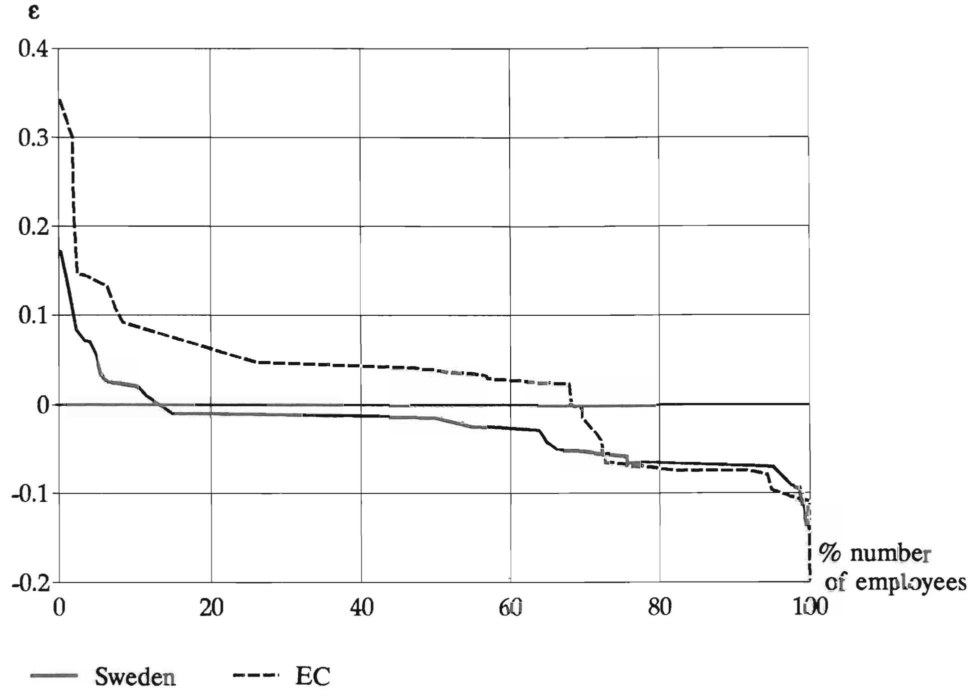
Figure 1 **The distribution of labor productivity between domestic and foreign (= EC) parts of Swedish engineering firms, 1988**



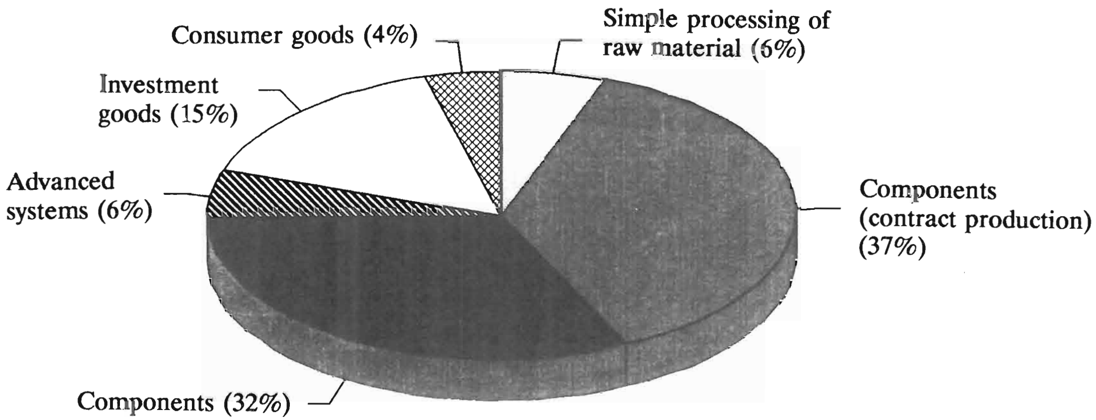
Source: Braunerhjelm 1990.

Figure 2 **Rates of return (ε) over the interest rate of long-term bonds in domestic and foreign (=EC) operations of Swedish firms, 1988**



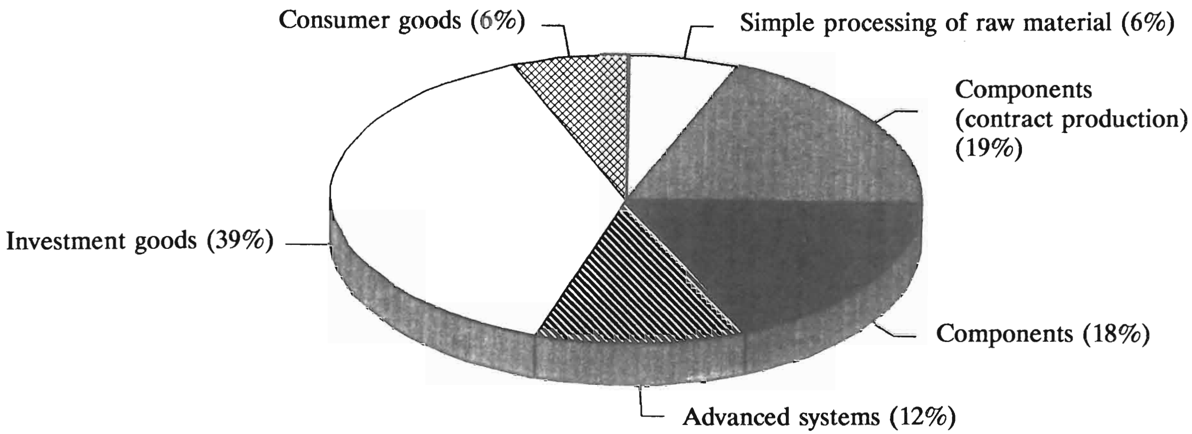
Source: Braunerhjelm 1990.

Figure 3a **Production of subcontractors distributed on different product groups, 1990**



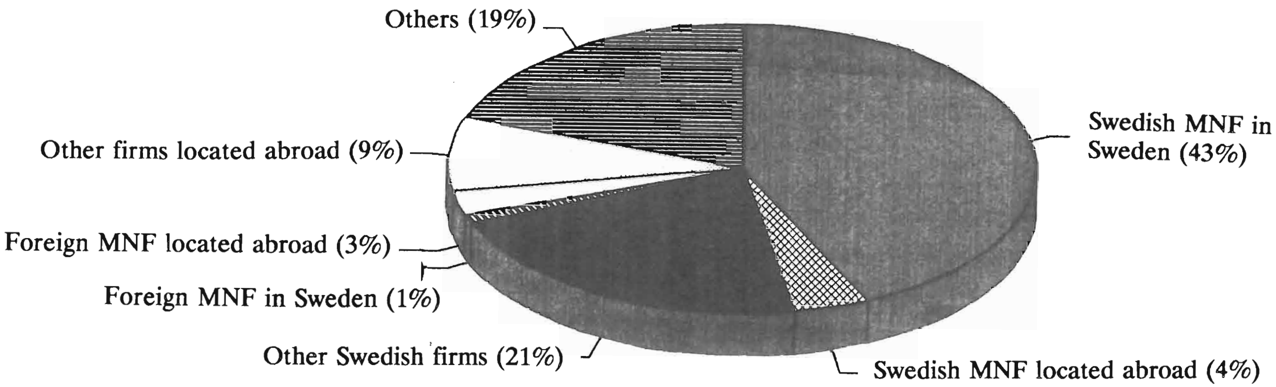
Source: Braunerhjelm 1991a.

Figure 3b **Production of small firms distributed on different product groups, 1990**



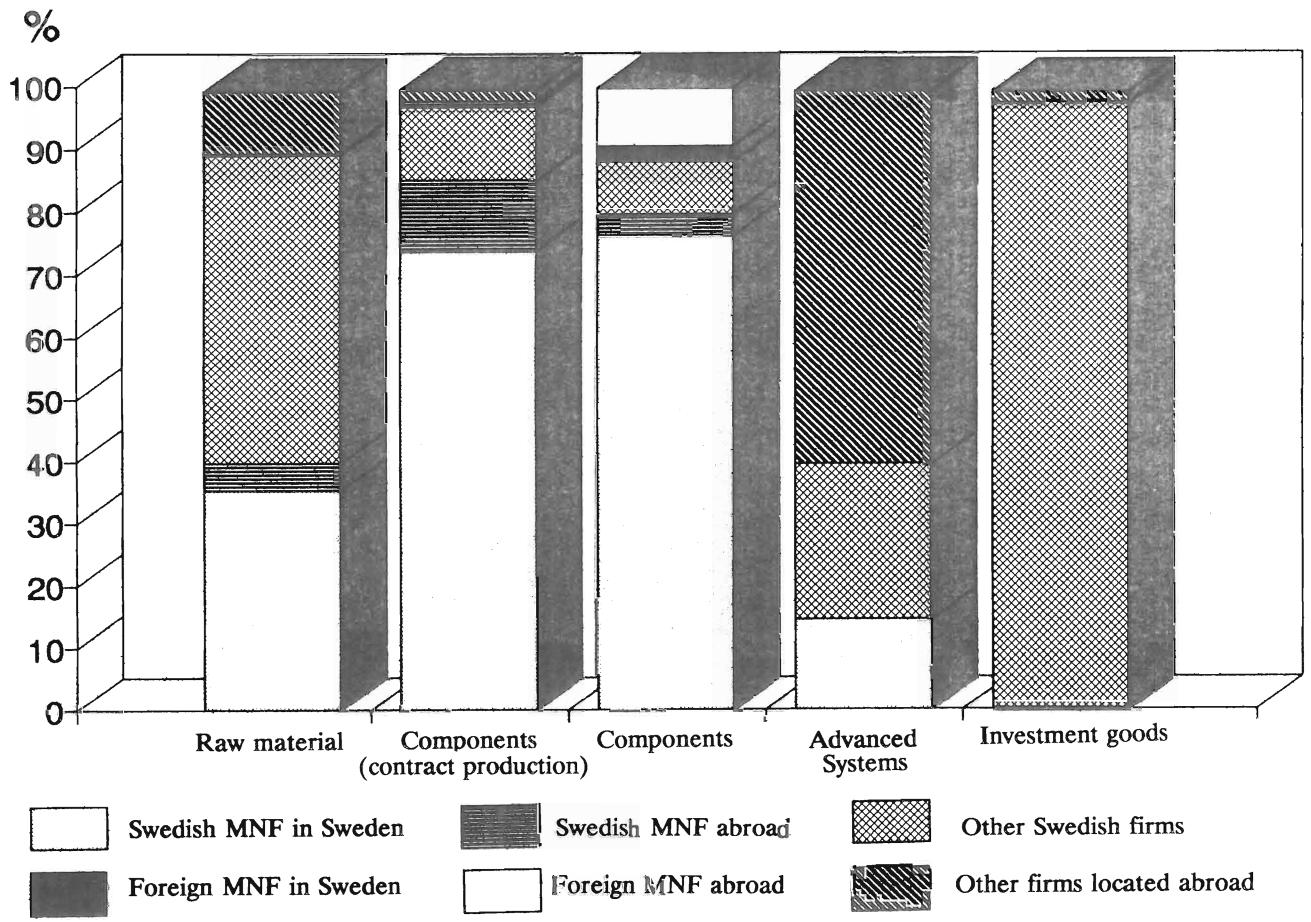
Source: Braunerhjelm 1991a.

Figure 4a The deliveries of subcontractors to different groups of customers, 1990



Source: Braunerhjelm 1991a.

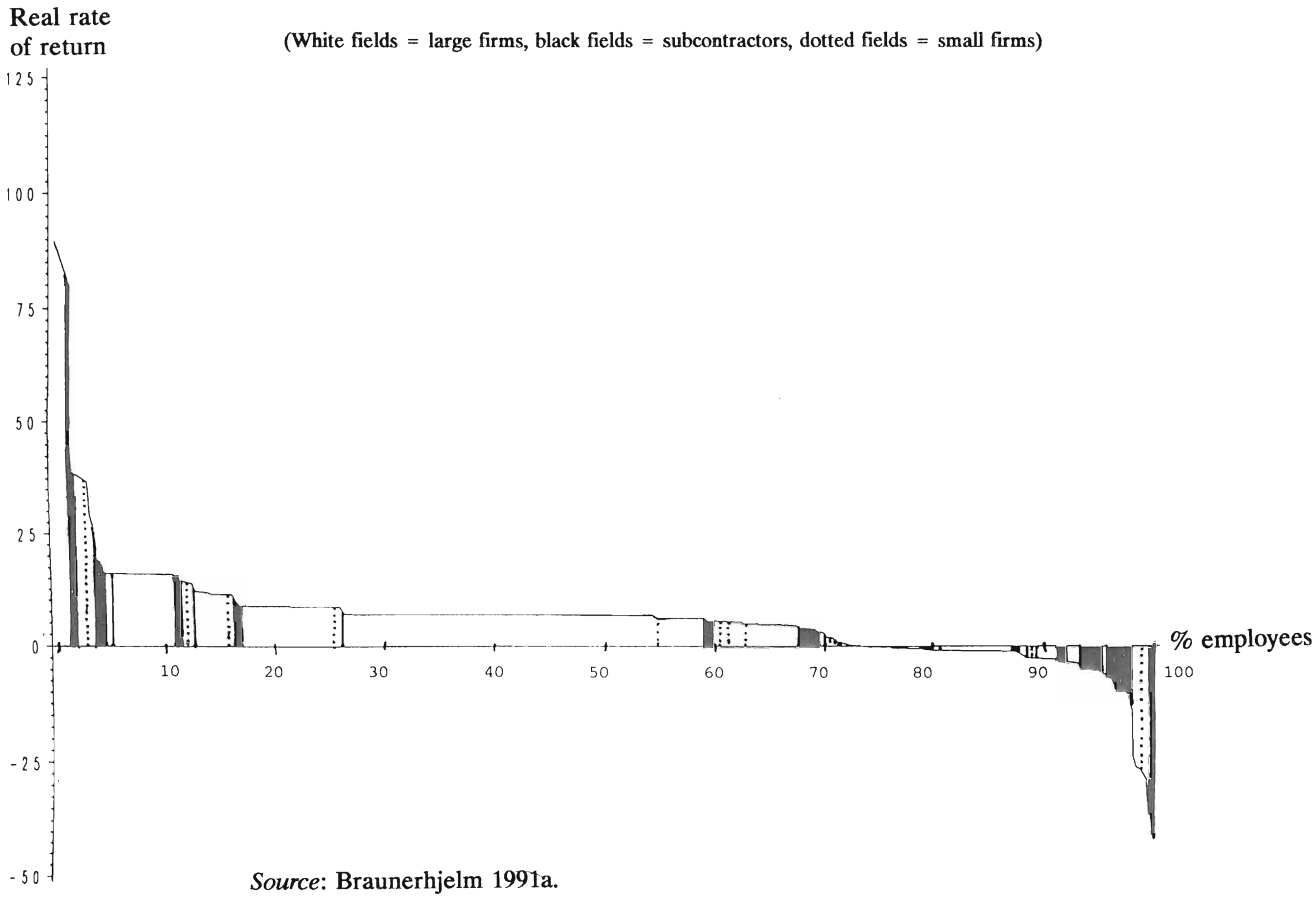
Figure 4b The composition of customers in different subcontracting production, 1990



Source: Braunerhjelm 1991a.

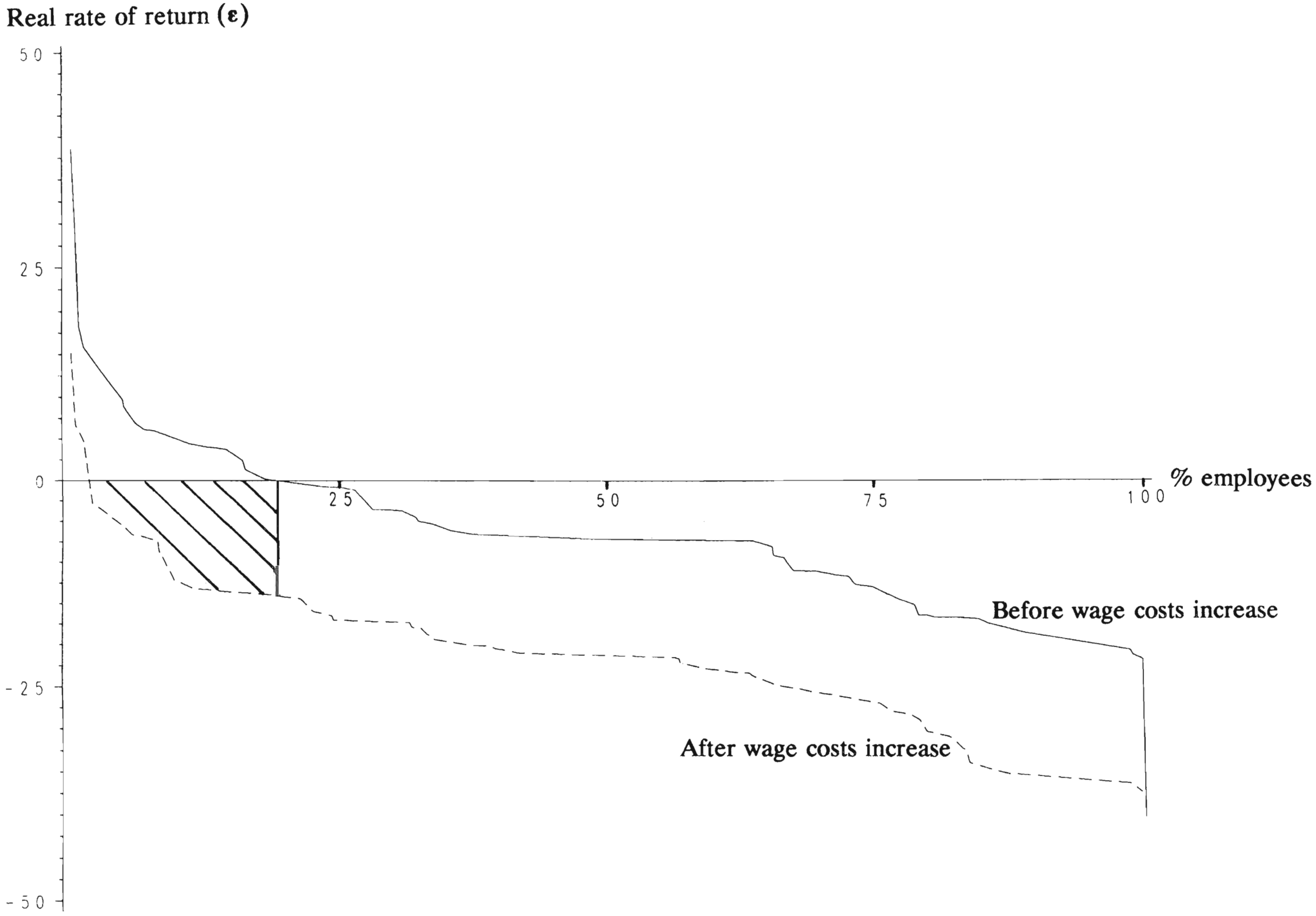
Figure 5 **The firms' distribution of the real rate of return (ε) over the interest rate of long-term bonds, 1988**

(White fields = large firms, black fields = subcontractors, dotted fields = small firms)



Source: Braunerhjelm 1991a.

Figure 6 **The effect of a 10 percent increase in wage costs for Swedish subcontractors, 1990**



Source: Braunerhjelm 1991a.

CHAPTER V

MOSES Macro Accounting System —Updating Procedures

Tomas Nordström

Contents

1. Introduction

The macro accounting system has basically two functions in MOSES. Firstly, it integrates the outcome of industrial firm-level processes of the micro part of the model into the framework of the total national economy. The links between the micro and macro parts of the model are of course two-sided. The micro solutions affect the macro development through demand for raw material and investment goods, labor etc. They also set guidelines for wages and prices for the whole economy. Developments outside industry, however, provide restrictions on the micro solutions in terms of available labor, and prices of goods needed in the production process.

Secondly, the macro accounting system assures consistency of solutions in a book-keeping sense. This is not the least important when aggregate prices, e.g., for private consumption, are constructed. Consistent macro deflators are also needed to properly allocate net lending of the total economy (i.e. on current account) between domestic sectors.

The distinguishing feature of MOSES is its specification of the industrial sector in terms of individual firms. This is also where the main modeling effort lies. Specifying and updating the micro part is a heavy task. For this reason the macro accounting system must be as simple and transparent as possible. This puts restrictions on the number of sectors outside industry, the treatment of indirect taxes and subsidies etc.

The difference of data sources for the micro and macro parts of the production system involves serious problems.

The basis for the macro accounting system is the Swedish System of National Accounts. These accounts are not directly consistent with the firm level data of the micro part of MOSES. The firms in each sector only make up a sample, firms may produce goods properly belonging to another sector (the macro accounting system allows for no mixed output), definitions of production, sales and employment may differ etc. As in the System of National

Accounts the use of residuals is unavoidable in the model. The sources of these residuals may well be easily identified, e.g., small business production and employment, undeclared taxable income. Efforts have been made to "model" even the residuals in MOSES. It is obvious, however, that too large residuals weaken the micro foundation of the macro results.

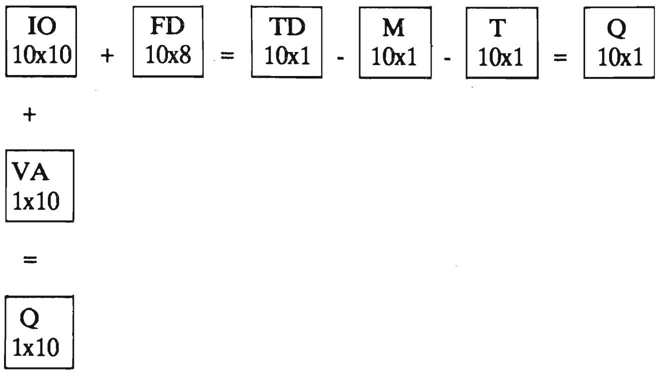
This paper deals with the specification and updating procedures of the macro accounting system of MOSES. A manual showing the use of data sources and programs for updating is given in Section 4. Before going into details, however, Section 2 will give some basic principles for the IO-system in the model, and Section 3 some general remarks on data sources. The relations between the micro and macro parts in MOSES will not be discussed further.

2. Some Basic Input–Output Relations

The macro accounting system is built by a number of identities showing supply and demand for each commodity in fixed and current prices. The number of commodity balances is equal to the number of production sectors (which is ten in MOSES) and no commodity is produced in more than one sector.

Following the format given in *MOSES Handbook*, Part 2, "The Initialization Process" (IUI Research Report No. 35, 1989) the layout of the commodity balances is given by Figure 1. The matrix diagram reads as follows. IO is a 10x10 input-output matrix, where, e.g., the first row tells the value (in fixed or current prices) of commodity 1 that is used as input in the ten-production sectors. The latter is given by the column index. Final demand is divided into eight components (cf. Appendix 1). The matrix FD gives these components in terms of commodity composition. Summing each row of IO and FD over column–indices results in the vector TD which is total demand in purchasers' prices. If imports (cif), M, and indirect taxes net, T, are subtracted from total demand, we are left with domestic production of each commodity in producers' prices, Q. Q, however, is also the sum of the value in purchasers' prices of input into each sector, plus value added since each sector produces

Figure 1 Macro accounting system layout



one and only one commodity. This can be seen from the lower part of the figure, where the vertical sum of IO for each sector plus value added, VA, equal output Q. Thus output of each commodity can be computed in two ways--from the supply side or from the demand side. These should always give identical results:

$$Q_i^s = \sum_j IO_{ji} + VA_i = Q_i^D = \sum_j IO_{ij} + \sum_j FD_{ij} - M_i - T_i$$

Summing over commodity index i results in the GDP identity for the market sector:

$$\sum_i \sum_j IO_{ji} + \sum_i VA_i = \sum_i \sum_j IO_{ij} + \sum_i \sum_j FD_{ij} - \sum_i M_i - \sum T_i$$

or $GDP = VA + T = FD - M$,

where *GDP* is given in purchasers' prices.

3. Data Sources

Commodity balances are regularly produced by the Central Bureau of Statistics in Sweden. Detailed primary data are, however, collected only every fifth year. In between extrapolations are made on the basis of data from other statistical branches. Extrapolated matrices are available with 45 commodities (cf. Appendix 2), while the results of the more thoroughly compiled IO-accounts distinguish between twice as many commodities.

Although the quality of the extrapolated matrices doubtless is lower than in the full-scale IO inquiries, they may still be good enough to be used as an accounting framework for MOSES. It should be observed that even the larger IO-system will have to be extrapolated to fit the National Accounts for the base year of the model simulations.

Also, although commodities and sectors in MOSES are defined in a somewhat unconventional way requiring strongly disaggregated data, the gain in having 90 instead of 45 commodities may not even compensate the cost of more complicated aggregation and data handling procedures. Neither is the more comprehensive coverage of the full IO-accounts in terms of, e.g., matrices for imports and indirect taxes of immediate interest for applications in MOSES.

Appendix 2 gives the complete 45x45 system of commodity balances for 1982 which is used to update the macro accounting system in MOSES. All figures are in fixed prices with 1980 as index base. This matrix system must, accordingly, not only be transformed to the ten MOSES commodities (sectors) but also be reflated to current prices. As can be seen from the final demand matrix only total gross investments are given compared to the four components required in MOSES. The investment vector will be split up after aggregation and reflation. Also three kinds of indirect taxes are distinguished besides customs duties. They will simply be added to one net tax already in the aggregation program.

Finally, before getting into details, one general remark should be made about the treatment of deflators (price indices) in MOSES. All values in fixed prices are assumed to be given in *producers' values*. To compute private consumption in current *purchasers' prices* from its value in fixed purchasers' prices the price index must include not only the change in the commodity tax rate but also the base-year rate itself. If the base-year tax rate is 20 % the price index in purchasers' prices is said to be 1.20 for the base year. This is a bit at odds with the common use of the concept of an index number, but will be adopted in the subsequent presentation.

4. Program Manual

As stated in the previous section updating of the macro accounting system involves two elements. One is to adapt the available IO-statistics to MOSES format. The other is to reflate the system to current prices. The second part is necessary only because commodity balances are still only published in fixed prices by Statistics Sweden. (Regularly published tables in current prices are under way.) These two steps are taken in the order given above in the updating procedure, i.e., first aggregation and then reflation. There is no compelling reason for this. Given the assumptions that have to be made in the reflation computations (cf. below) the results would, however, *not* necessarily be identical if the steps were taken in reversed order.

4.1 Aggregation Program

The program that transforms the 45-commodity balance available from the Central Bureau of Statistics in Sweden is written in FORTRAN. It is called I082.FOR and is stored on the DEC-10 machine at Stockholms Datorcentral. The complete code is given in Appendix 4 and will be described step by step with reference to line numbers.

<u>Line 100–1800</u>: Comment statements.

<u>Line 1900–2100</u>: Declaration of variables.

Line 2200–2700: OPEN statements.

The 45–sector system is stored on file SCB82.DAT. After some completions and rearrangements, row- and column sums of this system are printed on KON82.DAT to check correct punching of SCB82.DAT as well as consistency with the National Accounts (cf. below). The 45x10 aggregation matrix (cf. Appendix 3) is stored on AMD.DAT and the resulting 10x10 MOSES system is stored on MO82.DAT. AX.DAT and X82.DAT are dummy-names (cf. below).

Line 3200: Read parameters.

The first line in SCB82.DAT sets some "parameters". The first, KFIL, identifies the aggregation matrix to be used. In the program shown the matrix is stored on AMD.DAT connected to unit 30 by the OPEN statement on line 2400. Thus, the first number of the first line of SCB82.DAT should be 30. The second number, IFIL, gives the unit number of the output file. In this case the aggregated system is stored on MO82.DAT, so IFIL should be 40 (cf. OPEN-statements). IDIM is the dimension of the aggregated system. By setting these parameters properly the program can easily be used for alternate aggregation matrices and dimensions without interfering with the standard application. The filenames AX.DAT and X82.DAT are used for such exercises, requiring the aggregation matrix to be stored in AX.DAT, KFIL to be 31, IFIL to be 41, and IDIM whatever dimension is desired. The result is stored on X82.DAT.

Line 330–4100: Read 45x45 system.

TILL = supply
FD = final demand
IO = intermediate goods
Cf. Appendix 4.

Line 4200–4600: Add tourist services.

The commodity balances must be corrected for tourist services to make private consumption equal not to consumption in Sweden as given by IO-data but to Swedish residents' consumption. This is accomplished by adding export of tourist services, TUEX, to exports of services and expenditures of Swedish tourists abroad, TUIM, to imports of services. Net tourist expenditures are added to private service consumption. Note that this does not affect the value of GDP. Figures for TUEX and TUIM are found in the National Accounts.

Line 4700–5000: Trade margins.

The commodity balances account for trade margins on each commodity. To avoid double counting the figure for production of trade services must exclude aggregated trade margins which, of course, makes the recorded figure close to zero for book-keeping reasons. The program lines just add total margins to production, TILL(36,1), and again subtract them in the new supply column TILL(I,9) which is zero for all I except 36 (the trade sector) where it is made equal to minus aggregated margins.

In this way we can properly solve for value added in the trade sector. The balance of resources in purchasers' prices for the whole economy will then read: value added in producers' prices + indirect taxes + imports = final demand. For each commodity, however, trade margins must be added to the supply side.

Line 5100–8400: Sum over rows and columns.

Note that FD(I,7) stands for the sum of final demand per commodity, while FD(I,8) is the sum of total demand, i.e., including demand for intermediate goods.

Line 8500–11200: Calibrate to National Accounts.

For different reasons total figures for the components of supply and demand in the 45x45 system may not exactly equal the National Accounts. Differences have been placed in sector 45 (other services). Note that differences in gross production are treated as residuals to assure that supply equals demand. This implies that total market sector GDP in producers' prices must be equal to the National Accounts' figure since all other components of the balance of resources are equal.

Line 11300–15100: Control print out.

This part checks that the system, i.e. SCB82.DAT, was correctly entered by computing total supply and demand for each commodity etc. Also computation of column sums, e.g., total gross investments, allows checks against the National Accounts. Note that value added is computed as a residual. Differences in this sum compared to the National Accounts' estimates are easy indicators of errors in the system (cf. Appendix 4).

Line 15200–15700: Read aggregation matrix.

Unit number KFIL is given in SCB82.DAT.

Line 15800–18100: Aggregation.

Dimension of aggregated matrix, IDIM, is given in SCB82.DAT.

Line 18200–19300: Result print out.

Unit number IFIL is given in SCB82.DAT.

4.2 *Reflation Program*

The program MO82.FOR computes commodity balances in current prices, given fixed price balances and National Accounts. The complete code is given in Appendix 5. The system matrices are the same as in the aggregation program IO82.FOR (cf. also Appendix 2). For each matrix in fixed prices, however, a matrix in current prices is defined by adding the letter "L" to the name. Also for supply and final demand matrices, deflator matrices are defined by putting the letter "P" before the name. So TILL(I,J) is the supply matrix in fixed prices, TILLL(I,J) in current prices and PTILL(I,J) the name of the corresponding deflators.

Line 100–900: Comment statements.

Line 1000–1500: Declaration of variables.

Line 1600–1800: OPENT statements.

The matrices IO, FD and TILL are stored on MO82.DAT, which is an output-file of IO82.FOR. PRIS82.DAT contains National Account data. On MOIO82.DAT, finally, the results are written. These include some rearrangements of the fixed price matrices (cf. below).

Line 1900–7600: Read and rearrange fixed price matrices.

After reading the commodity balances from MO82.DAT rearrangements take place on line 3900. First, trade margins are added to row number 10 in the IO matrix, i.e., they are treated as inputs of services in each sector. The implication is that trade margins are related to domestic output rather than to absorption--a simplification that is justified if the components of supply and demand grow at a fairly equal rate. Note that trade margins must also be added to gross output to keep value added unaffected. The second rearrangement is to subtract the residual between total supply and demand from gross output (line 4400). Finally, indirect taxes and subsidies are added and an aggregated "tax rate" is defined with public sector purchases, and private consumption as tax base. This is again a short-cut which is acceptable in a model focusing on firm behavior like MOSES.

Line 7700–10200: Read National Accounts in current prices.

VALP is value added in current prices as given by the National Accounts and aggregated to MOSES' sectors (this is done outside the program). Note that DVALP, a residual in the National Accounts, is distributed proportionally between the ten sectors (cf. line 9500). This is a bit at odds with the treatment of the residual in fixed prices, FD(I,6), the distribution of which is given by the FD-matrix. Preliminary deflators for exports and imports can be constructed from the National Accounts. Since it is not possible to identify exactly the MOSES sectors in the published National Accounts, multiplying these deflators with values in fixed prices will not add up to total recorded values in current prices. The adjustments are laid on sectors 1-4 since these sectors are more difficult to identify in the National Accounts than the other sectors (line 9600-9700). It should be emphasized that the program requires data inputs in this section to be consistent. The solution algorithm will not converge if aggregated value added plus commodity taxes plus imports differ from final demand. This is certainly no problem if all figures are taken from the same source. If, however, a revised figure for, e.g., investments is taken from another source, it is necessary to change some other component of the aggregated balance of resources.

Line 10300–16700: Computation of prices.

In order to explain the solution of prices (deflators) and the simplifying assumptions which are used it is necessary to make a brief digression.

In fixed prices each commodity balance i is given by (with index i running from 1 to 10)

$$Y_i + M_i + T_i = \sum_j IO_{ij} + FDA_i + FDB_i + E_i \tag{1}$$

where Y_i = gross output excl. indirect taxes

M_i = imports cif

T_i = indirect taxes

IO_{ij} = use of commodity i in sector j

FDA_i = domestic final demand charged with indirect taxes (intermediate goods in public sector plus private consumption)

FDB_i = domestic final demand *not* charged with indirect taxes (fixed investments, stockbuilding)

E_i = exports.

Note that trade margins are included in Y and IO.

The strategic assumption in the computation of prices is that the domestic price of a commodity, excluding taxes, is independent of its use. With this assumption commodity balances in current prices are given by

$$PY_i \cdot Y_i + PM_i \cdot M_i = PH_i (\sum_j IO_{ij} + FDA_i (1 - TRB_i) + FDB_i) + PE_i \cdot E_i \tag{2}$$

where PY_i = deflator for gross output

PM_i = deflator for imports

PH_i = deflator for domestic demand excl. taxes

PE_i = deflator for exports

TRB_i = tax rate in fixed prices, i.e. the tax rate in the base years.

Note that the base *FDA* of indirect taxes *T* includes taxes. The tax rate *TRB* is given by *T/FDA*.

As can be seen from (1) and (2) commodity balances in current prices are formally constructed simply by multiplying each component in the fixed price balance by an appropriate price index.

At this stage of the updating procedure commodity balances in fixed prices are already solved and all variables in (1) are known. Among prices in (2) only PY and PH are unknown since PM and PE are computed directly from the National Accounts (cf. 7700 - 10200). This leaves us with 20 variables to determine and so far 10 equations. The 10 missing equations are derived from the supply (cost) side:

$$PY_i \cdot Y_i = VALP_i + \sum_j PH_j \cdot IO_{ji} \tag{3}$$

where $VALP_i$ = value added in producers' prices.

(3) simply states that the value of output equals total costs plus excess profits. Technically, when updating the system, VALP, which consists of labor and capital cost as well as excess profits, is exogenous.

The equations (2) and (3) will determine PY and PH. However, to get a set of prices consistent with the National Accounts, we must also compute the deflator for FDA, i.e., in purchasers' prices. This deflator obviously differs from PB to the extent that indirect tax rates have changed from the base year of the price indices to the year for which we solve the system.

The relation between PH and PFDA can be derived in the following way. Let TR be the current tax rate. Then, if TL are indirect taxes in current prices, we get for each commodity:

$$TL_i = TR_i \cdot PFDA_i \cdot FDA_i$$

The current value of tax-charged demand in purchasers' prices equals tax-charged demand excluding taxes plus taxes, i.e., $PFDA_i \cdot FDA_i = PH_i \cdot FDA_i \cdot (1\text{-}TRB_i) + TR_i \cdot PFDA_i \cdot FDA_i$. Solving for $PFDA_i$ yields:

$$PFDA_i = PH_i \cdot (1-TRB_i)/(1-TR_i) \tag{4}$$

This relation between the deflator PFDA for taxcharged demand in fixed *purchasers' prices* and the deflator PH for demand in fixed *producers' prices* is like all relations used in the updating procedures, an identity that assures consistency in a book-keeping sense.

Although all deflators by definition take the value unity in the base year, the MOSES program treats all variables in fixed prices as given in producers' prices. The pseudo price index that transforms the fixed price value excluding taxes to current price value including taxes will *not* be unity for the base year. To see this, let's call the pseudo price index P, defined as:

$$P_i \cdot FDA_i \cdot (1-TRB_i) = PFDA_i \cdot FDA_i$$

This gives P_i in terms of the proper price index $PFDA_i$ as

$$P_i = PFDA_i/(1\text{-}TRB_i)$$

Also P_i can be expressed in terms of PH using (3) above:

$$P_i = PH_i/(1\text{-}TR_i)$$

The use of such a pseudo index is, of course, perfectly allright as long as the relations to PFDA and PH given above are fulfilled.

The relations (2)–(4) allow us to compute the balance of resources in purchasers' prices for the whole market sector of the economy. Adjustments will be necessary to make these aggregated results compatible with the National Accounts. Among these adjustments the treatment of indirect taxes deserves special attention. For the current year we only know the total amount of commodity-based indirect taxes in current prices from the National Accounts. The computation of current tax rates will be based on tax rates in fixed prices, i.e., tax rates for the base year of price indices. Adjustments are made proportionally until computed total current taxes are in accordance with the National Accounts. Since changes in tax rates, in fact, differ between commodities this procedure is a short-cut that can be defended only on the grounds that MOSES is not a model for detailed analysis of indirect taxes. However, this kind of crudeness in the macro part of the system may give rise to troublesome residuals in other parts of the system, where more precise data from other sources are used. So far, no comprehensive investigation has been made in MOSES to identify and estimate the effects of such residuals.

The basic equations (2)–(4) are solved by a Gauss-Seidel algorithm. Usually, the system converges fairly rapidly—after 5–10 iterations. Line 10600 –11400 sets preliminary values for the endogenous variables PY and TR (cf. definitions above). Export prices are used as initial prices for domestic demand, PH. The variable PP, which will be explained below, has been set to unity.

The first task is to compute PH, the price of domestic demand in producers' prices. Disregarding PP for a moment, HP in line 11900 is exactly the component in (2) multiplied by PH. Then PH is given by the right-hand side of (2) decreased by exports in current prices divided by HP (line 12100).

The variable PP is an "adjustment" constant. When the system is solved on the assumption of equal prices PH throughout all components of domestic demand for each commodity, the aggregated value of each final demand component in current prices will, not surprisingly, differ from those of the National Accounts. The PPs adjust prices PH to exact accordance with the National Accounts. For each component, e.g., private consumption, one constant PP is applied to each commodity price PH. By implication the solution will, in fact, yield prices on domestic demand that do differ between components for a certain commodity. The price of commodity 1 in private consumption will be PP(2)·PH(1), while the price of the same commodity used for investments will be PP(3)·PH(1). A similar approach is taken on the supply side of the system, where the basic hypothesis that market sales from the public sector have the same price as gross output from industry, is modified by PP(5) to achieve accordance with National Accounts.

So far, all computations have been based on the preliminary PY. Given PH, however, new values of PY can be computed from the cost side, given value added (VALP). These new PY are compared to the PYs from the previous iteration (or, in the first iteration, with the preliminary values). The iteration loop is halted if all differences between actual and previous solutions of PY do not affect the fourth decimal of the price index. (In fact the condition is even a bit tougher than that.) If this condition is not fulfilled for some PY the calculations are repeated with the actual PY used to compute PH. The value is stored in PY1 to permit comparison with PY as computed in the new iteration.

If the break condition is fulfilled, the loop is left and PH is recomputed with the last PY.

Line 16800–END: Print out.

All variables are computed in current prices and the three basic matrices, the input matrix, the final demand matrix, and the supply matrix, are printed on MOIO82.DAT. Adjustment constants PP, some of the deflators, and tax rates are also printed. Note that the deviation of the PPs from unity can be seen as a check on the hypothesis that (producers') prices are equal between domestic demand components. Large deviations should be analyzed. Also the difference between tax rates in fixed and current prices should be considered. Information that tax or subsidy rates for some commodity have changed differently from the others could be used to improve the accuracy of the price indices.

APPENDIX 1 MOSES' Macro Sectors

1 Raw material
2 Intermediate goods
3 Investment goods and consumer durables
4 Consumption goods (excl. durables)
5 Agriculture, forestry, fishing
6 Mining and quarrying
7 Oil
8 Construction
9 Electricity
10 Other services

APPENDIX 2 The 45x45 Commodity Balances

The system of commodity balances is given as three matrices in the tables below. Since the same format is used in the aggregation and reflation programs the variables in the tables will be described more closely.

Table 1 is the supply matrix called TILL in the programs. With i as commodity index the matrix also shows the appropriate column index added in the table:

TILL(i,1) = gross production in producers' prices (excl. residual)
TILL(i,2) = sales of market products from the public sector (note that public enterprises are recorded in the first columm of TILL)
TILL(i,3) = imports cif
TILL(i,4) = customs duties and import levels
TILL(i,5) = trade margins
TILL(i,6) = commodity taxes
TILL(i,7) = subsidies
TILL(i,8) = value added taxes

Table 2 shows final demand, FD:
FD(i,1) = use of intermediate goods in the public sector
FD(i,2) = private consumption
FD(i,3) = gross investments
FD(i,4) = stock building
FD(i,5) = exports
FD(i,6) = residual between supply and demand

Table 3, finally, is called IO and shows the intermediate use of each commodity (row index) in each production sector (column index).

Table 1 Supply matrix

Year 1982	Fixed prices		Purchase values							
Intermediate use code IO	1	2	3	4		5	6	7	8	SUM
101[a)]	20186	53	4689	108	25036	4421	372	-4536	1667	26960
102	9585	365	712		10662	1229			90	11981
103	626		91		717	128		-16	73	902
104	1627		3		1630	48				1678
105	1173		981		2154	168				2322
106	1179	54	14359		15592	299			52	15943
107	26630	40	1305	228	28203	6150		-728	5017	38642
108	13333	32	4544	239	18148	5047	491	-183	2812	26315
109	3594		954	17	4565	3142	9225	-10	3046	19968
110	7941	52	10622	344	18959	10361			4577	33897
111	11480	28	318		11826	1461			42	13329
112	12802	28	1596	16	14442	3252			1040	18734
113	7384		256		7640	410				8050
114	13981		392		14373	975			60	15408
115	6237		872	4	7113	744	6		204	8067
116	16672	53	938		17663	1534	215		1072	20484
117	2194		1880	29	4103	764			259	5126
118	11723		9761	46	21530	1949			63	23542
119	9057	204	4825	12	14098	3660	182	-2520	1022	16442
120	3122		1349	12	4483	787	9		311	5590
121	16549		16190		32739	4621	8457		123	45940
122	7918		1910	18	9846	2035	34		211	12126
123	16263		4542	16	20821	2865			6	23692

124	7702		3862	4	11568	1416			2	12986
125	21686	115	7430	32	29263	2479	37		690	32469
126	32536		16238	166	48940	4343			516	53799
127	31463		11862	103	43428	5293	658		2414	51793
128	2998	65	3579	50	6692	1259			486	8437
129	19241		10582	187	30010	3904			1589	35503
130	7007		1099	2	8108	193			178	8479
131	1744	22	1566	21	3353	1843			699	5895
132	20279		989		21268		2404			23672
133	330				330					330
134	1564				1564					1564
135	74250				74250				5716	79966
136			2356		2356	1538				3894
137	9041	886			9927				1008	10935
138	45596	467	5904		51967		152		224	52343
139	14856		534		15390					15390
140	26061		34		26095					26095
141	52933				52933					52933
142	10966	363			11329					11329
143	29898	1270	2716		33884				964	34848
144	9933		34		9967				1435	11402
145	29103	1994	227		31324	610	1218		367	33519
Sum	670443	6091	152101	1654	830289	78928	23460	–7993	38035	962719

[a] For sector codes 100-145 see p. 307.

Note: 1 = Gross production in producer prices (excl. residual); 2 = sales of market products from the public sector; 3 = imports cif; 4 = customs duties and import levels; 5 = trade margins; 6 = commodity taxes; 7 = subsidies; 8 = value added taxes.

Table 2 Final demand matrix

Year 1982	Fixed prices	Purchase values						
Intermediate use code IO	Inputs	1	2	3	4	5	6	SUM
101[a)]	16339	405	8844	322	82	1251	–283	26960
102	11138		498	653	427	150	–885	11981
103	306	9	397			334	–144	902
104	659				46	1014	–41	1678
105	2256				–3	694	–625	2322
106	16084	206	107		222	356	–1032	15943
107	8457	1860	26450		69	1544	262	38642
108	8013	523	15343		5	1272	1159	26315
109	1627	24	17253		35	139	890	19968
110	5424	935	25305	256	98	3738	–1859	33897
111	6612	88	39		–489	7002	77	13329
112	11055	395	5302	844	–287	3193	–1768	18734
113	3055				15	4955	25	8050
114	5555	242	82		–4	10277	–744	15408
115	5003	368	748		–131	2391	–312	8067
116	12145	1991	5227		6	654	461	20484
117	2948	127	1353		–50	873	–125	5126
118	15379	82	360		333	5539	1849	23542
119	6275	2370	5100		16	3824	–1143	16442
120	3024	449	1291		–5	914	–83	5590
121	23556	2408	15340		–808	6313	–869	45940
122	10100	317	940		–202	1564	–593	12126
123	16772	82	45		–724	8504	–987	23692

124	9078	85	19		-28	3618	214	12986
125	17001	857	2267	3249	-505	7037	2563	32469
126	15339	1394	984	15508	-1225	22571	-772	53799
127	13812	1893	11931	6090	-689	19689	-933	51793
128	1268	709	1579	2168	-65	2362	416	8437
129	11857	1486	5958	5008	-960	10849	1305	35503
130	1540	487	991	1828	-279	3907	5	8479
131	631	418	3510	69	-81	944	404	5895
132	11630	2076	9574			384	8	23672
133	57	4	120				149	330
134	1226	307					31	1564
135	19379	3771		56816				79966
136	1534					1538	822	3894
137	2407	821	7410				297	10935
138	29295	3273	7401			12880	-506	52343
139	6509	1658	4530			497	2196	15390
140	21924	243	2425			14	1489	26095
141			52933					52933
142	7518	2893	749				169	11329
143	18977	5157	477	6422		6301	-2486	34848
144	4817	277	6366			82	-140	11402
145	12184	3070	18879			492	-1106	33519
SUM	399765	43760	268127	99233	-5181	159660	-2645	962719

[a] For sector codes 100-145 see page 307.

Note: 1 = use of intermediate goods in the public sector; 2 = private consumption; 3 = gross investments 4 = stock building; 5 = exports; 6 = residual between supply and demand.

Table 3 Goods-sector matrix, inputs

Year 1982	Fixed prices	Purcharse values												
Intermediate use code IO	101	102	103	104	105	106	107	108	109	110	111	112	113	114
101[a)]	639						11143	3516	320	80		3		
102	19	398			2			27		7	5257	561	2270	2322
103	33						2	198						
104				164										
105					12									
106	142			5	2	67				4			10	190
107	81						4810	1008	83	148				
108	3370		9				496	3035	92	2		4	6	63
109								2	519					
110	67	73	39	9	35		54			2551		278	48	239
111			1			3	6			4	881	1457	961	788
112	42	46	24		27			23	8	14	40	1976	20	222
113										3			14	2886
114	43	6	4				158	77	51	55		19	2	568
115	8			1		4	245	314	74	53	1	162	8	129
116	25	13		3	4	6	33	43	41	39	44	63	13	58
117	53	33		1			5		5	10		3		
118	1500	25		14	42	8	146	276	22	419	57	588	557	696
119	61		9	19	16	35	7	44	24	27	58	209	5	89
120	2	4		1	2	8	169	164	54	62		37		4
121	673	202	87	81	35	25	374	184	57	195	140	155	242	728
122	69			33	24	11	11	97	125	12		379	24	46
123				7							22	27	25	52

124							8	106	10			4		
125	54	54	2	24	43	14	39	217	340	68	209	592	106	129
126	619	327		39	38	75	33	22	12	120	79	27	113	157
127				4	6									
128														
129			2	3	4		5	8	2	6	35	33	36	145
130			41											
131										35				2
132	482	40		131	106	79	227	106	33	102	212	170	444	1243
133							3							
134				1		4	16	10	2	11	22	9	5	14
135	843	108		57	45	6	118	54	23	38	45	50	53	103
136							13	12	1	31	73	29	96	123
137				4	3		19	12	6	21	8	18	7	16
138	216	761	6	410	70	69	448	246	80	99	283	272	27	82
139	15	3		4	6	2	46	46	8	41	19	45	10	33
140	322	21	8	30	29	3	149	100	39	57	57	97	72	227
141														
142				5	3	2	77	42	9	22	23	19	16	28
143	207	25		16	20	3	357	216	104	227	121	258	78	215
144	210	39		14	15	4	100	20	14	17	89	43	22	18
145	95	3		9	3	1	135	44	10	66	64	88	34	91
SUM	9890	2181	232	1089	592	429	19452	10269	2168	4646	7839	7675	5324	11706

[a] For sector codes 100-145 see p. 307.

Table 3 Goods—sector matrix, inputs (cont.)

Year 1982	Fixed prices		Purchase values											
Intermediate use code IO	115	116	117	118	119	120	121	122	123	124	125	126	127	128
101			75	2	21									
102	42			3	39			2	3		7			1
103														
104									495					
105								25	385	1423	409	2		
106			4	285	20		13723	604	74	23	4	4	10	
107				1	139			7						
108			4	104	88									
109				28	28	1								
110		4	193	13	4	7		9	54		20	167	345	17
111	76		2	2	22			9			45	18	182	3
112	8	4	11	2				47	64	8	216	207	699	4
113	16			123		4								
114	1512	2209	1	34	32	30	18	43	2	6	7	12	40	
115	597	880	1	72	262	64		45	2		71	109	59	10
116	12	3915	10	46	188	35	59	82	41	2	130	229	133	22
117		18	240	13				6	1		5	351	919	19
118	334	21	301	4164	1318	1277	178	251	169	161	169	132	147	
119	87	291	24	151	1160	1	84	10	25	3	561	132	263	14
120	21	18		76	164	50	21	58	2		90	442	360	6
121	78	101	56	1373	292	40	985	510	1621	107	337	349	424	18
122	4	3	2	23	68	11	51	1075	243	19	108	162	299	15
123	7	3		3		16	4	168	5940	13	4032	2617	2362	39

124	9	1		55	154	2		15	468	3756	991	293	457	53
125	9	64	57	49	164	5	157	103	336	465	2247	2027	1116	35
126	9	27	16	226	36	56	206	41	376	49	356	6311	1646	42
127											4	201	8290	
128		4		3	4						39	173	266	508
129	7	4	4	38	6	10	47	30	157	5	246	703	1366	127
130													18	
131		4	2		6					60	3	8	3	
132	97	95	45	602	96	101	68	250	819	262	318	285	261	15
133		3							29		4	2		
134		6	2	12	5	2	44	7	8	1	17	21	18	2
135	25	80	15	44	62	25	18	67	108	37	127	206	169	12
136	47	6	8	68	40	8	55	18	89	30	85	244	239	26
137	7	37	7	23	29	6		20	23	6	39	76	51	8
138	80	181	33	110	152	67	9	257	303	89	341	452	421	27
139	23	247	12	33	47	12	20	39	48	18	88	168	112	19
140	104	91	24	64	83	27	100	83	181	59	145	240	163	26
141														
142	13	17	5	22	17	4	23	20	35	13	37	50	56	4
143	127	1090	74	194	292	74	77	226	279	92	382	619	762	102
144	6	30	5	16	17	7	5	52	31	9	50	57	115	5
145	15	307	28	37	50	29	21	55	98	15	177	275	212	30
SUM	3372	9761	1261	8114	5105	1971	15973	4234	12509	6731	11907	17344	21983	1209

Table 3 Goods—sector matrix, inputs (cont.)

Year 1982	Fixed prices	Purchase values												
Intermediate use code IO	129	130	131	132	133	134	135	136	137	138	139	140	141	142
101							77		241			2	62	10
102			15				128						35	
103									73					
104														
105														
106	10		52	5		8	775						52	11
107			14						1379	582				
108									653					
109									947	60				
110	16	68	64				360	150	55	175	72	31		
111	4	151	140	5			1313			140			194	10
112	62	105	26				6398	326	13	235	37			
113				9										
114	52	1	62	3			112	77	3	119	9	33	3	2
115	119	2	25	3			402	690	41	21	12	45	5	5
116	191	46	38	19		4	327	1673	42	272	486	280		144
117	135	18	35	5			187	227		602				
118	596	296	131	6		22	988	23						
119	87	176	142			6	1373	51	37	246	49	12	186	20
120	287	6	36	3			216	309	102	39	14	53	5	2
121	141	85	44	3040	106	25	1409	1368	318	5188	114	250	416	773
122	197	106	17			3	6515	71	176				84	
123	283	514	93				545							

124	1005	29	508				1073	49						
125	221	881	114	67	2	14	5727	279	20	422	52	11	238	24
126	335	808	10	1098			1488	151		131	35	11		
127		157					3	139		1310				
128	25	43					17	22		3		12	2	
129	5298	168	20	183		17	1888	434	21	111	190		112	9
130		732								749				
131	4		140				26	75	15	15	7	22	3	1
132	191	64	30	637	2	64	184	989	109	528	219	124	618	559
133				16										
134	14	6	5			30							616	264
135	241	33	7	2126	24	299		494		1016	954		10628	838
136	151	35	7											
137	65	10	6	17		2	111	738	14	202	63	200	34	22
138	285	38	18	25		2	2677	10242	34	8446	1061	288	6	2
139	154	17	8	34		3	228	1118	31	496	609	1481	99	33
140	192	33	10	35	2	3	349	592	45	584	104	15883	654	332
141														
142	37	8	3				137	2234	336	183	351	996		
143	799	112	52	47		6	722	1859	76	850	492	1964	268	100
144	18	13	3	80	2	17	555	794	55	1835	47	29	51	22
145	205	44	17	131		1	511	1220	150	518	256	301	3699	463
SUM	11420	4805	1892	7594	138	526	36821	26394	4986	25078	5233	22028	18070	3646

Table 3 Goods—sector matrix, inputs (cont.)

Year 1982	Fixed prices	Purchase values		
Intermediate use code IO	143	144	145	SUM
101	2		146	16339
102				11138
103				306
104				659
105				2256
106				16084
107			205	8457
108			87	8013
109	15		27	1627
110	32	72	103	5424
111	38		157	6612
112			141	11055
113				3055
114	99	8	43	5555
115	38	8	416	5003
116	1601	132	1601	12145
117	2	9	46	2948
118	36	44	265	15379
119	92	114	275	6275
120	67	9	61	3024
121	434	84	292	23556
122		17		10100
123				16772

124			32	9078
125	7	57	140	17001
126	1	210	3	15339
127		3698		13812
128	111		36	1268
129	65	171	141	11857
130				1540
131	167	7	26	631
132	136	152	335	11630
133				57
134			52	1226
135		43	138	19379
136				1534
137	151	36	290	2407
138	299	58	223	29295
139	308	96	630	6509
140	227	70	208	21924
141				
142	1743	36	892	7518
143	4092	132	1169	18977
144	40	94	152	4817
145	294	128	2254	12184
SUM	10097	5485	10586	399765

APPENDIX 3 Aggregation Matrix

The 45-sector system does not allow for an exact specification (aggregation) of the sectors in MOSES (cf. Appendix 2 and *MOSES Handbook*, IUI Research Report No. 35, Stockholm 1989). The distribution of commodities between MOSES sectors shown in the table below can be further improved.

Classification of economic activities – intermediate use "45-level"

Interme-diate use code IO	SNR group	Title of category
101	1100	Agriculture, hunting
102	1200	Forestry and logging
103	1300	Fishing
104	2100	Iron ore mining
105	2200	Non-ferrous ore mining
106	2300	Coal mining, crude petroleum production, other mining and quarrying
107	3111	Protected food manufacturing
108	3112	Import-competing food manufacturing
109	3120	Manufacture of beverages and tobacco
110	3200	Textile, wearing apparel and leather industries
111	3411	Saw mills, planing mills, wood preserving plants
112	3412	Prefabrication of wooden building materials, manufacture of wooden packaging products, furniture and other manufacture of wooden products
113	3421	Wood pulp industries
114	3422	Manufacture of paper and paperboard
115	3423	Manufacture of fibreboards, containers and boxes of paper and paperboards; others
116	3430	Printing, publishing and allied industries
117	3510	Manufacture of rubber products
118	3521	Manufacture of industrial chemicals, fertilizers and plastic materials
119	3522	Manufacture of other chemical products
120	3523	Manufacture of plastic products
121	3530	Petroleum refining and manufacture of products of petroleum and coal
122	3600	Manufacture of non-metallic mineral products, except products of petroleum and coal
123	3710	Iron and steel basic industries
124	3720	Non-ferrous metal basic industries
125	3811	Manufacture of fabricated metal products except machinery and equipment
126	3812	Manufacture of machinery and equipment except electrical
127	3813	Manufacture of transport equipment except ship building
128	3814	Manufacture of professional and scientific measuring and controlling equipment and of photographic and optical goods, watches and clocks
129	3830	Manufacture of electrical machinery, apparatus, appliances and supplies
130	3843	Ship building and repairing
131	3900	Other manufacturing industries incl. public semi-industrial activities
132	4100	Electric light and power, steam and hot water supply
133	4200	Gas manufacture and distribution
134	4410	Water works and supply
135	5000	Construction
136	6100	Wholesale and retail trade
137	6300	Restaurants and hotels
138	7100	Transport and storage
139	7200	Communication
140	81+82	Financial institutions and nominal industry for unallocated banking services. Insurance
141	8300	Letting of dwellings and use of owner-occupied dwellings
142	8400	Letting of other premises
143	8500	Business services
144	9510	Repair services not elsewhere classified
145	9other	Other personal services

SNR group	MOSES Macro Sectors									
	1	2	3	4	5	6	7	8	9	10
1100					1.0					
1200					1.0					
1300					1.0					
2100						1.0				
2200						1.0				
2300							1.0			
3111				1.0						
3112				1.0						
3120				1.0						
3200		0.2	0.2	0.6						
3411	1.0									
3412		0.5	0.25	0.25						
3421	1.0									
3422		1.0								
3423		0.8		0.2						
3430				1.0						
3510		0.8		0.2						
3521		1.0								

3522		0.5		0.5						
3523		0.5		0.5						
3530							1.0			
3600		0.9		0.1						
3710	0.5	0.5								
	Raw material	Inter-mediate goods	Investment goods, consumer durables	Consumption goods (excl. durables)	Agriculture, forestry, fishing	Mining and quarrying	Oil	Construc-tion	Electricity	Other services

	MOSES Macro Sectors									
SNR group	1	2	3	4	5	6	7	8	9	10
3720	0.5	0.5								
3811		0.8	0.1	0.1						
3812			1.0							
3813			1.0							
3814			1.0							
3830			1.0							
3843			1.0							
3900				1.0						
4100									1.0	
4200									1.0	
4410									1.0	
5000								1.0		
6100										1.0
6300										1.0
7100										1.0
7200										1.0
81+82										1.0

8300										1.0
8400										1.0
8500										1.0
9510										1.0
9other										1.0
	Raw material	Inter-mediate goods	Investment goods, consumer durables	Consumption goods (excl. durables)	Agriculture, forestry, fishing	Mining and quarrying	Oil	Construc-tion	Electricity	Other services

APPENDIX 4 Aggregation Program Code (IO82.FOR), Variables, and Print Out

Beside the basic variables defined in Appendix 2 the following main variables have been used:

VA(i) = value added in producers' prices
Y(i) = gross production in producers' prices (incl. residual)
GG(i,j) = aggregation matrix (cf. Appendix 3).

22FD, NR, TINR are aggregate values (column sums) of respective component of final demand and supply taken from the National Accounts.

```
C        PROGRAM IO82.FOR.
C        KONTROLL OCH BEARBETNING AV SCB:S 45*45 MATRIS 1982
C        INDATA P] SCB82.DAT, KONTROLLDATA P] KON82.DAT
C        AGGREGERINGSMATRIS P] AMO.DAT (AX.DAT)
C        RESULTAT P] MO82.DAT (X82.DAT)
C        TILL[GG G\RS F\R TURISTTJ[NSTER (EJ MED I SCB-MATRISEN)
C        SEPARAT KOLUMN BILDAS F\R HANDELSMARGINALER, MED NOLLOR I
C        ALLA CELLER UTOM F\R VARUHANDELN SOM GES V[RDET MINUS
C        SUMMA MARGINALER. D[RMED KAN SUMMA HANDELSMARGINALER DIREKT
C        S[TTAS IN I CELLEN F\R PRODUKTION I VARUHANDELN (36)
C        TILL:1=PROD 2=OFS  3=IMP  4=TULL 5=HMAR 6=SVS
C              7=SUB  8=MOM  9=HMAR
C        FD:   1=LF   2=PK   3=INV  4=LAG  5=EXP  6=RES
C        KORRIGERING TILL SENASTE AGGREGERADE NR-DATA
C        G\RS I TJ[NSTESEKTORN.
C        NR-V[RDEN F\R FINAL DEMAND=FDNR(1-6),
C        DITO F\R TILLF\RSEL (EXKL BRUTTOPROD)=TINR(2-9),
C        V[RDEN L[SES IN SIST I SCB82.DAT
         REAL FD(46,8),TILL(46,10),IO(46,46),VA(46),Y(46)
         REAL FD1(11,11),TILL1(11,10),IO1(11,11),VA1(11),IOX(11,46)
         REAL FDNR(6),TINR(9),AGG(45,10)
         OPEN(20,FILE='SCB82.DAT')
         OPEN(21,FILE='KON82.DAT')
         OPEN(30,FILE='AMO.DAT')
         OPEN(31,FILE='AX.DAT')
         OPEN(40,FILE='MO82.DAT')
         OPEN(41,FILE='X82.DAT')
C        L[S SCB-MATRISEN, TURISTTJ[NSTER OCH NR-DATA
C        FIL-NUMMER F\R AGGREGERINGSFIL (KFIL) ,FOR RESULTATFIL
C        (IFIL) SAMT FOR DIMENSION  FOR AGRREGERAD MATRIS(IDIM)
C        LIGGER FORST I SCB82.DAT.
         READ(20,'(3I)')KFIL,IFIL,IDIM
         DO 1 I=1,45
1        READ(20,'(8F)')(TILL(I,J),J=1,8)
         DO 2 I=1,45
2        READ(20,'(6F)')(FD(I,J),J=1,6)
         DO 3 I=1,45
         READ(20,'(11F)')(IO(I,J),J=1,11)
         READ(20,'(11F)')(IO(I,J),J=12,22)
         READ(20,'(11F)')(IO(I,J),J=23,33)
```

```
3       READ(20,´(12F)´)(IO(I,J),J=34,45)
C       L[S TURISTTJ[NSTER OCH KORRIGERA PRIV KONS, EXPORT OCH IMPORT
        READ(20,´(2F)´)TUEX,TUIM
        FD(45,2)=FD(45,2)+TUIM-TUEX
        FD(45,5)=FD(45,5)+TUEX
        TILL(45,3)=TILL(45,3)+TUIM
        DO 24 I=1,45
24      TILL(36,9)=TILL(36,9)-TILL(I,5)
        TILL(36,1)=TILL(36,1)-TILL(36,9)
C       ==============================================================
C       BER[KNING AV SUMMOR I SCB-MATRISEN
C       ==============================================================
C       TILLF\RSELMATRISEN
        DO 4 I=1,45
        DO 5 J=1,9
5       TILL(I,10)=TILL(I,10)+TILL(I,J)
4       TILL(46,10)=TILL(46,10)+TILL(I,10)
        DO 6 J=1,9
        DO 7 I=1,45
7       TILL(46,J)=TILL(46,J)+TILL(I,J)
6       SL5=SL5+TILL(46,J)
C       IO-MATRISEN
        DO 9 I=1,45
        DO 9 J=1,45
9       IO(I,46)=IO(I,46)+IO(I,J)
        DO 10 J=1,45
        DO 10 I=1,45
10      IO(46,J)=IO(46,J)+IO(I,J)
        DO 12 I=1,45
12      IO(46,46)=IO(46,46)+IO(I,46)
C       FINAL DEMAND MATRISEN
        DO 15 I=1,45
        DO 16 J=1,6
16      FD(I,7)=FD(I,7)+FD(I,J)
15      FD(I,8)=IO(I,46)+FD(I,7)
        DO 18 I=1,45
        FD(46,7)=FD(46,7)+FD(I,7)
18      FD(46,8)=FD(46,8)+FD(I,8)
        DO 20 J=1,6
        DO 21 I=1,45
```

```
21    FD(46,J)=FD(46,J)+FD(I,J)
20    SL3=SL3+FD(46,J)
      SL4=SL3+IO(46,46)
C     KOLUMNSUMMOR I FD- OCH TILL-MATRISERNA KORRIGERAS TILL
C     AKTUELLA NR-V[RDEN. [VEN BRUTTOPRODUTKIONEN KORRIGERAS.
      READ(20,'(6F)')FDNR
      READ(20,'(8F)')(TINR(I),I=2,9)
      DO 26 I=1,6
      SS1=FDNR(I)-FD(46,I)
      S1=S1+SS1
      FD(45,I)=FD(45,I)+SS1
26    FD(46,I)=FD(46,I)+SS1
      FD(46,7)=FD(46,7)+S1
      FD(45,8)=FD(45,8)+S1
      FD(46,8)=FD(46,8)+S1
      DO 27 I=2,9
      SS2=TINR(I)-TILL(46,I)
      S2=S2+SS2
      TILL(45,I)=TILL(45,I)+SS2
27    TILL(46,I)=TILL(46,I)+SS2
C     BRUTTOPRODUKTIONEN I TJ[NSTESEKTORN KORRIGERAS S] ATT
C     KORR ANV=KORR TILLF
      TILL(45,1)=TILL(45,1)+S1-S2
      TILL(46,1)=TILL(46,1)+S1-S2
      TILL(45,10)=TILL(45,10)+S1
      TILL(46,10)=TILL(46,10)+S1
C     BER[KNING AV BRUTTOPRODUKTION (MINUS RES) OCH F\R[DLINGSV[RDE
      DO 22 I=1,46
      Y(I)=TILL(I,1)-FD(I,6)
22    VA(I)=Y(I)-IO(46,I)
C     ==========================================================
C     UTSKRIFT AV SUMMOR I SCB-MATRISEN F\R KONTROLL
C     ============================================================
      WRITE(21,'(/,A)')' TILLG]NG PER VARA:'
      DO 8 K=1,5
8     WRITE(21,'(9F8.0)')(TILL(I,10),I=(K-1)*9+1,K*9)
      WRITE(21,'(/,A,F8.0)')' SUMMA TILLG]NG=',TILL(46,10)
      WRITE(21,'(/,A)')' TILLG]NG PER KOMPONENT:'
      WRITE(21,'(9F8.0)')(TILL(46,J),J=1,9)
      WRITE(21,'(/,A,F8.0)')' SUMMA TILLG]NG=',SL5
```

```
      WRITE(21,'(/,A)')' INSATS PER VARA:'
      DO 11 K=1,5
11    WRITE(21,'(9F8.0)')(IO(I,46),I=(K-1)*9+1,K*9)
      WRITE(21,'(/,A,F8.0)')' SUMMA INSATS=',IO(46,46)
      WRITE(21,'(/,A)')' INSATS PER BRANSCH:'
      DO 13 K=1,5
13    WRITE(21,'(9F8.0')(IO(46,J),J=(K-1)*9+1,K*9)
      DO 14 J=1,45
14    SL2=SL2+IO(46,J)
      WRITE(21,'(/,A,F8.0)')' SUMMA INSATS=',SL2
      WRITE(21,'(/,A)')' FINAL DEMAND PER VARA:'
      DO 17 K=1,5
17    WRITE(21,'(9F8.0)')(FD(I,7),I=(K-1)*9+1,K*9)
      WRITE(21,'(/,A)')' ANV[NDNING PER VARA:'
      DO 19 K=1,5
19    WRITE(21,'(9F8.0)')(FD(I,8),I=(K-1)*9+1,K*9)
      WRITE(21,'(/,A,F8.0)')' SUMMA ANV[NDNING=',FD(46,8)
      WRITE(21,'(/,A)')' ANV[NDNING PER KOMPONENT:'
      WRITE(21,'(/,A,F8.0,A,F8.0)')' SUMMA ANV[NDNING=',SL4,
     1'      SUMMA FINAL DEMAND=',SL3
      WRITE(21,'(/,A)')'BRUTTOPRODUKTION (MINUS RES):'
      DO 25 K=1,5
25    WRITE(21,'(9F8.0)')(Y(I),I=(K-1)*9+1,K*9)
      WRITE(21,'(/,A,F8.0)')' SUMMA BRUTTOPRODUKTION=',Y(46)
      WRITE(21,'(/,A)')' F\R[DLINGSV[RDE:'
      DO 23 K=1,5
23    WRITE(21,'(9F8.0)')(VA(I),I=(K-1)*9+1,K*9)
      WRITE(21,'(/,A,F8.0)')' SUMMA F\R[DLINGSV[RDE=',VA(46)
C     ================================================================
C     L[S AGGREGERINGSMATRIS AGG OCH IO-SYSTEMETS DIMENSION IDIM
C     SAMT NUMMER P] UTSKRIFTSFILER.
C     ========================================================
      DO 55 K=1,45
55    READ(KFIL,*)(AGG(K,I),I=1,IDIM)
C     FINAL DEMAND-MATRISEN
      DO 80 J=1,8
      DO 80 I=1,IDIM
      DO 81 K=1,45
81    FD1(I,J)=FD1(I,J)+AGG(K,I)*FD(K,J)
80    FD1(IDIM+1,J)=FD1(IDIM+1,J)+FD1(I,J)
```

```
C       TILLF\RSEL-MATRISELN
        DO 82 J=1,10
        DO 82 I=1,IDIM
        DO 83 K=1,45
83      TILL1(I,J)=TILL1(I,J)+AGG(K,I)*TILL(K,J)
82      TILL1(IDIM+1,J)=TILL1(IDIM+1,J)+TILL1(I,J)
C       IO-MATRISEN RADVIS
        DO 84 J=1,46
        DO 84 I=1,IDIM
        DO 85 K=1,45
85      IOX(I,J)=IOX(I,J)+AGG(K,I)*IO(K,J)
84      IOX(IDIM+1,J)=IOX(IDIM+1,J)+IOX(I,J)
C       IO-MATRISEN KOLUMNVIS
        DO 86 I=1,IDIM+1
        DO 86 J=1,IDIM
        DO 87 K=1,45
87      IO1(I,J)=IO1(I,J)+AGG(K,J)*IOX(I,K)
86      IO1(I,IDIM+1)=IO1(I,IDIM+1)+IO1(I,J)
C       ===========================================================
C       UTSKRIFT AV RESULTAT
C       ==========================================================
        WRITE(IFIL,'(/,A)')' INSATS-MATRIS:'
        DO 100 I=1,IDIM+1
100     WRITE(IFIL,'(11F7.0)')(IO1(I,J),J=1,IDIM+1)
        DO 101 I=1,IDIM+1
101     WRITE(IFIL,'(I2,8F8.0)')I,(FD1(I,J),J=1,8)
        WRITE(IFIL,'(/,A)')' TILLF\RSEL-MATRIS:'
        DO 102 I=1,IDIM+1
102     WRITE(IFIL,'(I2,F8.0,8F7.0,F8.0)')I,(TILL1(I,J),J=1,10)
        END
```

APPENDIX 5 Reflation Program Code (MO82.FOR), Variables, and Print Out

Beside variables defined in Appendices 2 and 4 the following main variables have been used:

TRB(i)	=	base year tax rate
TR(i)	=	current tax rate
VALP(i)	=	value added in current producers' prices
PVA(i)	=	ditto deflator
PH(i)	=	price of domestic demand excl. taxes
PP(i)	=	adjustment factor for PH

For IO, FD, TILL and Y the following rule applies. The letter "p" before the name denotes the corresponding price index. The letter "L" added at the end of the name denotes the corresponding value in current prices.

```
C        PROGRAM MO82.FOR
C        MATRIS AGGREGERADE TILL MOSES-NIV].
C        HANDELSMARGINALER L[GGS IN I IO-MATRISEN (RAD 10)
C        OCH ADDERAS TILL BRUTTOPRODUKTIONEN.
C        D[RMED  INNEH]LLER S]V[L TILLF\RSEL SOM ANV[NDNING
C        DUBBELR[KANDE HANDELSMARGINALER. F\R[DLINGSV[RDE TILL
C        PRODUCENTPRIS F]R R[TT V[RDE.
C        SAMTLIGA INDIREKA SKATTER (INKL TULLAR) BELASTAR
C        PRIVAT KONSUKTION OCH OFFENTLIG INSATSANV[NDNING.
         REAL FD(11,8),TILL(11,10),IO(11,11),VA(11),Y(11)
         REAL FDK(11,8),TILLK(11,10),IOK(11,11),SHARE(11)
         REAL T(11),TRB(11),TR(11),TL(11)
         REAL VALP(11),FDL(11,8),TILLL(11,10),IOL(11,11),YL(11)
         REAL PP(5),PH(11),PY1(11),PY(11),PFD(11,8),PTILL(11,10)
         REAL PVA(11),PT(11),HP(11),SL(11)
         OPEN(30,FILE='MO82.DAT')
         OPEN(31,FILE='PRIS82.DAT')
         OPEN(32,FILE='MOIO82.DAT')
C        ==============================================================
C        BER[KNA OCH SKRIV UT F\RS\RJNINGSBALANSER I FASTA
C        PRISER P] MOSES-FORMAT
C        ==============================================================

C        L[S IO-MATRISEN P] SCBFORMAT MED MOSESAGGREGAT
C        OBS!!!! HANDELSMARGINALERNA I TJ[NSTESEKTORNS PRODUKTION!!
C        (AGGREGERINGSPROGRAM IO82.FOR, UTSKRIFT P] MO82.DAT)
C        INSATS-MATRIS
         READ(30,'(/)')
         DO 1 I=1,11
1        READ(30,'(11F7.0)')(IO(I,J),J=1,11)
C        ANV[NDNINGSMATRIS
         READ(30,'(/)')
         DO 2 I=1,11
2        READ(30,'(I2,8F8.0)')K,(FD(I,J),J=1,8)
C        TILLF\RSEL-MATRIS
         READ(30,'(/)')
         DO 3 I=1,11
3        READ(30,'(I2,F8.0,8F7.0,F8.0)')K,(TILL(I,J),J=1,10)
C        L[GG IN HANDELMARGINALER I IO-MATRISEN OCH BER[KNA
C        BRUTTOPRODUTKION INKL RESIDUAL
```

```
      DO 4 I=1,11
      IO(10,I)=IO(10,I)+TILL(I,5)
      IO(11,I)=IO(11,I)+TILL(I,5)
    4 Y(I)=TILL(I,1)+TILL(I,5)-FD(I,6)
C     SUMMERA INDIREKTA SKATTER
      DO 5 I=1,11
    5 T(I)=TILL(I,4)+TILL(I,6)+TILL(I,7)+TILL(I,8)
C     BER[KNA F\R[DLINGSV[RDE OCH SKATTEKVOT
      DO 6 I=1,11
      IF(I.NE.6)TRB(I)=T(I)/(FD(I,1)+FD(I,2))
    6 VA(I)=Y(I)-IO(11,I)
C     BER[KNA IO-KOEFFICIENTER MM
      DO 7 I=1,11
      DO 7 J=1,11
      IOK(I,J)=IO(I,J)/Y(J)
    7 IF(J.LE.5)FDK(I,J)=FD(I,J)/FD(11,J)
C     BER[KNA N[RINGSLIVETS BNP
C     TILLF\RSEL (INKL OFF F[RS[LJNING OCH SKATTER)
      DO 8 I=1,10
      BNPT=BNPT+VA(I)+TILL(I,2)+T(I)
C     ANV[NDNING
    8 BNPA=BNPA+FD(I,1)+FD(I,2)+FD(I,3)+FD(I,4)+FD(I,5)-TILL(I,3)
      WRITE(32,'(/,A,2F10.0)')' BNPT, BNPA:',BNPT,BNPA
      WRITE(32,'(/,A)')' INSATS-MATRIS:'
      DO 9 I=1,11
    9 WRITE(32,'(11F7.0)')(IO(I,J),J=1,11)
      WRITE(32,'(/,A)')' ANV[NDNINGS-MATRIS:'
      DO 10 I=1,11
      SL(I)=0
      DO 42 J=1,5
   42 SL(I)=SL(I)+FD(I,J)
   10 WRITE(32,'(I2,6F8.0)')I,(FD(I,J),J=1,6)
      WRITE(32,'(/,A)')' TILLF\RSEL-MATRIS:'
      DO 11 I=1,11
   11 WRITE(32,'(I2,5F8.0,F8.4)')I,Y(I),TILL(I,2),TILL(I,3),T(I),
     1VA(I),TRB(I)
C     ==========================================================
C     L[S NR-DATA MM F\R AVST[MNING
C     =======================================================
      READ(31,'(5F)')(VALP(I),I=1,5)
```

```
            READ(31,´(6F)´)(VALP(I),I=6,10),DVALP
            READ(31,´(5F)´)(PFD(I,5),I=1,5)
            READ(31,´(5F)´)(PFD(I,5),I=6,10)
            READ(31,´(5F)´)(PTILL(I,3),I=1,5)
            READ(31,´(5F)´)(PTILL(I,3),I=6,10)
            READ(31,´(8F)´)(FDL(11,I),I=1,5),TILLL(11,3),TL(11),TILLL(11,2)
C           KORRIGERINGAR
            DO 20 I=1,10
            VALP(11)=VALP(11)+VALP(I)
            SL1=SL1+PFD(I,5)*FD(I,5)
            IF(I.LE.4)SL2=SL2+PFD(I,5)*FD(I,5)
            SL3=SL3+PTILL(I,3)*TILL(I,3)
20          IF(I.LE.4)SL4=SL4+PTILL(I,3)*TILL(I,3)
            DO 21 I=1,10
            VALP(I)=(1+DVALP/VALP(11))*VALP(I)
            IF(I.LE.4)PFD(I,5)=(1+(FDL(11,5)-SL1)/SL2)*PFD(I,5)
            IF(I.LE.4)PTILL(I,3)=(1+(TILLL(11,3)-SL3)/SL4)*PTILL(I,3)
            FDL(I,5)=PFD(I,5)*FD(I,5)
21          TILLL(I,3)=PTILL(I,3)*TILL(I,3)
            VALP(11)=0
            DO 40 I=1,10
40          VALP(11)=VALP(11)+VALP(I)
C           ==================================================
C           BER[KNING AV PRISER
C           ==================================================
C           PRELIMIN[RA V[RDEN
            DO 22 J=1,10
            SL1=0
            IF(J.LE.5)PP(J)=1
            DO 23 I=1,10
23          SL1=SL1+IOK(I,J)*PFD(I,5)
            TR(J)=TRB(J)
            PY1(J)=VALP(J)/Y(J)+SL1
22          PY(J)=VALP(J)/Y(J)+SL1
C           ITERATIV L\SNINGSALGORITM
            IX=0
100         IX=IX+1
            DO 25 I=1,10
            HP(I)=IO(I,11)+(PP(1)*FD(I,1)+PP(2)*FD(I,2))*(1-TRB(I))+
           1PP(3)*FD(I,3)+PP(4)*FD(I,4)
```

```
25    PH(I)=(PY(I)*(Y(I)+PP(5)*TILL(I,2))-FDL(I,5)+TILLL(I,3))/HP(I)
C     BERIKNA SKATTEKVOT
      SL1=0
      SL3=0
      DO 26 I=1,10
      SL2=(PP(1)*FD(I,1)+PP(2)*FD(I,2))*(1-TRB(I))
      SL3=SL3+PH(I)*SL2/(1-TR(I))*TR(I)
      SL1=SL1+PH(I)*SL2/(1-TR(I))
26    CONTINUE
      DO 27 I=1,10
      IF(I.NE.6)TR(I)=(TL(11)-SL3)/SL1+TR(I)
27    CONTINUE
C     BERIKNA PRISKORRIGERINGAR
      DO 28 I=1,5
28    SL(I)=0
      DO 29 I=1,10
      DO 30 J=1,2
30    SL(J)=SL(J)+PH(I)*PP(J)*(1-TRB(I))/(1-TR(I))*FD(I,J)
      SL(3)=SL(3)+PH(I)*PP(3)*FD(I,3)
      SL(4)=SL(4)+PH(I)*PP(4)*FD(I,4)
29    SL(5)=SL(5)+PY(I)*PP(5)*TILL(I,2)
      DO 31 J=1,4
31    PP(J)=FDL(11,J)/SL(J)*PP(J)
      PP(5)=TILLL(11,2)/SL(5)*PP(5)
      DO 34 J=1,10
      SL1=0
      DO 32 I=1,10
32    SL1=SL1+IOK(I,J)*PH(I)
34    PY(J)=VALP(J)/Y(J)+SL1
      IFOR=0
      DIFFS=0
      DO 33 I=1,10
      DIFF=((PY(I)-PY1(I))*10000)**2
      DIFFS=DIFFS+DIFF
33    IF(DIFF.GE..1)IFOR=1
      IF(IX.GE.2)TYPE '(I3,F10.2)',IX,DIFFS
      IF(IFOR.EQ.0)GOTO 1000
      DO 35 I=1,10
      SL1=PY(I)
35    PY1(I)=SL1
```

```
      GOTO 100
 1000 CONTINUE
      DO 36 I=1,10
      PVA(I)=VALP(I)/VA(I)
      HP(I)=IO(I,11)+(PP(1)*FD(I,1)+PP(2)*FD(I,2))*(1-TRB(I))+
     1PP(3)*FD(I,3)+PP(4)*FD(I,4)
   36 PH(I)=(PY(I)*(Y(I)+PP(5)*TILL(I,2))-FDL(I,5)+TILLL(I,3))/HP(I)
C     ==========================================================
C     UTSKRIFTER P] MOI082.DAT
C     ============================================================
      WRITE(32,'(//,A)')' L\PANDE PRISER 1982:'
      DO 47 I=1,10
      YL(I)=PY(I)*Y(I)
      TILLL(I,2)=PP(5)*PY(I)*TILL(I,2)
      SL1=PP(1)*FD(I,1)+PP(2)*FD(I,2)
      SL2=(1-TRB(I))/(1-TR(I))
      TL(I)=TR(I)*PH(I)*SL2*SL1
      PFD(I,1)=PH(I)*PP(1)*SL2
      PFD(I,2)=PH(I)*PP(2)*SL2
      PFD(I,3)=PH(I)*PP(3)
      PFD(I,4)=PH(I)*PP(4)
      DO 52 J=1,4
   52 FDL(I,J)=PFD(I,J)*FD(I,J)
      DO 47 J=1,10
      IOL(I,J)=PH(I)*IO(I,J)
   47 IOL(I,11)=IOL(I,11)+IOL(I,J)
      DO 49 J=1,10
      DO 48 I=1,10
   48 IOL(11,J)=IOL(11,J)+IOL(I,J)
      YL(11)=YL(11)+YL(J)
   49 IOL(11,11)=IOL(11,11)+IOL(11,J)
      WRITE(32,'(/,A)')' INSATS-MATRIS:'
      DO 50 I=1,11
   50 WRITE(32,'(11F7.0)')(IOL(I,J),J=1,11)
      WRITE(32,'(/,A)')' F\R[DLINGSV[RDE:'
      WRITE(32,'(11F7.0)')VALP
      WRITE(32,'(/,A)')'BRUTTOPRODUKTION:'
      WRITE(32,'(11F7.0)')YL
      WRITE(32,'(/,A)')' FINAL DEMAND-MATRIS:'
      WRITE(32,'(/,6(A9))')'OFFLF','PRIVK','INV','LAGER','EXPORT',
```

```
      1'SUM'
      DO 44 I=1,11
      DO 45 J=1,5
45    FDL(I,6)=FDL(I,6)+FDL(I,J)
44    WRITE(32,'(6F9.0)')(FDL(I,J),J=1,6)
      WRITE(32,'(/,A)')' TILLF\RSEL'
      WRITE(32,'(/,5(A9))')'PROD','OFS','IMP','IND SK','SUM'
      DO 41 I=1,11
      TILLL(I,5)=YL(I)+TILLL(I,2)+TILLL(I,3)+TL(I)
41    WRITE(32,'(5F9.0)')YL(I),TILLL(I,2),TILLL(I,3),TL(I),TILLL(I,5)
      WRITE(32,'(A,5F6.3)')' PP',(PP(I),I=1,5)
      WRITE(32,'(A,10F6.3)')' PE ',(PFD(I,5),I=1,10)
      WRITE(32,'(A,10F6.3)')' PM ',(PTILL(I,3),I=1,10)
      WRITE(32,'(A,10F6.3)')' PY ',(PY(I),I=1,10)
      WRITE(32,'(A,10F6.3)')' PH ',(PH(I),I=1,10)
      WRITE(32,'(A,10F6.3)')' TRB',(TRB(I),I=1,10)
      WRITE(32,'(A,10F6.3)')' TR ',(TR(I),I=1,10)
      END
```

CHAPTER VI

Initial State Dependency —Sensitivity Analyses on MOSES

Erol Taymaz

This chapter summarizes the results of "noise" experiments. We made four experiments. The first experiment is the BASE case. In the second experiment, EXP05, we added ±5% random noise to initial wages and the maximum potential output (QTOP) variables. Note that the QTOP variable directly affects the measure of labor productivity.

Noise is created as follows. For each firm and variable, a number, μ_{vf} is randomly drawn from a uniform distribution over [-.05,+.05], where v denotes the variable (W or QTOP) and f represents firms. Then the firm variable is increased μ percentage (for example, $W_f \leftarrow W_f * 1+\mu_{Wf}$).

In the third and fourth experiments, the noise was 10% and 25%, respectively.

Figures 1 and 2 show the relative noises for wage and QTOP variables for each firm. Figure 3 and 4 show absolute noise levels (three firms that have very high QTOP values are not exhibited in Figure 4). As shown in these figures we introduced quite substantial "noises." Figure 5 shows potential labor productivity and the corresponding wage rate distributions (i.e., both variables are ranked by potential labor productivity) for EXP25 (solid lines represent EXP25, dotted lines represent the BASE case). The potential labor productivity curve appears not to have changed significantly, as may be expected from Figure 4. Figure 6 shows potential output (QTOP) and the corresponding wage distributions for the same experiment. There is no dramatic change. Why does a 25% noise in the QTOP variable induce so little (relatively speaking) noise in the QTOP distribution? Figure 7 to some extent explains why.

Figure 7 is similar to Figure 6, but in this figure, the QTOP and W distributions of EXP25 (solid lines) are ranked by the BASE experiment's QTOP values (noiseless case). Figure 7 shows that changes are quite substantial. What happens in Figure 5 and 6 can be explained as follows. We introduce noise randomly, i.e., some firms have higher W and QTOP values than the BASE case, and others have lower values. These changes cancel each other to some extent in Figure 5 and 6. For example, the firm that have the fourth highest QTOP value had a negative noise in EXP25 and the firm that have the fifth highest QTOP value had a positive noise so that they changed their ranks in EXP25 (compare Figure 6 and 7). Thus, the QTOP distribution as shown in Figure 6 did not change much.

Figures 7-11 compare these experiments for various variables. In all variables, the differences between experiment results are negligible. Figures 12 and 13 show actual labor productivity and potential output (QTOP) distributions at the end of the simulation period. These curves are also quite similar. In brief, we can conclude that *random* noise in initial *micro* variables may not be a serious problem. Hence, if statistical errors in the initial state description of the MOSES database are randomly distributed there should be no problem in medium term in simulations. The MOSES model, as it is currently calibrated (see Section 3 in *MOSES on PC*), is sufficiently robust to accommodate such noise at the macro level.

Figure 1 Relative wage noise

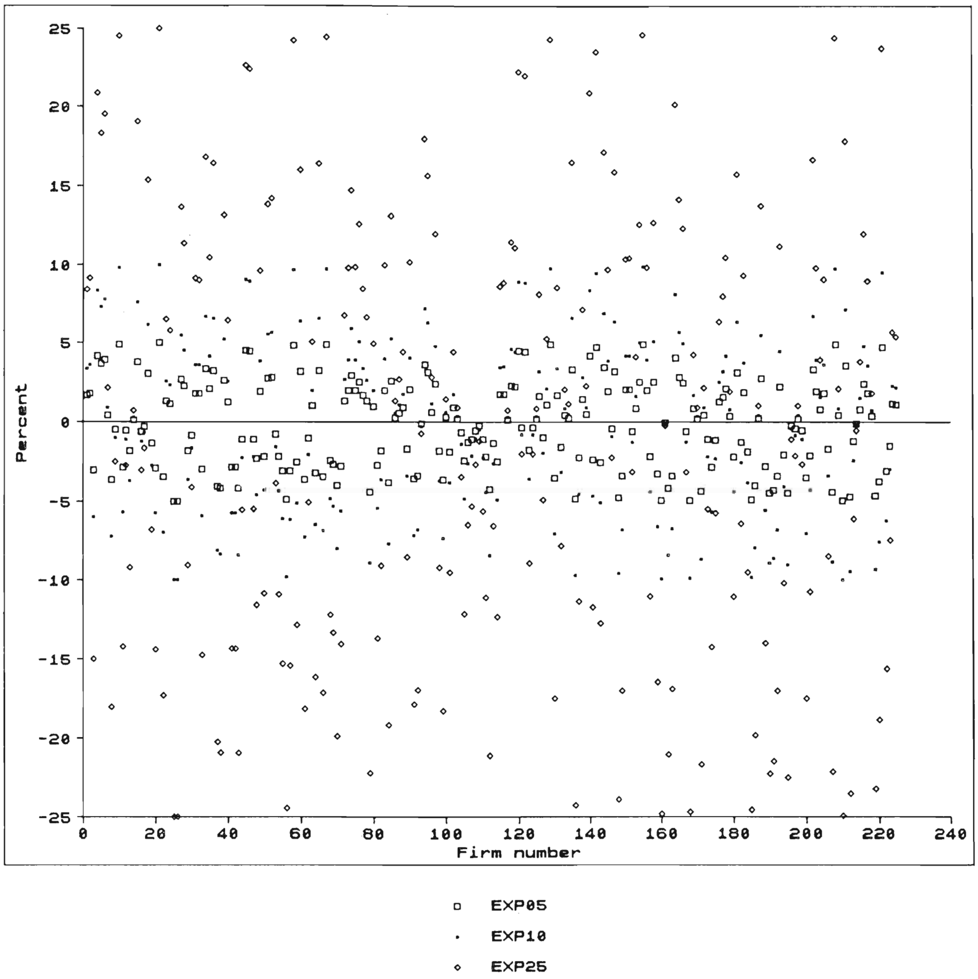


Figure 2 Relative QTOP noise

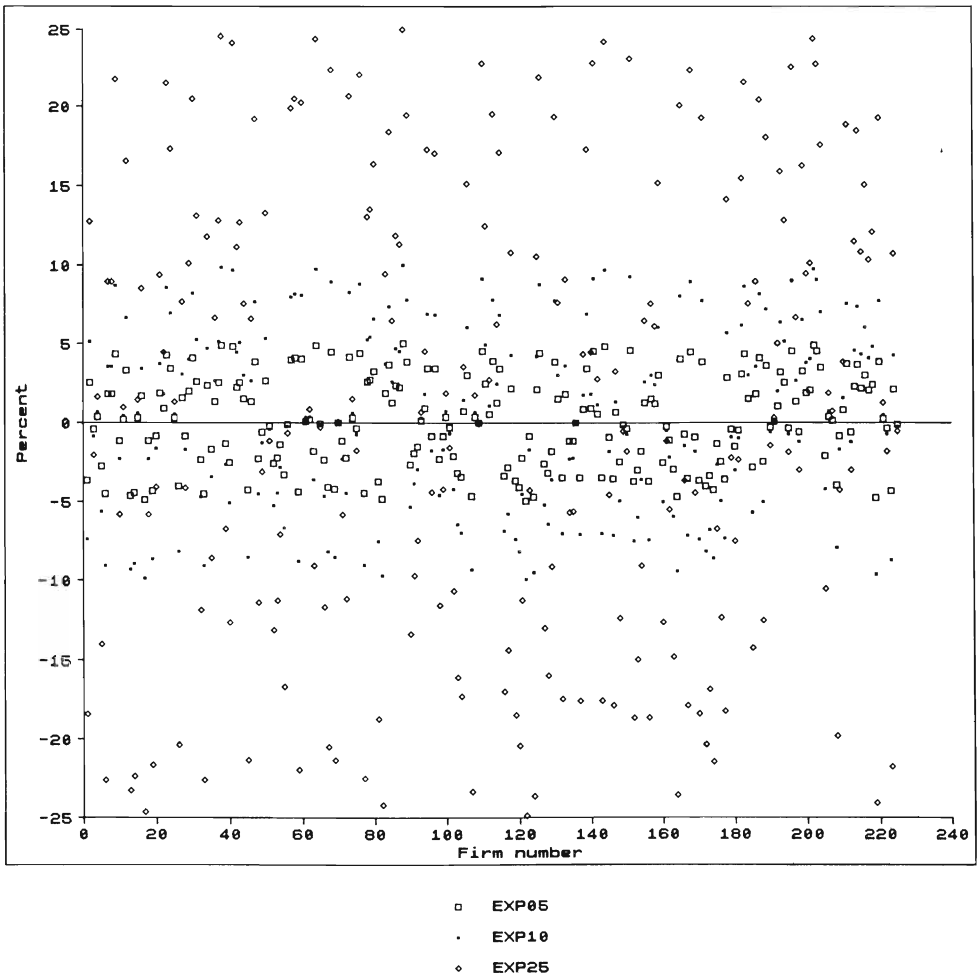


Figure 3 Noises in wages

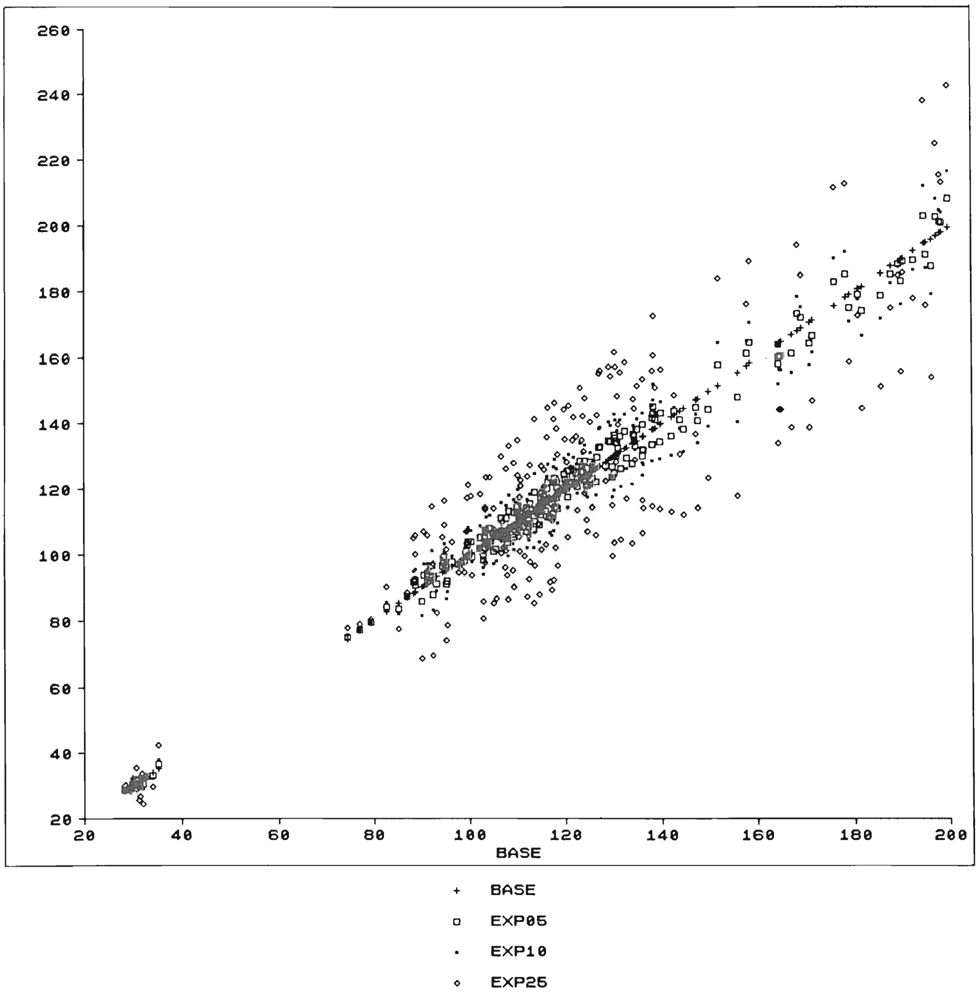


Figure 4 Noises in QTOP

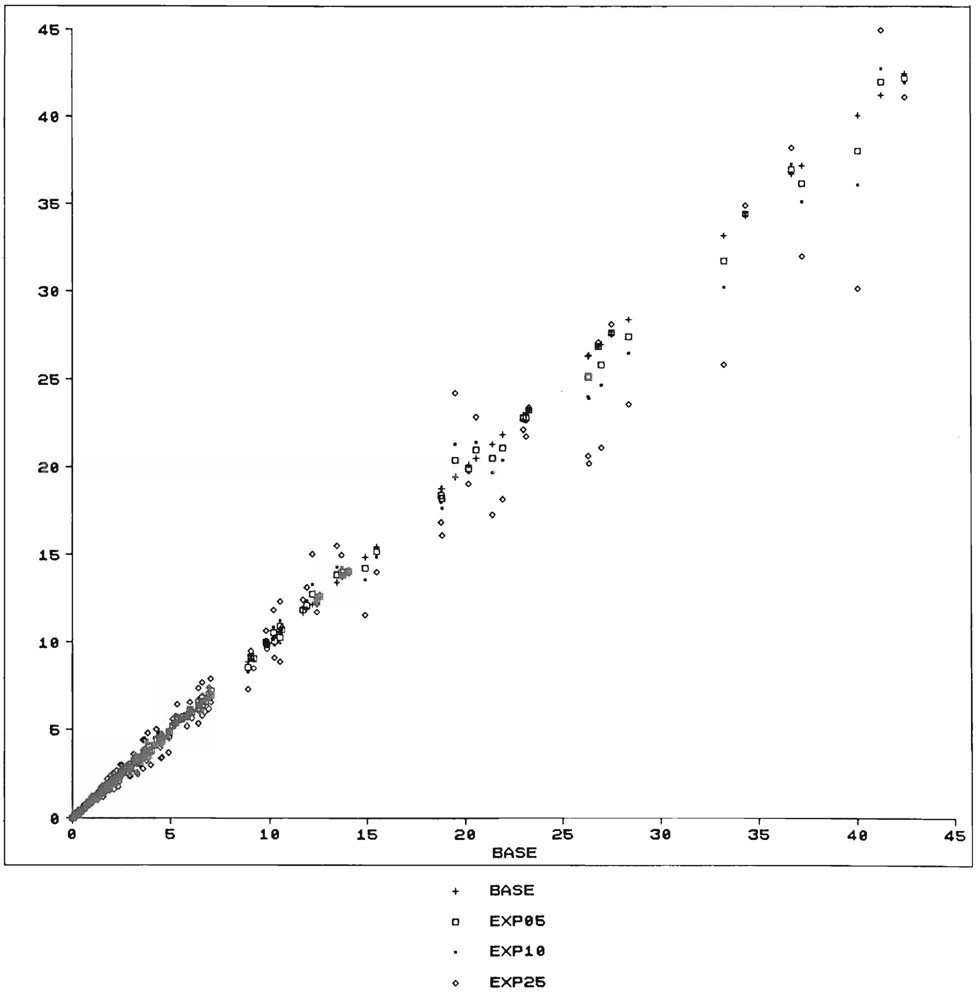


Figure 5 **Potential labor productivity (100 units of output/employee) and wages (4000 SEK/employee)**

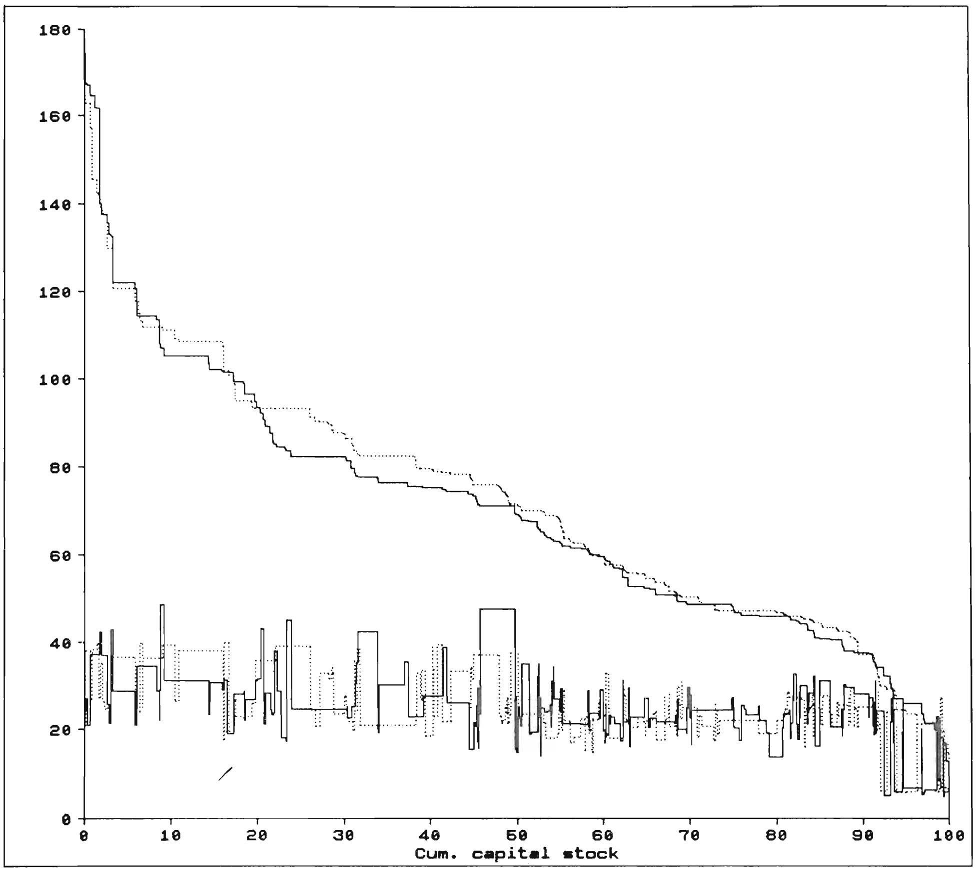


Figure 6 **Potential quarterly output (QTOP) and wages (1000 SEK/employee) (10^7 units of output)**

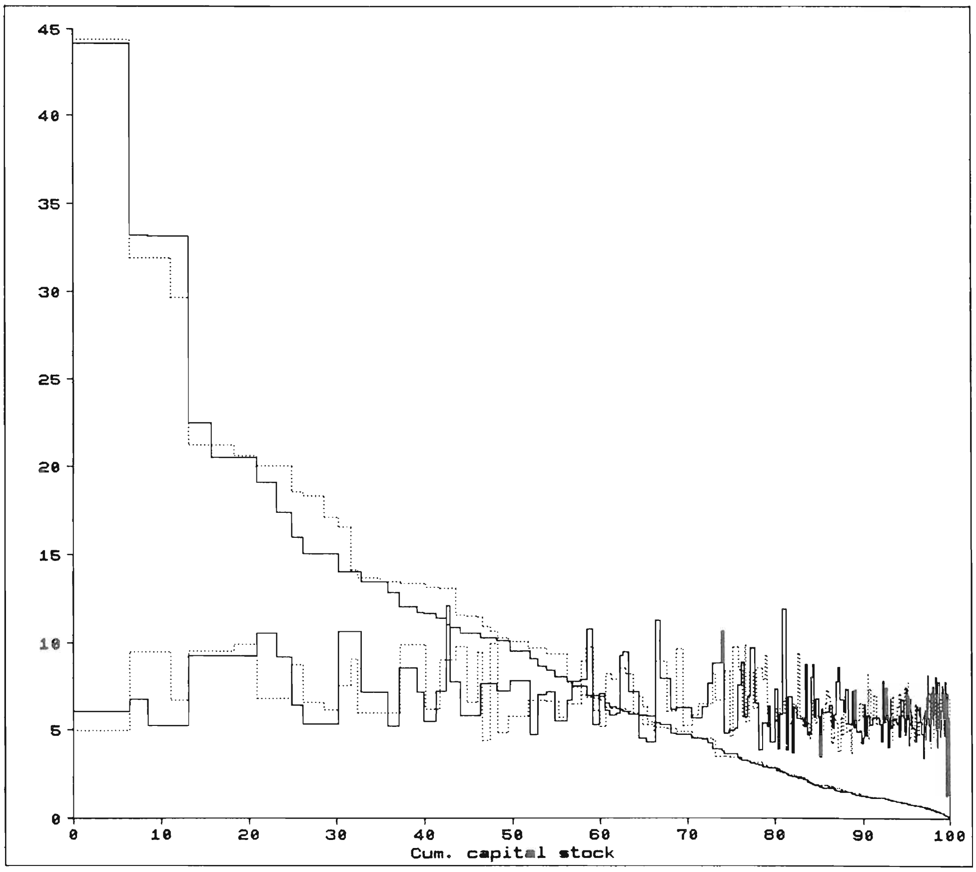


Figure 7 Potential quarterly output (QTOP) and wages (1000 SEK/employee) (10^7 units of output)

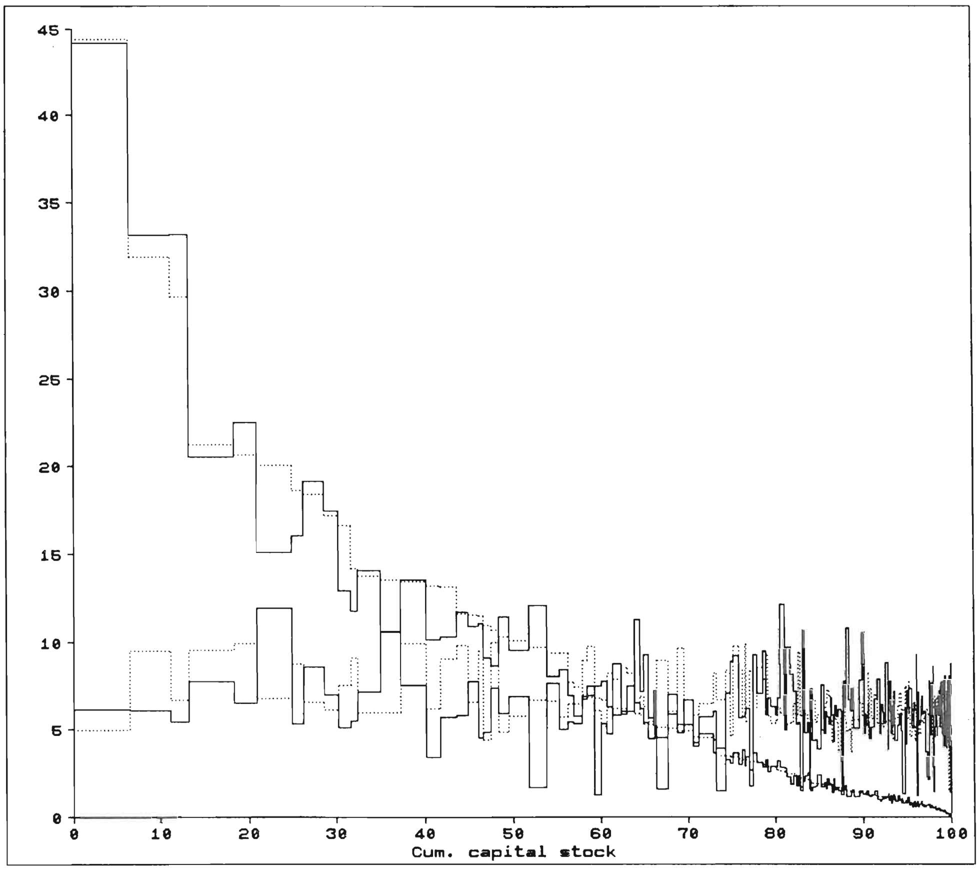


Figure 8 QTOP

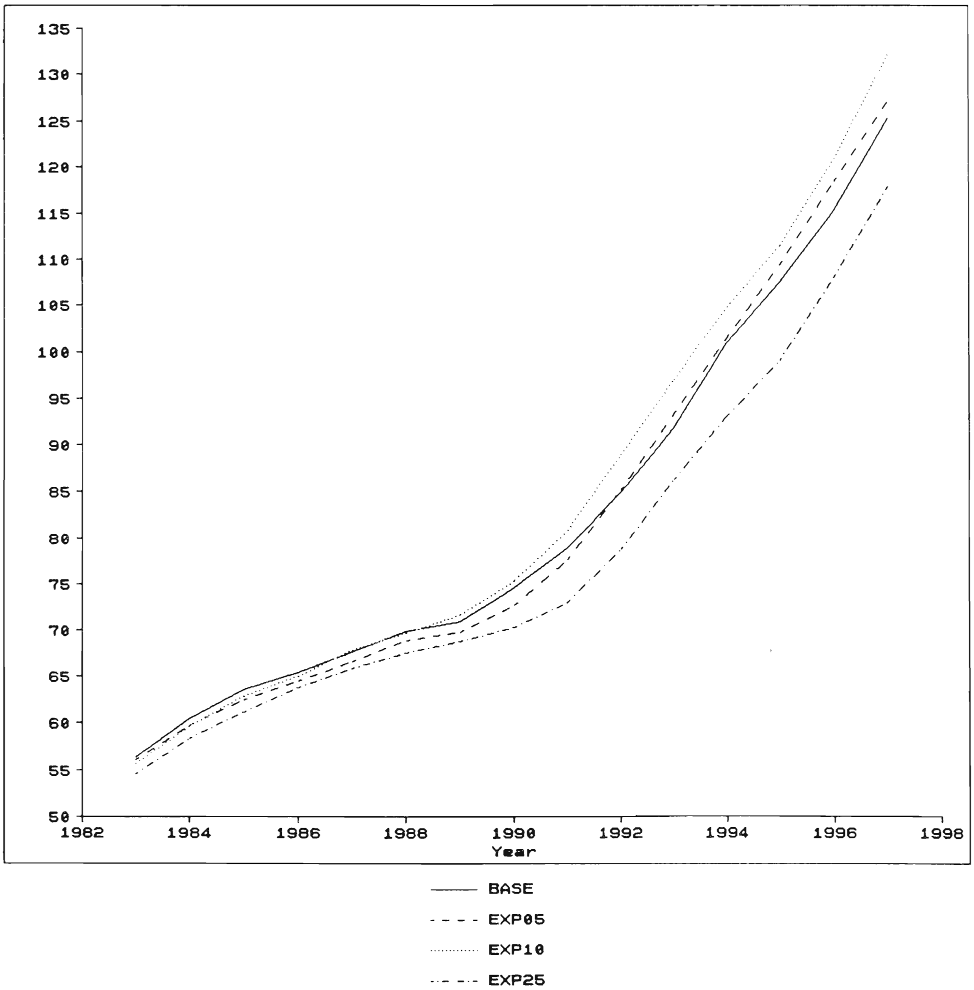


Figure 9 TEC

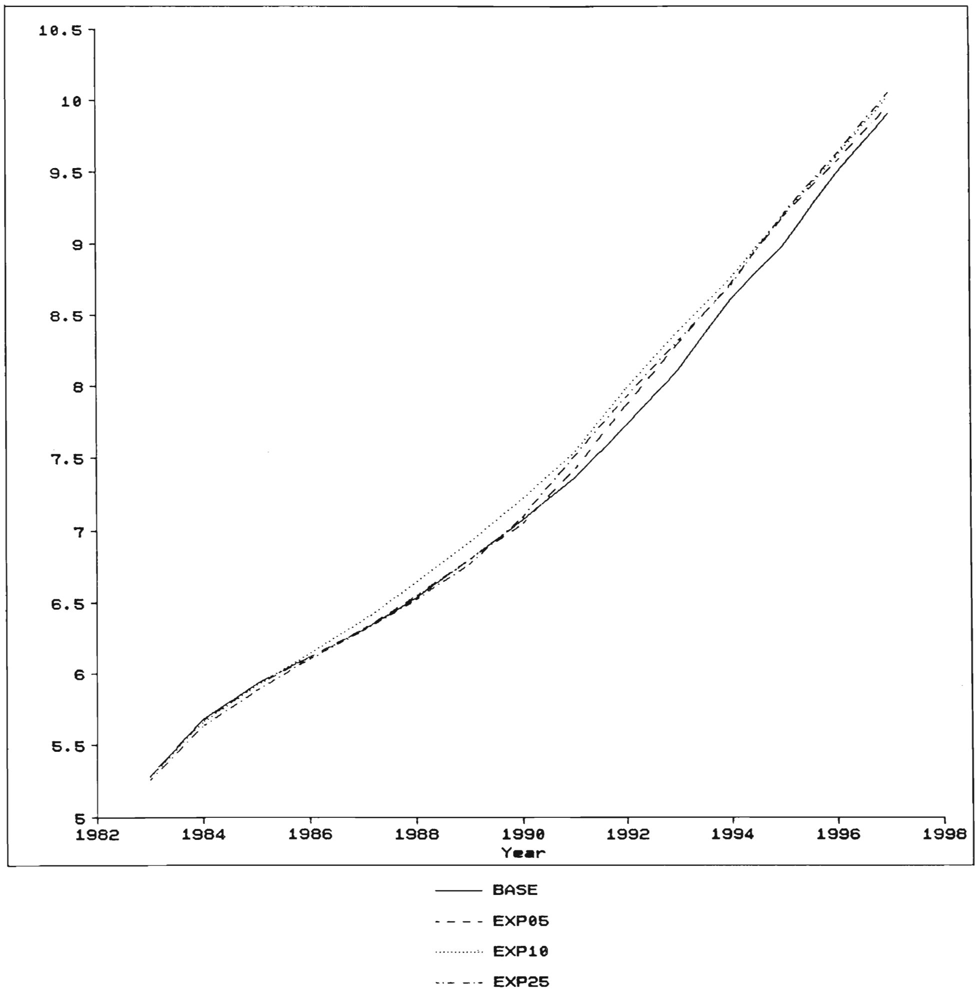

10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
1982
1984
1986
1988
1990
1992
1994
1996
1998
Year
BASE
EXP05
EXP10
EXP25

Figure 10 Labor productivity

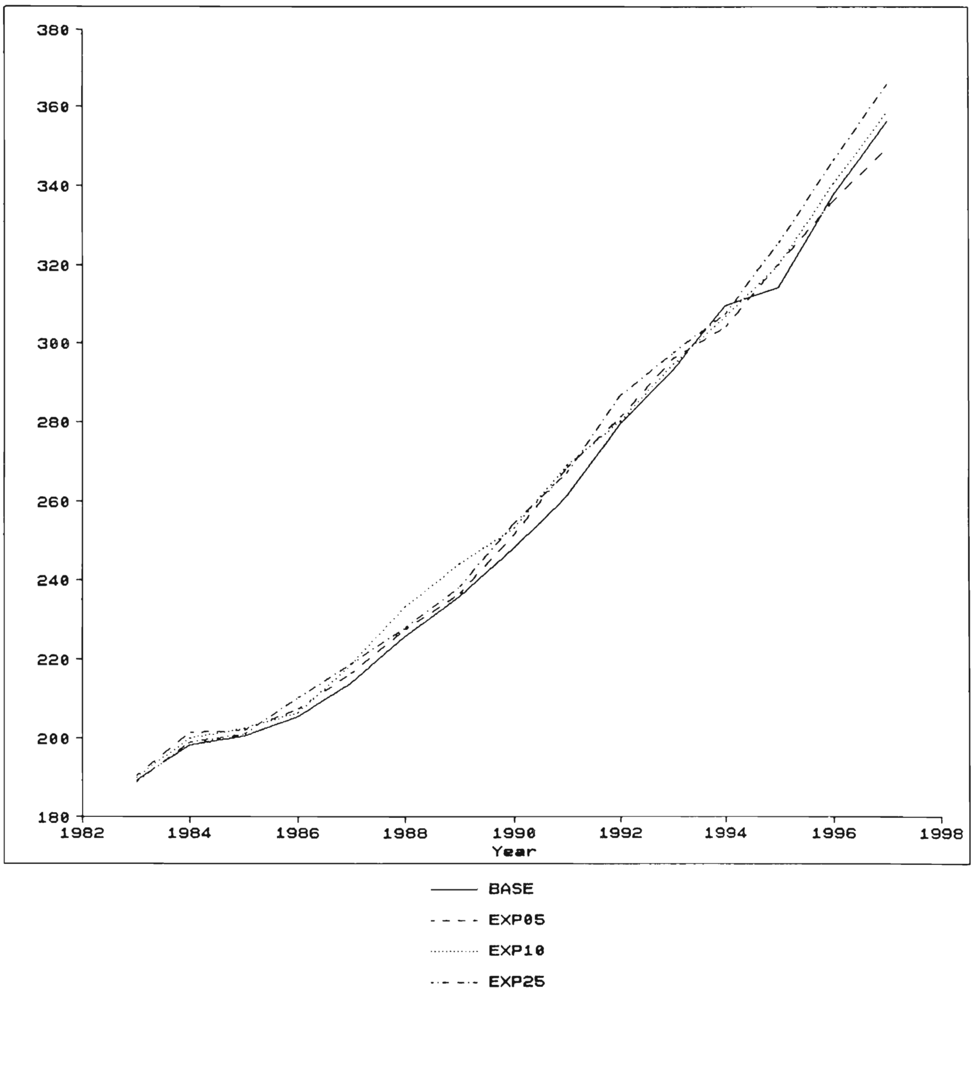


Figure 11 Annual output growth rates

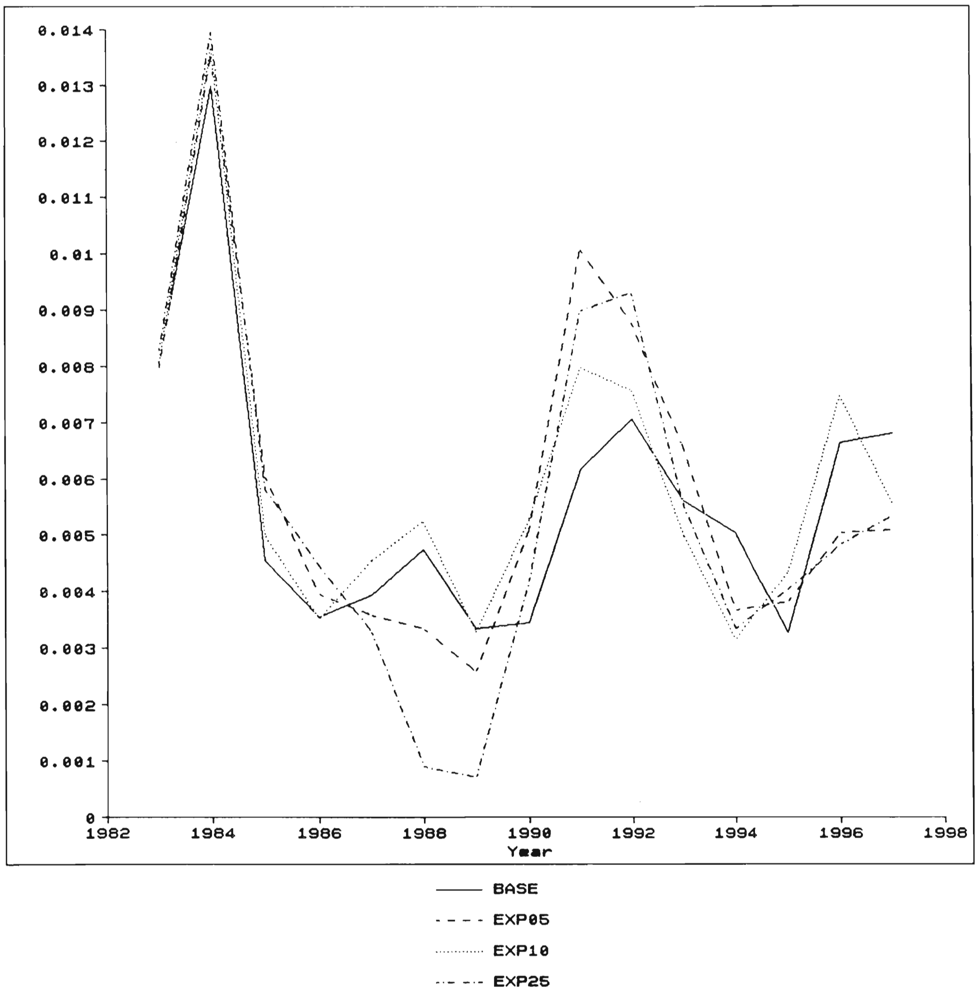


Figure 12 Labor productivity 1997 (1000 units of output/employee)

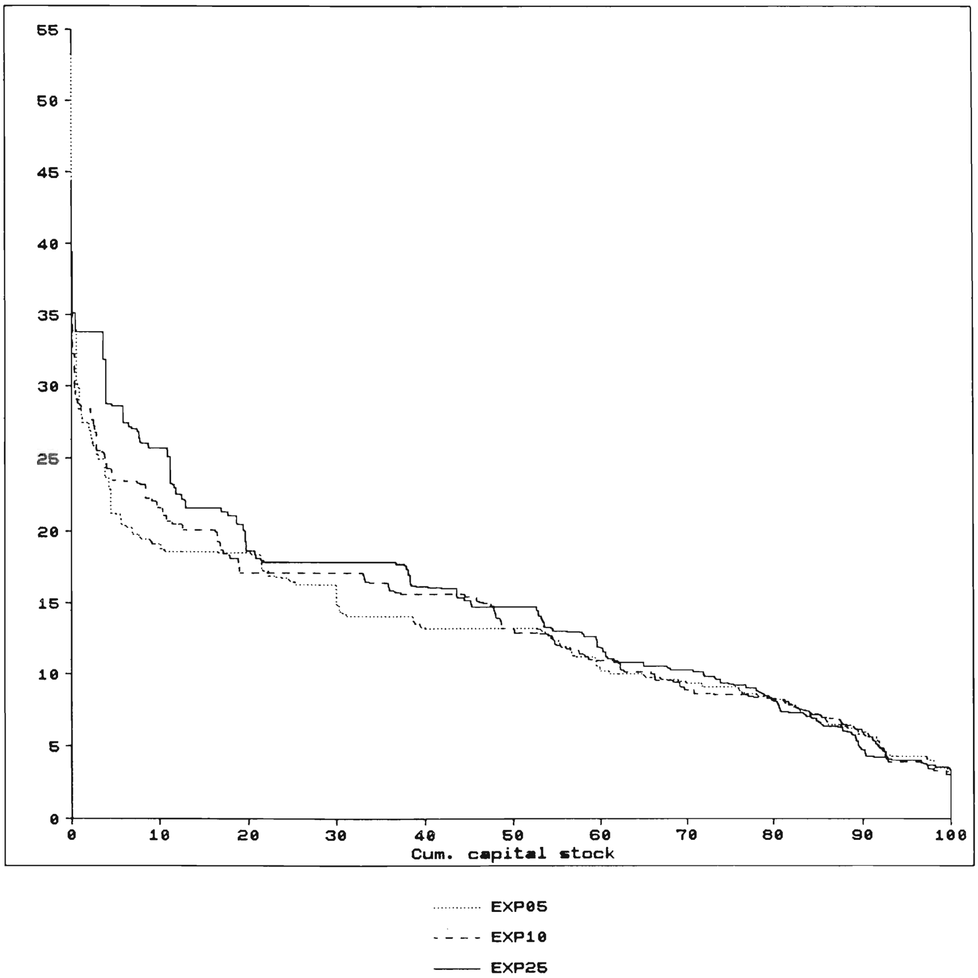
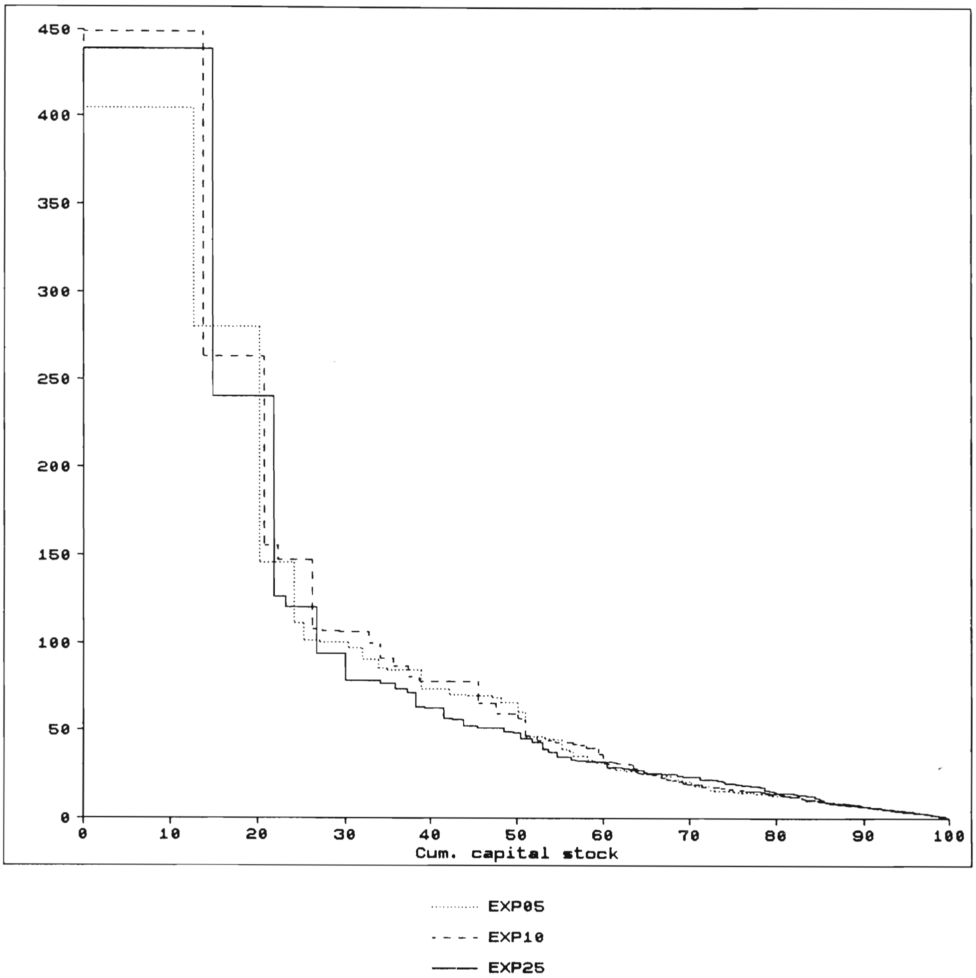


Figure 13 Potential output (QTOP) 1997 (10^7 units of output)



CHAPTER VII

The Minimum Data Requirements to Start and Run MOSES

Erol Taymaz and Jörgen Nilson

CONTENTS

1.1 Introduction

The MOSES model requires a tremendous amount of information on firms and some aggregate macro variables. These data have to be prepared in a specific file called R19*tt.vv* where *tt* denotes the data year, and *vv* the database version. When running the model, a database name has to be entered into the simulation menu (for details, see Taymaz, 1991, Section 1.2). There are three ways to generate a model database.

1) Collect all necessary micro- and macrodata and store them in the *raw* micro and macro datasets, named MIC*tt* and MAC*tt*, respectively, where *tt* denotes the data year. Then, use the MOSES initialization program, MOSES.INIT, to generate *MOSES* dataset R19*tt.vv*. If the model is to be implemented for other countries, this is the only way to prepare the model dataset. Information on firms can be obtained by surveys or through artificial methods based on macrodata (see Chapter I). Survey results are directly entered into the raw micro dataset. Note that the parameter values that affect the behavior of households and firms are also assigned in the initialization process. (The initialization procedure is explained in detail in Bergholm, 1989, Part II, and Taymaz, 1991, Section 2.)

2) A synthetic database can be prepared by simulating the model and saving those variables that are necessary in a MOSES database by using the function SAVE▲OUTPUT. Recall that an initial model database is necessary to create a synthetic database for later years. For example, we have a model database for Sweden for 1982. It is possible to generate a synthetic database for any year *after* 1982 by this method. Since the original datasets contain confidential firm data, a synthetic database for 1990, R1990.10, has been prepared by this method for external use of the model (for details, see Taymaz, 1991, Sections 1.6.1 and 3.4).

3) Finally, real (or synthetic) firms can be added into the model database in any year of a simulation experiment. Although macro consistency is affected in this case, if the total size of new firms is small relative to the economy, this may not be a problem (for details and the micro variables needed for this process, see Taymaz, 1991, Section 1.6.2).

Here we will present the minimum database requirements for those who want to implement MOSES in a new economy, trying to gather all the data needed. It is, however, important to remember that even though all data may not be available for your particular case, substitute measures may serve the same purpose.

The procedure of implementing the MOSES model in a new country can be summarized as follows.

1) Collect the raw microdata and store them in a file called MIC*tt* by using the format and variable names as specified in Section 1.2.

2) Collect the raw macrodata and store them in a file called MAC*tt* by using the format and variable names as specified in Section 1.3.

3) Use the initialization program, MOSES.INIT, to generate a model database, R19*tt.vv*. (Recall that if you use a synthetic database, you do not need to use the initialization program, since it is already on the appropriate format). The parameter values and exogenous variables are also assigned in this process. You can produce several sets of parameter values, or you can calculate model variables in different ways by using various initialization variants. In other words, various variants of the same micro- and macrodata can be prepared.[1]

4) Use the model, *moses*, for simulations.

1.2 Micro database

The micro units of the MOSES model are firms or divisions. They are the decision units. Most of the data for these units (sales, employment, etc.) have to be obtained through surveys. However, financial data (book value of fixed assets, dividend payments, etc.) are usually obtained only at the firm level. Thus, the micro database contains two main matrices: one for those variables that are available at the division level, and one for those variables that are available at the firm level. Firm-level variables are disaggregated into division data by the initialization procedure.

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1. Although the initialization program and the model code have been written to accommodate a wide variety of compatible forms, there may be some problems when they are applied without any modification. First, although the number of internal (whose data are used at the micro level) and external (whose data are used at the macro level) sectors are defined by the MKT and IN variables to make changes easy, explicit numbers are used in a number of cases. Therefore, it is advisable to follow the sectoral classification of the currently used model (see Bergholm, 1989). Second, there are a few *ad hoc* specifications in the initialization code, namely the pricing calculation and value added adjustments in the ESTABLISHMENTS∆91 function (see Albrecht et al., 1989: 256, 265-266). Third, the model version 2.0 which is created by the function VERSION20 assumes that the original Swedish data for 1976 or 1982 are used. If you want to use VERSION20, the special specifications of this version need to be removed. Because of these problems, the initialization and model code should be thoroughly checked when a different dataset is used.

The following variables should be specified in the raw micro database.[2]

X	an e*56 matrix for divisions' data where e is the number of establishments.
F▲DATA[3]	an f*65 matrix for firms' data where f is the number of firms
FIRMID	an e-element vector matching establishments and firms. For example, if the first establishment in the X matrix is a part of the 10th firm in the F▲DATA matrix, then $FIRMID_1 = 10$. In other words, Establishment B's data are stored in the first row of the X matrix, and the data for Firm BB to which Establishment B belongs are stored in the 10th row of the F▲DATA matrix.
LIST	a vector of establishment codes whose firm data are available in the F▲DATA matrix. Note that each establishment has a unique code.
R▲MARKET	an e-element vector that contains market codes for each establishment. For example, if the first establishment in the X matrix is in the third sector (consumer goods sector), then $R▲MARKET_1 = 3$.

Those variables are used by the ESTABLISHMENTS▲91 function during the initialization procedure. This function, by using the LIST variable, deletes those divisions whose firm data are not available in the F▲PARA matrix. Then, the firm data are disaggregated into establishments. Finally, micro variables used in the MOSES model are formed.

The columns of the X matrix contain the following establishment variables. (Columns that are not specified in the following table can be used to store other kinds of data, or can be filled with 0s. Column numbers are almost identical to the question numbers of the 1982 Planning Survey. See Chapter III of this volume.)

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2. Note that you cannot change variable names.

3. ▲ is the APL character entered by Shift-h.

Column No.	Variable
1	Establishment code
2	Number of employees at time t-1[4]
3	Number of employees at time t
4	Total wage bill at time t-1 (in 10^6 units)[5]
5	Total wage bill at time t (10^6)
6	Value of exports at time t-1 (10^6)
7	Value of exports at time t (10^6)
8	Expected value of exports for time t+1 (10^6)
11	Value of domestic sales at time t-1 (10^6)
12	Value of domestic sales at time t (10^6)
13	Expected value of domestic sales at time t+1 (10^6)
17	Value of inputs (raw materials, electricity, fuel, etc.) at time t (10^6)
21	Value of investments on building at time t (10^6)
24	Value of investments on machinery at time t (10^6)
	[If only total investment figures are available, enter the total into column 21, and zero into column 24.]
26	Increase in the *volume* of output from t-1 to t (in percent)[6]
28	Expected increase in the *volume* of output from t to t+1 (in percent)
30	Maximum possible increase in the volume of output from t-1 to t with infinite amount of labor (in percent)
	[This question is used to determine the A22 variable. See Chapter III of this volume.]
32	Maximum possible increase in the volume of output from t-1 to t with current amount of labor (in percent)
	[This question is used to determine the A21 variable. See Chapter III of this volume.]
44	Current input inventories/total inputs ratio at time t (in percent)
46	Optimum input inventories/total inputs ratio at time t (in percent)
48	Current output inventories/sales ratio at time t (in percent)
50	Optimum output inventories/sales ratio at time t (in percent)

4. The initial data year is denoted by t. t-1 refers to the last year's data. Unless otherwise stated, *annual* data are referred to.

5. E.g., enter 10 for SEK 10 million.

6. I.e., enter 10 for 10% increase.

The columns of the F▲DATA matrix contain the following firm variables. (Columns that are not specified in the following table can be used to store other kinds of data, or can be filled with 0s.)

Column No.	Variable
3,4,6, 8,9,10	Various components of the current assets at time t. Total will be equal to the total value of the current assets (10^6) [K2 variable of the model]
5	Total value of input and output inventories at time t (10^6) [K3 variable of the model]
11	Replacement value of fixed assets—machinery, building, etc., at time t (10^6) [K1 variable of the model]
16	Short-term borrowing from banks at time t (10^6)
17	Long-term borrowing from banks at time t (10^6)
22	Book value of fixed assets—machinery, building, etc. at time t (10^6)
31	Value of sales (domestic+exports) at time t (10^6)
47	Dividends paid at time t (10^6)

1.3 Macro database

The macro database should contain the following variables.[7]

Variable	Description
AMAN▲YEAR	1-element vector. Time for using the AMAN functions. Enter 0. (Kept in the model for some technical reasons.)
BLD▲RATE1	1-element vector. *Index*[8] of the annual growth rate of investment in building and construction at time t. Used in the

7. In addition to these variables, the function AGGRITAX should also be available in the macro database.

8. I.e., enter 1.12 for 12% annual growth in construction.

	MARKETS function[9] to calculate investment in building and construction in the last quarter.
BLD▲RATE2	1-element vector. Index of the long-term trend of the annual growth rate of investment in building and construction. Used in the MARKETS function to calculate exogenous quarterly growth rate of investment in building and construction.
EXO▲QTXVA1	4-element vector. Value added tax rate for capital goods for the next four quarters, i.e., at time t+1 (%).[10] Used in the TAX▲PARAMETERS function to calculate exogenous quarterly *change* in the VAT for capital goods. Enter the same value for each element.
EXO▲QTXVA2	4-element vector. Value added tax rate for consumer goods for the next four quarters (%). Used in the TAX▲PARAMETERS function to calculate exogenous quarterly *change* in the VAT for consumer goods. Enter the same value for each element.
EXO▲RI	q-element vector. Exogenous value of the annual rate of interest (%). Enter q-many quarterly values. If q<NQR where NQR is the simulation period in quarters, the last element of the EXO▲RI vector[11] will be repeated NQR - q times. Used in the MONETARY function.
EXO▲RIBWFOR	Similar to the EXO▲RI variable. Exogenous value of the rate of interest on foreign debts.
EXO▲RIDEPFOR	Similar to the EXO▲RI variable. Exogenous value of the rate of interest on foreign deposits.
EXO▲TXC	q-element vector. Quarterly exogenous value of the corporate tax rate. If q<NQR where NQR is the simulation period in quarters, the last element of the EXO▲TXC vector will be repeated NQR - q times. Used in the TAX▲PARAMETERS function.
EXO▲TXI1	Same as the EXO▲TXC variable. Exogenous income tax rate.
EXO▲TXW	Same as the EXO▲TXC variable. Exogenous payroll-tax rate for the non-government sector.
EXO▲TXWG	Same as the EXO▲TXC variable. Exogenous payroll-tax rate for

9. Unless otherwise stated, all functions referred to in this section are used in the MOSES.INIT workspace.

10. I.e., enter .12 for 12% tax rate.

11. For the definitions of the MOSES variables, see Albrecht et al., 1989: 196-220, and Bergholm, 1989: 98-118.

	the government sector.
FIRST▲SIM▲YEAR	1-element vector. First simulation year. Enter the value of t+1, i.e., 84 for 1984.
G▲RATE1	1-element vector. Index of the annual growth rate of public investment at time t. Used in the PUBLIC▲SECTOR function to calculate public investment in the last quarter.
G▲RATE2	1-element vector. Index of the long-term trend of the annual growth rate of public investment. Used in the PUBLIC▲SECTOR function to calculate public investment in the last quarter.
HIST▲TXVA2	4*4 matrix. The rate of value added tax for each sector (rows) in the last four quarters (columns) (%). Used in the MARKETS function.
HOURS▲PER▲YEAR	1-element vector. Total number of hours worked per year. Used in the ESTABLISHMENTS▲91 and PUBLIC▲SECTOR functions.
HUSHALLSDEP	1-element vector. Total households' wealth (*in units*).[12] Used in the HOUSEHOLDS function to calculate the WHSUM variable.
IMPLP▲REF	10-element vector. Used in the model's transcription functions to aggregate all sectors.
IMPL▲PRIS	4*4 matrix. Price indices for four internal sectors at time t-2, t-1, t, and t+1 (rows are sectors, and columns are years). Indices are equal to 100 for all sectors at time t. Used in the MARKETS function.
IMPL▲PRIS▲IN	6*4 matrix. Prices indices for six external sectors at time t-2, t-1, t, and t+1. Indices are equal to 100 for all sectors at time t. Used in the MARKETS function.
IN▲RATE1	1-element vector. Index of the annual growth rate of investment in the external sectors at time t. Used in the MARKETS function to calculate investment in the external sectors in the last quarter.
IN▲RATE2	1-element vector. Index of the long-term trend of the annual growth rate of investment in the external sectors. Used in the MARKETS function to calculate exogenous quarterly growth rate of investment in the external sectors.
IO*tt*	14*21 matrix. I-O table for time t. (For details, see Bergholm 1989.)
IOCOEFF*tt*	13*19 matrix. I-O coefficients for time t. (For details, see

12. Enter $10*10^9$ for SEK 10 billion.

	Bergholm 1989.)
LAST▲YEAR	1-element vector. Enter the value of t-1.
LGTRENDCH	1-element vector. Quarterly exogenous increase in the level of public employment. Used in the PUBLIC▲SECTOR function to calculate the EXO▲REALCHLG variable.[13]
LIQB	1-element vector. Liquid balances of the bank at time t (in units).
LIQBFOR	1-element vector. Liquid foreign balances of the bank at time t (in units).
LON	4-element vector. Wage payments in four internal sectors at time t (in units). Used in the ESTABLISHMENTS function.
LON▲OFF	2-element vector. Wage payments in the public sector at time t and t+1, respectively (in units). Used in the PUBLIC▲SECTOR function to calculate QWG and WG variables.
NMARKETS	1-element vector. The number of internal sectors. Enter 4.
NWB	1-element vector. The net value of the bank (assets–liabilities) at time t (in units).
POSG	1-element vector. Government's net position in the bank at time t (in units).
QCHRI	1-element vector. Change at the level of the domestic interest rate in the last quarter (%).
QINPAY	1-element vector. Households' aggregate wage and capital income from the external sectors during the last quarter (in units).
QPFOR	4-element vector. Indices of foreign prices of four explicit internal sectors in the last quarter.
QTTAX	1-element vector. Total tax receipts by the government in the last quarter (in units).
RI	1-element vector. The domestic rate of interest in the last quarter (%).
RU	1-element vector. The unemployment rate at time t (%).
<u>RSUBS</u>	4*q element matrix. The exogenous subsidies/sales ratio in four internal sectors for *q* quarters (%). Used in the PUBLIC▲SECTOR function to calculate the EXO▲RSUBS variable which is a 4*NQR matrix and which contains quarterly exogenous industrial subsidies data. If $q <$ NQR where NQR is

13. This specification is replaced in the VERSION20 function. When data for a different country are used, the specification of the VERSION20 function should also be modified accordingly.

	the simulation period in quarters, the last column of the RSUBS matrix will be repeated NQR-*q* times to generate the EXO▲RSUBS variable.
SALES*tt*	4-element vector of annual sales in four internal sectors at time t. Used in the ESTABLISHMENTS▲91 function.
THIS▲YEAR	1-element vector. Enter t.
TIM	4-element vector. Number of hours worked in four internal sectors at time t. Used in the ESTABLISHMENTS▲91 and CONTROLS functions.
TIM▲OFF	2-element vector. Number of hours worked in the public sector at time t and t+1. Used in the PUBLIC▲SECTOR function.
TRENDM	6-element vector. Trend values of quarterly price increases in the external sectors (%). Used in the MARKETS function.
TXC	1-element vector. Corporate tax rate at the end of time t (%).
TXI1	1-element vector. Income tax rate at the end of time t (%).
TXVA1	1-element vector. Value added tax rate for capital goods at the end of time t (%).
TXVA2	1-element vector. Value added tax rate for consumer goods at the end of time t (%).
TXW	1-element vector. Payroll-tax rate for the non-government sector at the end of time t (%).
TXWG	1-element vector. Payroll-tax rate for the non-government sector at the end of time t (%).

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