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THEORY CONSTRUCTION AND ECONOMIC MEASUREMENT AT DIFFERENT LEVELS OF AGGREGATION – parallel theories and data on families and firms

by

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THEORY CONSTRUCTION AND ECONOMIC MEASUREMENT AT DIFFERENT LEVELS OF AGGREGATION*

– parallel theories and data on families and firms

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1. Why is efficient micro–macro database design such a formidable theoretical problem?

Social scientists live and work in different camps. They may study the same objects but since they use different languages they may not find a good meeting ground. We have the theory of consumption and the empirical study of household economic behavior, as well as the classical theory of the firm and firm behavior. Unfortunately, theory and behavior rarely meet on common ground. This is especially the case when we study the evolution of firms or households, or the dynamics of institutional change. This problem has to be faced squarely when designing micro databases for institutions like households and firms, as is the task of this paper and this book.

The firm and the family are financial decision units

This essay attempts a number of things. It discusses the methodology of two ongoing micro database projects at IUI; one concerned with the firm, the other with the household or the family. Most attention will be paid to the firm database project since it is already effectively put to use in the MOSES modeling project. Even though households are not yet specified in micro in the MOSES Model, the design of a micro–macro household (HUS) database (see Klevmarken, 1986) serves as a useful complementary experience. One could say that I have had four purposes in mind when writing this paper. First, there is the need for a common conceptual framework (a theory) for dealing with the two database projects, the reason being that the micro–to–macro (MOSES) model of IUI has a long–term ambition to incorporate also households, not only firms. I will argue that this common theoretical framework requires a financial definition of the observation unit in both cases. Second, this orientation of measurement reveals a particular problem orientation that also has to be reflected in the database design.

Third, the observation unit is rarely stable as to operational content, and this is especially the case with the firm, which is afflicted with frequent, recurring reorganizations as to content (see Jagréns chapter). This makes it necessary to discuss the problem of institutional instability and how to deal with that in

theory and database design. Fourth, and finally, all three of these factors point in one direction; the behavior of decision units and their interrelation in markets and with hierarchies has to be understood in order to understand the macro behavior of an economy. In different words good macro theory needs an organizational base. Then micro simulation is the only available quantitative method to carry on micro-macro analysis. Micro-macro theory is used to represent how the dynamics of markets and its institutions enter macroeconomics.

This design of the paper also introduces the organization of this Database book on the Micro-Macro Modeling project MOSES. The following set of papers will deal with various aspects of database work; the interior dynamics of the financial unit called a firm (papers by Jagrén and Johansson); the modern manufacturing firm emerging from a base in factory production being transformed into a dominant service producer (paper by Lindberg–Pousette). We will present the firm as a knowledge intensive information processor, spending a dominant share of its resources on upgrading technology (technological information processing), combining and filtering activities and people (entry, exit and labor mobility). Unfortunately, being unaware of its extent until recently the important educational activity (see Table I.1) has not been covered adequately by surveys carried out so far.

The financial and real databases (paper by Lindberg) will be integrated into a consistent macro database (paper by Nordström) to be finally initiated into the MOSES economy (paper by Albrecht – Lindberg).

All the chapters of this book are concerned with the micro-to-macro database built around the MOSES model. There are technical presentations and definitions and there are inserted empirical highlights and studies to illustrate the nature of this data set. The data set has a variety of possible uses beyond serving as input and test data for the MOSES model. During the course of this modeling project we have naturally learned a lot about the micro-to-macro structures of a modern industrial nation, especially about what takes place within the firm, the unclear demarcation lines of the firm and the diffuse notion of a market. The "economics of information processing" is a conceptualization of the measurement problem we now see. Most, perhaps all economic activities are really concerned with information processing in one

way or another. Much of this insight goes beyond the MOSES model and database designs, but will soon have to be tackled head on if economic theory and measurement are to stay relevant. Hence, I have taken the liberty to begin my introductory chapter with a broad-based, somewhat philosophical discussion about what kind of taxonomical problems economics will have to face. This discussion also serves the dual purpose of both overwhelming the reader with statistical problems, and – for our american friends – not stimulating an excessive urge to run off a sequence of rapid regressions on the available, rich data sets. Really, econometrics carries little information if you don't understand how the data are defined and relate to the objects measured.

There is finally one particular aspect the reader should notice. It may appear trivial but it is not, and it has affected the organization of this first chapter.

Micro–to–macro theory really is, and should be much more than the current MOSES model is capable of representing, a theory of how human industrial competence affects agent performance and macroeconomic behavior. Such competence is largely not observable, except for its production results and the resources applied in accumulating it. A particular kind of such "tacit" industrial competence resides exactly in the intersection between the family organization and the production organization. The family portfolio holds a large or small financial stake in the production unit, and contributes competence to the production unit. For this competence contribution the asset holder is compensated in the form of capital gains. We are not only talking about the family farm or the small family firm. We are also talking about the dominant owners and executives in large business corporations and the rapidly growing, extremely heterogeneous population of highly specialized, human capital intensive service producers that increasingly organize themselves as partnership or small consulting firms rather than working as salaried staff in large corporations. Today such enterprises may employ more people than all manufacturing. They may employ much more human competence than manufacturing altogether, and they may mean more than manufacturing for long-term sustainable macroeconomic growth of advanced industrial nations. Except for case reports we know practically nothing economically relevant about these activities, since the statistical

systems were designed a long time ago to measure quite different things. Hence, I feel that this awareness has to be carried along the presentation of the MOSES database design, even though we have a long way to go before the MOSES model and databases properly capture these realities.

Theory guides measurement

Explicit theory helps to achieve consistency of measurement design. Some theory or prior beliefs always have to enter the sample design of statistical surveys, but bad theory can seriously distort the quality of data, and consistency can only be a secondary criterion. Measurement has to relate to a scientific, political or commercial decision problem (a hypothesis) of someone's choice, which means that the information will often be distorted when used in other contexts. Doing the right thing less well is always better than doing the wrong thing with perfection. In our case relevance boils down to choosing the right object of measurement. Consistency is to measure according to a coherent theoretical system that relates to actual decisions within and behavior of the object chosen.

Table I.1 The four productive activities in the information–based economy

1.	Knowledge creation	through – Technical information processing – Innovation – Entrepreneurship
2.	Coordination	through – Competition in markets – Administration in hierarchies
3.	Filtering	through – Selection, entry, exit and mobility
4.	Knowledge transfer	through – Education and experience

The firm as an information processor

The natural way to introduce the database design of MOSES is to look at economics as the "economics of innovation and information" and to organize data as far as possible on the taxonomy of Table I.1. This means viewing the firm as an information processor and a profit seeking portfolio manager. The household will also appear as a production and utility seeking unit that supplies work effort and talent in the market, draws utility from consumption and leisure and manages the portfolio of an extended family – like the firm, as an ongoing financial institution.[1]

Table I.2 gives an idea of the importance of various forms of information processing in Swedish manufacturing industry. This table uses the three level categorization of corporate decisions of Figure I.1 that we will use, and in which product development and design as well as process scheduling involve the use of technical information at various levels of abstraction. Marketing becomes a down-to-earth kind of information processing in the form of identifying, informing and convincing customers. From this table at least 44 percent of total labor costs of Swedish manufacturing is devoted to various forms of information processing. The table covers 70 percent (by employment of Swedish manufacturing, the large firms). As it appears, at least in sophisticated factory production, within the factory itself, about half of labor costs again can be labeled information processing activities, work scheduling, supervision, control, quality, inspection etc. (Eliasson, 1980, 1981.)

[1] This later household aspect has been developed in Eliasson (1982b).

Table I.2 **Labor costs distributed over various activities in Swedish manufacturing, global operations 1978**
Percent

1.	Strategic, structure changing activities	
	– innovation	?
	– reorganization	?
	– product development	5
	– design, construction	5
2.	Coordination	
	– administration	8
	– other	1
3.	Operative or rationalization	
	– process scheduling	35
	– factory production	56
	– marketing and distribution	21
		100

Source: Data from special survey to planning survey sample (see chapter by Pousette – Lindberg in this volume, using data from Swedenborg 1982 and special compilations in Eliasson 1985b).

Firm behavior is controlled long term by financial markets

It is natural to view the firm as a financial decision entity controlled from above by its owners' ambition to earn a high and stable return to their equity stake – to become rich – and coordinated internally by administrative, technical and other non-market factors (Eliasson 1976, 1984). It is, in fact, as appropriate to view the family as a financial entity, also coordinated internally by technical, moral and non-economic factors. Take labor supply as an example. It has to be viewed as a simultaneous choice between leisure and lifetime consumption in a family context. This makes the decision to save and create wealth central, and it also advises on the nature of the family concept, namely the extended family including several members not currently occupying the household (e.g. grand parents, grown–up children). The family contract is normally implicit. The most important aspects of the firm control system are implicit, even though the firm is the legally best defined entity of the two.

The firm objective is value creation to its owners. The family objective is income and wealth creation for maximum utility over time, and to distribute resources internally for consumption according to some fair rules that defines a family culture that is oriented towards the preservation of the family as a unit. The family may not always succeed with the latter objective.

The family supplies labor inputs and human capital services to firms through the labor market and investment resources (saving) through the credit markets. The latter makes it natural to model both firms and families as ongoing institutions that "plan" for longer life spans than its individual owners and members.

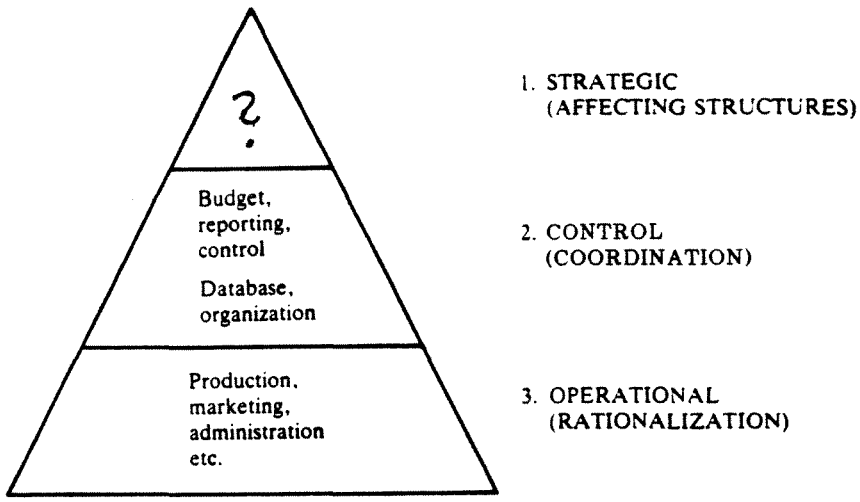
When internal, technical, moral and other non-economic links cease to contribute to the overall value creation or utility objectives of the firm and the family the financially defined units begin to break up and recombine. Hence, institutional change somehow has to be made an endogenous part of a micro–macro theory. Relevant macro theory needs organization theory as a base. This is not easy.

Owners of firms

If the aim is to achieve a consistent family and firm micro–macro model, and a consistent database design it becomes necessary to model also the behavior of the very rich (the sophisticated savers; Eliasson 1982b). This last ambition can be discarded, as is conventionally done, if one assumes a priori that there is no correlation (relation) between the human productive knowledge supplied to the production system from the upper stratum of sophisticated savers and wealthy people. This is, I believe, a completely erroneous assumption that biases current theorizing in economics. Figure I.1 introduces these levels of decisions in the firm. The lower operations level represents the factory concept of the firm that is standard in microeconomic theory, and also, currently, in MOSES. The middle level coordinates activities dynamically in ways planned to be programmed into the MOSES system (see Eliasson 1985b, Supplement I to Chapter III). The top level introduces the structure changing decisions closely linked to top executives and/or the dominant owners of the firm.

Dominant owners come from different parts of society and may be organized differently (public ownership, cooperatives etc.) but in a capitalistically organized market economy they are predominantly private persons, or family trusts of some sort. To understand the objectives that guide the structure changing forces at the top of the pyramid in Figure I.1 we also have to understand the objectives that guide such family group interests. Their contribution is not only financial resources but also industrial competence in various forms. Hence a proper theoretical system should also include saving through human capital creation and the passing on between generations of such wealth. It is, however, extremely difficult to bring all these matters together into a coherent theoretical and database framework. I am not arguing that it should be done now and here and in mathematical garb. I am saying that this larger conceptual whole has to be kept in mind and in the text as you go along modeling the elements of the macroeconomic machinery; and design the matching databases.

Figure I.1 **Levels of decision–making within a business organization**



Organization of chapter

I will organize the rest of my paper as follows. I begin with a general discussion of the ad hoc nature of all theory and all measurement – being dependent on the problem chosen. Part of the problem has to do with the possibility of achieving universal database designs. I continue to outline the general endogenous nature of all institutions and the necessity to deal with endogenous institutional and organizational change in database design. This is not trivial since change in economic efficiency – a typical economic problem – is linked to institutional and organizational change. Various forms of "market activities" keep institutions apart. The problem is that the market process can only be defined in terms of an ongoing interaction between institutions that "produce" and exchange information, the latter being, as we have found, perhaps the most resource using activity in an industrialized market economy. This discussion naturally carries over to the choice of an elementary observation unit for the database that is reasonably invariant to institutional change.

I then proceed directly to account for how these problems have been solved in designing and collecting a database for a micro–to–macro model of the Swedish economy. (So don't feel frustrated. The beginning philosophical discussion will be followed by a down–to–earth account of how to collect data on the firm.) I will then turn around again and discuss, briefly, the problems firms themselves encounter when they design their own databases and their need for universal information systems to cope with the constantly changing nature of their decisions. Very subtle philosophical problems appear to have extremely practical applications. We should also note already here that our choice of measurement unit and our database have been deliberately designed such that we should be able to tap the internal accounts of firms directly, without intermediary manipulation of any "respondent". This is economical from a survey point of view. It means that our observation unit has to be an actual business decision unit and the database design that of the decision unit.

We will then tackle the critical problem of all information systems, the main point of Wittgenstein's philosophical system, namely that no information system or database can include information on something that has not been

experienced before, classified and observed, or measured and been made part of the decision oriented vocabulary. In the firm the ongoing operations at the floor level of Figure I.1 are run on an information system that has developed over time. Any break in the relations between the data coded in that system and the actual physical activities of the firm, means a deterioration of the quality of the information system. In fact, a fully automated machining process requires an exact one–to–one relationship between the coded information of the system and the actual, physical activity. The amount of measurement and database work needed to achieve that was generally underestimated in the early automation attempts (Eliasson 1981). In economic applications this precision of measurement as a rule is impossible to achieve. Economic data in particular are very approximate. The problem, however, is that any innovative change at the top of the pyramid in Figure I.1, reduces the quality of the information on what goes on at the bottom floor, that is used to coordinate activities at the middle level (see Eliasson 1984).

2. Market agents and market processes – the need for new theory

The units of measurement

The classical agents in economic theory are the firm, viewed as a profit maximizing goods producing unit, and the individual, viewed as a utility maximizing consumption unit. Agents are separated by markets for products, labor and capital (savings). Does there exist a rational reason for such a choice of taxonomy and what then should we mean by a market? Somehow the products of the firms have to be designed to suit the consumer. The consumer has to know about the product and it also has to be available to him. The market accomplishes that, but it is, of course, not a timeless activity free of charge, as is commonly assumed. If nobody is there to carry out the above information activities there would be a tremendous profit opportunity to enter and do the job, something that is well illustrated by the fact that the physical production cost of most products is only a fraction of what the consumer eventually pays. The market is full of traders that store, move, package, market, improve etc. goods. These agents, or institutions

engage in service, or even goods production and are part of the ongoing market process. They are called firms as well. And they have to be efficient and competitive to stay in business.

The market process is made up of the activities of firms that add a significant part of total value added in the final value of goods after it has left the factory.

Whenever profit opportunities exist there is a tendency for new firms to be created (to enter) to exploit them. Existing theory (like e.g. Alchian–Demsetz 1972) is very elaborate on the necessary conditions for the existence of such firms. However, the dynamics of their formation (entry) and internal change has still escaped theoreticians. Somehow this has to be part of a good database design. For instance, a theory of entry and exit is needed to define the population of firms. And the critical notion for both micro theory and database design that for all practical purposes is absent from the traditional conceptual framework in economics is that the set of all possible combinations of activities that make up the potential set (the opportunity set, state space; see Eliasson 1987) is unknown and can only partially (locally) be perceived by each agent. Since individual agents perceive this local, potential set differently and since the next potential set of all possible combinations depends on what actions are taken by all agents, enumerability of all possible elements of the set is not attainable. Such institutional dynamics lends a distinct flavor to relevant micro theory.

Some of the transactions associated with the agents in the market, for instance, can be carried out within the production firms and the content of ongoing activities keeps changing steadily, as we have noted in several IUI studies (see Pousette – Lindberg 1986 and in this volume). Some firms sell their goods through separate agents. Other firms carry on the market activities themselves. The more specialized the products (the more customer oriented markets), the more common that the "factory firm" integrates vertically into markets and distribution.

However, the very fact that there exists a choice between carrying out, trading and intermediation within the internal financial market (the hierarchy) called a firm and separately in the external market means that a categorization of intermediation activities (traders, agents) has to be part of both theory and measurement system.

Similarly individuals and consumers meet producers more or less along the way. Some products are carried to their doors. For other products considerable time is needed for searching "in the markets". This is a typical information processing activity, but it can go on as information processing in markets through competition and within firms through hierarchies. Relative information costs in a Coasian (1937) sense mark the dividing line between the administrated system (the firm) and the market (all other firms). This dividing line is not well defined, and it is constantly shifting.

The individual supplies labor time directly to the firm and capital, indirectly through his/her savings. The individual is a member of a family or a household. The household carries on a number of production activities that are more or less substitutable for market activities carried on by firms. Sometimes households sell their products in markets and hence are to be labeled both firms and households. How to handle this double activity is a classical statistical problem, namely to draw a reasonably sharp line between the household and the firm. The typical problem unit of statistical offices is the family farm. This study being concerned with the firm as a financially defined profit seeking unit adds another problem, namely the intersection of owners that hold a financial stake in the firm, and supply a significant element of "tacit" entrepreneurial and industrial knowledge for which the family, through its portfolio is compensated in the form of capital gains.

Similar problems appear when decision units cross national boundaries, as firms often do. Swedish statistical data on manufacturing firms are traditionally limited to domestic activities. This certainly constitutes a problem when about one third of the activities (on the average) are located abroad, but controlled rather monolitically from a Swedish–based Corporate Headquarter (see below).

It is interesting to ask which institution – the firm, the household or the public body – that exhibits most stability over time. For instance (Eliasson 1985a), two thirds of the largest Swedish exporting firms, defined as financial decision units, started production before the turn of the century. However, the interior of the firm, so defined, has undergone continuous, sometimes dramatic, change. Firms frequently do have identity crises and it is difficult to find some interior, measurable components of a firm that has remained "stable" throughout the history of a firm (see Jagrén's chapter). A family probably exhibits more stability if defined as a sequence of overlapping generations of "families". There may be dramatic crisis experiences (death, divorce, etc.) but they still have reasonably well defined components (individuals).

Firms to a large extent carry on financial activities to finance production and trade. Well dimensioned financing capacity is even an important factor of production. Imagine, for instance, what a shaky financial position means for the ability to plan ahead and grab business opportunities. Large firms operate sizable banking activities internally and their main long–term objective is to mix its portfolio of assets to obtain as large a profit as possible.

The family has a similar portfolio problem. Its objective is said to be to manage that portfolio to maximize the life time consumption of its members. However, problems arise about how individuals combine into families and family members may, or may not be concerned about one another and future generations of the same family. Hence, standard theory of the household and micro consumption analysis tend to focus on the individual. This is much simpler, but makes for biased analysis. (See Eliasson 1982b.)

Family portfolios are linked to other institutions (firms, public bodies, etc.) by the credit market that consists of financial institutions with their own portfolios.

(By this list of observations I have said nothing new. However, in theorizing as well as database design we would all like to, and we also conventionally do, regard these problems as trivial and excusable enough to neglect. This makes the technicalities of analysis easy, but it is a bad theoretical tradition in economics that we should get rid of.)

The reasons for the urgent need for a new theoretical and empirical tradition are that (1) the soft part of service oriented production within the goods producing firms is large and increasing rapidly, and (2) that the location of such service oriented production is quite unstable, being dependent in a Coasian (1937) sense on relative production costs. It is either located within the goods producing firm or separated off as intermediary, non–production activities, organized as firms. This badly measured activity is very large in volume. The dominant presence of intermediary trading and information activities makes lack of information and lack of overview embarrassing. Furthermore, the very multiplicity of information processing agents in the market economy, places focus on a classical problem in theory, the traditional (since Walras) assumption that information costs are negligible and that a state of full information is attainable at no costs. The presence and dominance of such intermediators of information cannot be neglected in household and firm database designs but we, nevertheless, find a good excuse to do so if we use a theory based on individuals and firms solely concerned with physical consumption and factory production, and with nothing but themselves.

The enforcement of contracts

All action that goes on in the market somehow has to be protected from disruption like theft, contract evasion, etc. This is a service to commercial life that is so self–evident that one tends to forget about it, especially that resources are needed to carry it out. Protection is normally produced by the nation state, but trade occurred long before the nation state developed. If protection is not there, profit opportunities in protection business, of course, exist and traders enter.

In early civilizations producers and traders carried their merchandise to the market themselves and weapons to protect it. In large scale commercial activities protection was instituted internally, as in the Hansa cities, in times before the strong nation states developed, by hiring protection (mercenaries) or through the mixing of commercial with protective and political activities as in the cities of Italy during renaissance times. Protection is rarely a truly public activity. Insurance is still a predominantly private, commercial

activity even though the public sector is currently monopolizing part of the insurance market in some industrial economies. And without insurance for calculable risks very little trade could occur.

Financial note on terminology and theory

(In general equilibrium theory firms are not allowed to set their own prices to see what happens[2] (Arrow 1959).[3] If firms, or intermediate traders are introduced as price setters, monopolistic market competition, and the existence of at least temporary monopolies, have to be accepted as a natural state of an ongoing economy. The firm then becomes defined by its ability (unique knowledge) to sustain that particular monopoly.

Game theory is currently experiencing a renaissance as a theoretical framework for the kind of phenomena that we want to discuss. Game theory, however, early lapsed into a state of methodological despair after an initial post Neuman – Morgenstern (1944) period of enthusiasm. It became too general and devoid of empirical content. Only empty conclusions could be derived. Enthusiasm is now gradually coming back. The sheer complexity of merging the various aspects of economic behavior discussed above, that is unavoidable if one wants to enter dynamics into general equilibrium theory will, however, bring ambitious researchers far beyond pure mathematical analysis. Numerical analysis is the solution. We have learned already in the MOSES micro(firm)-to-macro model, that a game theoretic problem formulation is natural. And it will become even more natural if we ever succeed in merging in household behavior as well. Theory and measurement method (design) will necessarily have to be integrated explicitly. As a consequence, micro simulation becomes the only viable method to theorize about and analyze an ongoing market process.

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[2] Hence, general equilibrium theory includes no market process, and hence no theory of the market (Pelikan 1985).

[3] Clower–Friedman (1986) have recently attempted to remedy this situation by replacing "the auctioneer" with many traders in the market that set prices.

As a consequence, I find it useful to make the following terminological distinction of the research field this book is a part of:

lements of micro–to–macro (M–M) economy

(1) M–M theory
(2) M–M modeling
(3) M–M accounting (principles and databases)
(4) Micro econometrics
(5) Micro simulation

M–M theory merges general principles of microeconomic behavior into a coherent economic systems scheme, hopefully with dynamic behavior on the part of its agents and also institutional change, as outlined above.

M–M modeling is an empirically based, quantified version of M–M theory. MOSES as presented in Eliasson (1985b) is one example, the Urban Institute-Yale model of Orcutt (1981) is another and the computable equilibrium models of Shoven – Whalley (1984) as well. Microeconometrics (see Brownstone 1983) is used to quantify parameters etc. and M–M accounting – the concern of this volume – serves as a basis for macroeconometric estimation and to initialize (see Lindberg, and Albrecht – Lindberg in this volume) and drive the model. Micro simulation, finally, is the art of quantitatively analyzing the properties of the M–M model and M–M theory!)

3. Endogenous institutional change

Institutions, or organizations make up the units of measurement in all "accounting systems" in social sciences. Hence, it is important for reliable measurement to know about the formation and disappearence, and of the stability of such entities.

We have noted that the nature and extent of trading in an economy depend on profit opportunities to trade. These opportunities are based on a number of factors, notably on competition among traders and on legislation; together they make up the conditions of the market game. Changes in the conditions of the game will cause institutional change. Institutions become endogenous entities that enter to exploit profit opportunities, or exit, when these opportunities cease. Many competitors, free entry and easy exit are characteristics of a dynamic market process, characterized by technological competition (Eliasson 1987). The government itself enters to cater for various needs for protection, where externalities and economies of scale are so obvious as to call for a non-economic solution. Non-economic solutions imposed from above as a rule mean that a monopoly situation shielded from market competition is created. (This is typical for the interior life of a firm, the household and, as first noted, the public sector. We will discuss this case below.)

Government monopolies are, however, not impenetrable bastions. Individuals and firms wired together too tightly react through the political system or through brute force. If, for instance, the tax system (a government monopoly) becomes excessive, the profit opportunities associated with evading it also become huge. An intense discussion about the "unobserved economy" has been going on for some time.[4] The institutions of the unobserved economy is a true, endogenous market response to profit opportunities associated with

[4] See Feige (1985).

the public tax monopoly. There is no particular worry except for the proponents of the tax monopoly and statistical surveyors.[5]

The tax system and inflation combined create enormous incentives for institutional changes (Södersten – Lindberg 1984), that affect the ownership and institutional mixes in the stock market. As a consequence, firms also shift their internal portfolio composition in directions which enhance profitability (see below) and can be accomplished internally or through the creation of new institutions.

(Less often quoted in a context like this is the Bretton Woods Cartel of 1944, which constituted an enormous global price control system. It worked well as long as economic conditions were right, i.e. as long as exchange rates were approximately in line with the relative competitive cost relationships between countries. What Bretton Woods demonstrated was that cartels of various kinds can persist for long periods even after the economic rationale for their existence is gone.)

I have many reasons for bringing these complications up in this context. First (1) and foremost, productivity change within firms and at all levels of aggregation critically depends on organizational and institutional change (Eliasson 1984b). Non–production activities (2) – as we shall see – are extensive and quantitatively very important in a modern, industrial society, and (3) one needs a complex theoretical framework as guidance, when attempting to design a database universal enough to capture and describe the ongoing economic process. When it comes to the manufacturing sector we have such a theory, that is certainly much more relevant for this purpose than received economic micro theory. It is, nevertheless, not up to the standards we would now set, had we known what we know now, when the Swedish micro–to–macro model (MOSES) was originally designed.

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[5] We have asked questions about it in the Swedish HUS project, with acceptable response rates. See Klevmarken (1986).

Less controversial but as obvious is the classical discussion of a grey credit market when the government, through its monopoly, legislative power, regulates the credit market, attempting to establish a below market interest rate (Eliasson, 1968, 1969, 1986a). This whole regulatory system, common to West European economies (Teigen 1976) disintegrated through the influence of market forces in the 70s.

This theory, or model, has been used to design and collect a database, primarily for the model, but also to be used in other research. I will continue to describe this work by first introducing the unit of observation. Then I proceed to discuss its interior decision processes and, finally, conclude by describing the database and discussing the problems associated with collecting it. For reasons already mentioned I will be brief on the household–family, but quite extensive in my account of the firm.

4. The unit of observation– producers, traders, families

The family can have many definitions, a judicial ("marriage"), or geographical (habitation), production (household) and economical (joint economic management). Sometimes they coincide, but often not.

The same characteristics apply to a firm. We have the legal entity (the corporation), the geographical location of activities, the production plant and the financially defined entity. As a rule a financially defined entity coincides with the legal entity, but not always.

With so many different categorizations one has to be clear about the analytical problem before deciding upon one particular taxonomy for designing a database. If the idea is to build a general purpose type of database one has to be even more aware of these problems before setting out to "measure". Since our ultimate object of study is the economics of the family or "household" and the "firm", it appears natural first to look for an economic or financial definition of the unit of measurement.

Choosing the observation unit is synonymous with choosing the level of aggregation for theory and empirical analysis. Theory, at least the theory I work with, requires a minimum degree of decision autonomy of the observation unit. Practical problems are associated with measuring it and keeping the database updated. It is, of course, a great advantage if decision autonomy and minimum measurement and information (transactions) costs coincide. Since decision units operate their own internal statistical systems, that cater for their own information needs, it becomes rational to build our database design on the categorization of the firm information system. That system generates good quality data for the purpose for which it has been designed. And good economic theory should be concerned with understanding the decisions taken within firms. For good economic theory, hence, the internal statistical systems should be the useful information bases to tap (see below).

Theorizing about, and collecting data on the family and the firm, of course, does not mean that we aim for extreme detail of prediction. It is rather the opposite situation. The potential of micro-macro analysis is to use the wealth

of micro information that exists, and can be systematically collected to improve understanding of macroeconomic development.

We argued already that such considerations suggested a financial definition of both the family and the firm concepts. We will continue along these lines here.

a) The extended family

A family is a team that exhibits superior performance characteristics over individuals in an environment consisting of other families, firms etc. A household is based on joint production and certain economies of scale that minimize internal effort and releases time resources for work in the market, and for leisure. These interior activities are insurance, human capital accumulation and income redistribution. With the rearing of children, the team, or the household, becomes a family. Marriage confers an explicit (legal) basis for the insurance contract of the family, that must otherwise be based on trust or mutual understanding. Hence, one can derive the economic rationale for the existence of a family from a set of easily acceptable axioms. But it would be ridiculous to abstract, in this theory, from family unifying factors like mutual understanding, social responsibility or genetically based grouping instincts.[6] Since all aspects of family life have an economic dimension, the natural definition of the extended family emerges; a financial team or entity that carries on internal production activities jointly, establishes internal rules for insurance and fairness of distribution, that generates external income and that manages a portfolio of wealth, including human capital that can be passed on to future generations, all for the purpose of maintaining a continuous consumption and saving activity. The theoretical difficulties have to do with the nature of interdependent preferences and

[6] Interdependent preferences have been a suggested device to handle these "sociological" phenomena.

internal coordination activities to whip family members together. How is the head of the household elected; on grounds of brute, economic or intellectual force? Under what circumstances does internal family coordination break down? More on this matter will eventually emerge from the HUS project. For our purpose to model and collect parallel data on families and firms we provisionally regard the family as an entity concerned with the creation and management of human and financial wealth. Success in this respect depends on the integration and/or interaction with the market production system or the firms.

b) The firm

The classical notion of a firm as a profit or value maximizing entity, subjected to a monolithic rate of return requirement from the owner and/or the capital market, corresponds exactly to a financial definition. The owners in turn reside in the families we have just discussed. They supply human competence (capital) and financial resources to the firm and in return they earn dividends or capital gains income. To capture this link we have, as we have just observed, to model the rich. The firm so defined, however, does not have to be a maximizer in a mathematical sense (Eliasson 1976). They can be viewed as rent or profit seekers, and we should not be too categorical about exactly how this search is organized in formal terms. A financial definition would, however, not be the best one for studying, for instance, materials (goods) processing within manufacturing firms or plants.

Given this restriction one has to consider a number of things. First, one needs some kind of theory in which this unit of observation figures in a well defined sense as part of a well defined population of similar units. The theory then becomes a specialized language for analyzing the particular set of problems chosen (cf. above).

Second, the unit of observation should exhibit some degree of autonomy in the sense of being a decision unit, that is reasonably well defined vis-à-vis its environment. The market environment this time is the behavior of all other financially defined units, which makes the markets for finance central. With an empirically oriented problem a behavioristic approach to theory should be

natural and this criterion for choice of elementary observation unit should coincide with choice of theory. The financial decision unit does not have to be the legally defined unit. One individual might own and operate two different, legally defined firms. The proper object for study would then be the two firms.

Preferably (third), the unit should be statistically distinguishable in the sense that it maintains its own statistical system that can be tapped directly for information without engaging an intermediary respondent, like the head of the household in the HUS project. One would expect the earlier criteria to define the optimal choice as regards availability of data from a source defined to suit the needs (also) of the researcher. If the unit of observation is a financially defined decision unit the decision maker of that unit and we – the surveyors – will be interested in drawing on the same database. However, there are numerous examples on how statistics are collected on a format that conflicts with the above criteria.

Fourth, the unit of measurement should preferably exhibit reasonable internal stability, in the sense of being predictable in terms of the chosen unit of measurement. If, for instance, we are studying the economics of a family or a household, we would like the composition of that unit to be stable and/or predictable. Exit of members through death or because of new household formation is fairly easy to handle. Also entry through birth should be manageable through some meaningful theory. However, the increasing rate of divorces and recombinations of informal, ad hoc households pose great theoretical difficulties, if one wants to explain the development over time of groups of families and generations. Households, however, still consist of well defined elements, human beings.

This problem of unit composition becomes considerably more difficult when one looks at business units. It is not empirically practicable to define a firm in terms of its members (individuals), a team, even though that might make a lot of sense. One needs a more "aggregate" approach.

One can often follow a firm called XXX and its financial accounts for years under the same label. The Swedish company "Stora Kopparberg" has carried roughly the same name for 700 years and it should in principle be possible to

reconstruct a 700 year sequence of statistical (financial) accounts for the company so labeled. Its internal composition, however, has changed drastically during the same period from exit and entry of "activities" and from internal recombinations (see Jagrén's chapter). It is normal for firms to go through frequent "identity crises" on a routine basis as part of its long–run survival strategy. In the family this consists of exit–entry and recombination of fairly well defined elements (individuals). The "division" – an abstract economic entity, defined by the statistical system of the firm – is the corresponding, internal firm unit. We can model how divisions exit, enter or grow at different rates. However, many such important productivity enhancing recombinations of firms linked to the entrepreneurial functions of firm management reach well below the division level, and forces changes in the statistical taxonomies of the firm. Even if all the statistical information residing in the files throughout one company would be simultaneously available at one central location, and even if all technical-analytical problems were solved it would still be impossible to derive (logically) from this information the consequences of recombinatorial activity within and between firms. To understand the "exogenous", Schumpeterian entrepreneur at work in the market or within a large business organization, such data are, however needed. A theory for how this process goes on requires an idea of how a matching measurement system should be organized and vice versa. Currently we have neither.[7]

c) Summing up

As a consequence, the optimal micro database taxonomy has to be based on a behavioral (decision) unit as the basic element or observation unit. A theory is needed that explains the internal life of that unit in terms of the variables chosen to represent it and how the unit interacts with its environment. This rules out aggregate representations of industry like sectors. However, disaggregation can become overwhelmingly costly, which is a common reason for database failures. And elaboration is counter-productive if it takes you down to a level where no meaningful theory to coordinate data can be formulated. In terms of our interests this means a theory of the household, or

[7] and we treat the entrepreneur as an exogenous, "stochastic" entity.

the firm, that defines their financial development as a consequence of decisions related to a reasonably well defined target for that unit. This theory has to be a reduced form of a model that is explicit in all variables necessary to explain the chosen financial variables and also how the model interacts with its environment, i.e., with all other agents (institutions). The "intersection" chosen may not be the only possible one. It is problem-dependent. However, the financial criterion for institutional delimitation has the advantage of allowing us to keep – but not be constrained by – the notion from received economic theory of the firm as a profit-seeking institution and the individual as a consumer that accumulates wealth to cater for future "utility" by himself, and his family and even a broader group of related individuals. We also have a fairly general micro-to-macro model of the Swedish economy that is responsive – as a minimum – to the traditional set of questions asked about an economy in which the micro units, the firms, are financially defined. In what follows I will describe the problems associated with designing the micro database for that model.

5. The interior life of a financially defined business unit – who knows what at various hierarchical levels?

The financially defined business unit places the owners – who reap the profits – and their rate of return demands at the center of attention. The dominant contact point between the production unit called a firm and controlling owners, hence, is that vis-à-vis the capital market. The firm so defined, if successful in terms of its rate of return, attacts resources to grow, and leaks resources if it is not (Eliasson 1976). The owners of the firms reside in the "household" or rather in the "family" sector. Wealth in the firm sector is part of their portfolio. Hence, there is a common interlinkage of objectives. And the dominant owner – families and firms meet across the capital market.

Success in profit terms is an internal competence and production problem in a broad sense. Business competence (human capital) is combined with physical capital and labor in an efficient way (Eliasson 1988b). The outcome is growth in the financial resource base and in household entitlements to wealth. To understand this process a finer grid of measurement than the financial definition is needed. Now, however, access to a well defined statistical system is not easy. For some large firms data on profit centers or divisions are kept for exactly the same reason as our need for better micro data; top firm management is interested in knowing better what goes on within the firm and lower level management wants to keep as much local information as possible for itself to pursue its own interests (Eliasson 1976). The only way of forcing lower level information to surface is to design the appropriate measurement system. This is the critical management problem of large business organizations. At some level of disaggregation – usually at what we call the product group level – a further profit center break down, with direct corporate headquarter access to data, however, stops for practical reasons (see section 6 below).

A company like Electrolux, with more than 140 000 employees, has about 30 product lines, while Sandvik Corporation with 25 000 employees has 200 product groups. Product groups are usually based on well defined taxonomies, each group corresponding to either a particular market or a function (meaning several markets, like luxury, large and small cars). Normally a well defined profit and loss statement can be made up for each product group and

product groups always add up one-to-one to divisions that are defined in terms of financial market categories and hence do not overlap. External and internal recombinations of divisions or firms often involve exit, entry or recombinations of "whole" product groups. However, somewhere between the product group and the division level Electrolux is divided into 6 divisions, or product areas, even though the 30 or so product lines are more important when it comes to decisions, responsibility and control. This was in 1985.[8] Since then Electrolux has acquired Zanussi of Italy and White Inc. of the U.S. It has been in a steady flux of reorganization. Since January 1984 the four divisions of Sandvik have been reorganized into 7 separate subsidiaries. The cost for maintaining a continuously updated, complete database on that grid became overwhelming. The firm, hence, requires that subsidiary supply aggregate performance data for product groups. Life histories of product group development are, however, rarely available directly from internal company accounts.

The production database of the MOSES model, for instance, feeds on a special survey carried out annually by the IUI and the Federation of Swedish Industries jointly (see Albrecht's chapter). This survey was originally designed in 1975 on the format of MOSES to serve as a database for MOSES. To illustrate my point, firms are asked to decide whether to fill in one form only, or several forms. The large firms always choose many forms, and we have found that the basic measurement unit they choose usually corresponds to divisions. But divisions are not stable as to content of activities. Large firms regularly reorganize their product groups into new divisions. Very frequently technical change, or new market conditions make the old product group concept obsolete and reorganizations also rip product groups apart destroying the continuity of the statistical system (cf. Jagrén's chapter). A redefined internal statistical system is developed to cope with the new situation, but firms seldom bother to update historical data on the new format. For obvious reasons they complete the question forms sent out regularly by the IUI and the Federation of Swedish Industries (The Planning Survey, see Albrecht's chapter) on the new format. This has been a first

[8] As described in Fries (1985).

major problem in database design; the difficulty of maintaining consistently defined life histories for the interior decision units that correspond to a clear market-product-production definition. To do that a theory that "predicts" divisional formation and reformation is needed for the database design.

The external observers (we) need such time-series to estimate behavioral relationships. For internal purposes planners, decision makers and accountants of the firm have direct access to the necessary "coefficients" without using econometric methods. The division is the important internal unit for the capital allocation decision.

6. The modern firm

The modern firm, represented in its measurement system as a financial decision unit controlled top-down by the rate of return requirements of its owners, internalizes a number of commercial functions. I have made up a minimum list, namely those of:

Table I.3 Important tasks of a large manufacturing firm

(1) an innovator
(2) a reorganizer
(3) a product developer
(4) an investment company
(5) a commercial bank
(6) an insurance company or risk manager
(7) a materials processor (factory part, production)
(8) a marketing organization
(9) an educational institution
(10) a welfare redistributional system

Table I.4 **Investments[a] in the 5 and the 37 largest Swedish manufacturing groups, 1978**
Firms have been ranked by foreign employment
Percent

	The 5 largest groups		The 37 largest groups	
	All group	Foriegn subsidiaries only	All group	Foreign subsidiaries only
R&D	25	10	21	6
Machinery and buildings	45	41	52	42
Marketing	30	49	27	52
TOTAL	100	100	100	100

[a] Investments in Marketing and R&D have been estimated from cost data.

Table I.5 **Labor input by type of work, 1974–79 in a modern engineering plant**
(percent of total manhours)

	Percent
Work scheduling	51
of which:	
administration	38
technical preparation	13
Production	49
of which:	
supervision, service, quality control, etc.	10
direct production	33
transports, inventories	6
TOTAL	100

Source: Eliasson (1980).

In the large manufacturing firm the non–factory activities (non-(7)–activities) already dominate in resource use (Eliasson 1982, 1984b) and this appears to become even more the case in the future. Tables 4 and 5 give an indication of this (see further chapter by Pousette - Lindberg). These facts have to be realized by any theory developer and database designer in the field; information gathering, processing, interpretation and use are dominant production activities in manufacturing. They always were, but their relative proportion seems to be on the increase. By a generous reinterpretation the "transactions costs" introduced by Coase (1937) to facilitate the definition of a firm can be said to represent these information activities. However, since transactions costs are dominant, also technical change has to be made a significant part of transactions costs. This makes relative transactions costs between market and non-market activities an extremely unstable demarcation line of the firm in the market. The implications of the information economy dominated by transactions costs (information processing) activities rather than physical production deal a devastating blow to the notion of market and non-market behavior. Information activities have to be carried out by some institution. This forces theory to explain institutional formation. And "information handling" in a broad sense can be both a market and a non-market activity. The impossibility of obtaining clear intersections between the market and its institutions is clear.

Let me go on illustrating this.

One urgent management problem of large corporations is to organize innovative activities within a predominantly routine and flow efficiency oriented business organization. Should the results of such activities be purchased in the market, placed in separate subsidiary companies, or is there an organizational solution to placing the innovative activity in the midst of low–brow routine activities (see Eliasson-Granstrand 1986).

The investment company function (2) in Table I.3 combines creative thinking with routine portfolio management. It is the typical long-term corporate headquarter interaction with division management. It is desirable to have this activity explicit in a firm database (see below) because divisions usually

correspond to a well defined product market. Aggregation above division levels makes it difficult to relate internal firm data to meaningful external market data.

All large firms have sizable internal banking activities. The extent of these activities depends on the external market environment. The less developed external credit market institutions, the more controlled external market institutions by government regulations and/or the larger profit opportunities in financial wheeling and dealing relative to industrial production, the more of banking you find within the company and (correspondingly) the less of banking services are purchased in the financial markets. During the last few years several large companies in the database, e.g., ASEA[9] and Volvo have separated off their commercial banking activities as a subsidiary corporation (a bank) within the group.

The firm in the market as seen through classical macro theory is a factory in the market, or to use Veblen's (1921) title: "The Engineer and the Price System". It is the classical statistical observation unit, the establishment, that we now find less and less well defined. However, the activities that go on in factories have to be well represented in our database, but in proportion to their relative resource use.

Marketing is equally unclear as to institutional definition. Large, modern firms have integrated backward and forward into "the market" to become more and more of international marketing organizations that develop their products, distribute and sell them. This description fairly well captures the large, international Swedish firms (Eliasson 1984). The bulk of their foreign subsidiary operations are concerned with marketing and distribution. However, the bulk of marketing activity for Swedish products in export markets is still carried out through agents and various intermediary traders. The number of possible institutional combinations to get the product from the factory gate to the final user is large, indeed. And the definition of the market becomes correspondingly diffuse.

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[9] See further Johansson's chapter in this volume.

The firm as an educational institution, finally, adds further complexity to our object of inquiry. The capital associated with product development, management, process innovation and marketing never shows in the accounts of firms. This is, however, the capital that matters in the modern firm. It is largely related to the gathering of information and the application of knowledge, and a firm that aims at a long and commercially successful life has to be organized such that its knowledge base is constantly updated, the knowledge transmitted through the organization and passed on to new vintages of employees. Taking care of this educational function is a significant cost item in the firm's accounts even though it is never properly accounted for (see Eliasson–Deiaco–Pousette–Lindberg–Carlsson 1986). Some authors want to define competitiveness as the unique knowledge base that makes the firm profitable. Since a cross section of Swedish firms would probably reveal that profitability declines with hardware capital intensity or the measured capital output ratio, if hardware capital is measured on a replacement basis, it is necessary to be able to measure the accumulation of unique human capital or business competence in a firm, for the old neoclassical representation of firm production – the production function – to survive. But if the unique knowledge base is "tacit", it is impossible to measure. Firms have no good statistical systems to keep track of such investments. Part of the competence built up is directly linked to selection procedures in hiring people and the organization of careers at all levels (the filter). Most accumulation of knowledge relates directly to ongoing work. Most large firms carry on institutionally separated educational programs. They may be internally run or managers or workers may be sent off to schools for shorter or longer periods. Such activities can be measured, but they are "inputs" and as well, probably not the really important educational experiences.

Concluding this section we take note of two practical things that matter importantly for the next section on actual database design, that, nevertheless, have to be handled crudely.

First, the concept of a firm is a fluid thing when it comes to the content of its internal activities. The endogenous content, or internal institutional change, will have to be handled by the theory of the firm if understanding of the

market economy is to be achieved. We have done a little bit of that in the MOSES model, but much too little. To go on is something much more sophisticated than estimating production functions on cross section or panel data. Second, the internal statistical systems of the firm are still designed on the old accounting frameworks. They do not distinguish between the important activities in the modern firm that we have made a point of. Notable examples are investments in marketing and education. It is unclear to what extent this is a reflection of old, obsolete designs of firm's information systems or, that such data are not needed to run a modern firm. My guess is that the information systems of firms simply have not been updated and that this is gradually becoming a serious deficiency when it comes to cost control and the efficiency of the internal resource allocation of the firm. This fact also affects our possibilities of building well designed databases. If the firms cannot do it for themselves, how can outsiders do it? They do not understand the decision problems of the firms.

7. The MOSES database

The database demands of the MOSES micro simulation model (for a brief description, see Eliasson 1983, 1985) are sizable. This volume is devoted to a fairly complete presentation of what has been done and what is in the pipeline. This section summarizes the principal problems. The fundamental idea of the model has been to exploit the wealth of micro data that exists in the MOSES system for improved understanding of macro behavior. 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 data 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 development (see more in next section), demand from households and competition from all actors in the markets. In making their plans each firm attempts to predict the behavior of markets (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 making and quantity adjustment of the MOSES model. We have found that the initial state description matters importantly for the dynamic simulation results. Internal database quality (consistency) is imperative for avoiding peculiar macro instabilities in simulations due to statistical errors. However, the internal information systems of firms are afflicted with the same kind of quality problems. Hence, adjusting database information to achieve consistency might mean that errors that affect firm decisions are removed and the corresponding effects also are removed from MOSES simulations.

The MOSES database recognizes several important business functions in Table I.3 above, but not all. The most critical flaw, as we now see it, is the absence of data on educational activities. To my knowledge, no such data have been collected elsewhere.

We have attempted to cover some of the most important business activities in our database, and to do it consistently with the corresponding macro data that are also being brought together on a modified sector design (see Ahlström 1978, and Nordström, in this volume). The design of the micro database has been formatted on the MOSES model. In fact, as has been mentioned, one statistical survey has been designed to suit the needs of the MOSES model exactly. This survey has been carried out annually since 1975, and also provides useful information for a variety of other research activities (see Albrecht 1978, 1979, 1984, and Albrecht – Lindberg 1982).

The complete database, however, requires that several databases be merged. This is the way we have organized work. The following four databases have been merged:

1. Financial data for business groups (Chapter II).
   Source: External data from corporate accounts by year. Data begin 1965.

2. Division data, production oriented (Chapter III).
   Source: Separate surveys (the "planning surveys") carried out annually by the Federation of Swedish Industries and IUI on all large divisions and (separately) on a sample of small firms. Data begin 1974. The small firm sample began in 1986.

3. Foreign subsidiary operations.
   Source: Three special surveys by IUI covering all subsidiary operations of Swedish companies 1965, 1970, 1974, 1978 and 1986.

4. The content of manufacturing production, covering resource use according to Table I.3 but at a somewhat more aggregate level (Chapter IV).

5. Macro, national accounts (Chapter IX).

The planning survey 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 X percent of Swedish domestic manufacturing employment. We use 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 is 100 percent for the years in question. In practically all instances we do not have a complete coverage on the division side. Some divisions are simply missing or they are engaged in non-manufacturing activities (wholesale distribution of other products, commercial cleaning (Electrolux), etc.). Our procedure has then been to define a residual up to the corporate group level. This consolidation work is just being completed (see further Johansson's consolidation of one company).

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.[10] 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 five historic (5 year) 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 life history basis.

The problem of sample representativity in MOSES analysis is handled in what we call the initialization process. Each division is placed in one of four

[10] There are two reasons for the high response rate, the most important reason probably being the good contacts between IUI and the Federation of Swedish Industries with the firms. However, we also believe that our database idea, to ask questions on the format of the internal statistical system of firms, matters significantly for the high response rate. The questioning reveals that we understand what the firms are doing.

manufacturing final product markets. ((1) Raw materials, (2) intermediate products, (3) durable goods for manufacturing investment as well as household durables, (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 our "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 – Lindberg 1982).

The MOSES model is, of course, not a sufficient reason (motive) 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. The full-scale format is, however, directly matched by the input and output format 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 also to a large extent leads a symbiotic life with the MOSES database. For a project to draw on the base it also has to chip in on complementing and updating of the base and on carrying out estimation work on the model.

8. Information systems in firms for internal use

Control and coordination are the key purposes of internal information systems of large business firms (Eliasson 1976). This has to be recognized when firms are asked to give statistical information about themselves. The quality of the data received will be best when one understands why and how the firm organizes its own internal statistical system and asks the questions the data are supposed to answer. This is the way we attempt to use the micro databases in the MOSES context. A glance at Table I.3 illustrates why separate and elaborate formal (statistical) systems are needed to control and to guide the various activities of a large business organization.

Complexity rules and there is no way of measuring everything with precision. Furthermore some concepts (like capital) are so badly defined that the content of answers will depend on varying interpretations by the respondents. Such data are useless for control purposes and corporate headquarter management always avoids such concepts.[11] There are two additional elements of complexity that frustrate corporate managers.

a) the difficulty, or impossibility, of a centralized knowledge base
b) the changing institutional arrangements.

The second 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 diminishes, or even destroys the information content of internal databases. There is no general solution to this problem. Corporate managers have simply learned to work with "deficient" information systems, which to my mind preclude generalized (all purpose) database designs. I will leave the subject at that (see further Eliasson 1988).

The first difficulty of centralizing information, however, is the prime concern of internal firm database designs. The key notion is again the purpose for which the data are gathered and I will conclude with some remarks on that.

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[11] This is the reason why profit margins rather than the rates of return are used for internal profit control in large corporations (see Eliasson 1976).

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 I.2 gives a principal illustration of our 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). In general, the intended use should affect theory, and theory should guide database design but this is only possible when your intended use is fairly stable. The feasibility of generalized measurement systems to cope with a multitude of intended uses is currently a topical concern in certain management circles (Eliasson 1984).

The major ambition of top level executives is to be able to control a complex business organization without getting involved in low level operations problems all the time. The executive level in Table I.6 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 and between levels 0 and 1 in Table I.6. 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 run. They need information (database) support from the level below to the reasonable targets, i.e., not overly high and definitely not too low. This task is always achieved through the budgeting process (Eliasson 1976) 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. The finer the measurement grid – the more perfect the overlap in Figure I.2 – the more precisely these targets can be set. However, the more dynamic the interior firm organization the more impossible to maintain a detailed measurement system and the further down 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.

Table I.7 gives an idea of how this compromise looks in practice. This solution also signals 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 people do not know themselves and have abstained themselves from attempting to get more detailed data because the measurement system is not reliable at lower levels of aggregation. (As a rule, confidentiality limits stop him long before that). In a large business entity Corporate Headquarter (top executive level in Table I.3) routine access to data never reaches below the product group level (3) in Table I.7. Often they stop at the division level. At product group level standardized cost comparisons are possible. Factor prices normally are 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 a good elementary unit with a well defined decision autonomy.

The product group 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 the 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. The product group is rarely a stable unit from which firm management reorganizes new combinations. Reorganizations of firm activities reach below level (3) in Table I.7.

9. The MOSES firm model

The ideas of the M–M (MOSES) project has been to model the interaction of decision units in markets – for the time being only firms in the manufacturing sector. To model behavior of manufacturing firms you have to be able to define reasonably well delimited, stable and autonomous decision units and you also need some of the data upon which they make their own decisions.

At this stage it is not difficult to see why a financial definition of the firm, and of 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 by 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. And the main purpose of MOSES modeling has been to use this wealth of micro data for a better understanding of macroeconomic behavior. Theorizing and research then naturally divide into understanding the interior decision machinery of the financial unit, on the one hand, and how the financial unit interacts with all other units and 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.

It is finally worth observing, what I observed already in my 1976 study on Business Economic Planning (1976), that the the information system by which large business groups are run, can be characterized by what Simon (1955) called "bounded rationality"[12] and that the art of interpreting and running the firm is most appropriately called "tacit knowledge" (Polanyi 1967). To attempt to extract more information from firms then corporate management finds useful to collect, and to go beyond the explicit knowledge that can be communicated outside the business organization means asking for

[12] Even though I did not use that name.

data of doubtful information content, which the statistical investigator might as well cook up on his own.

Table I.6 The functions of a large firm

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

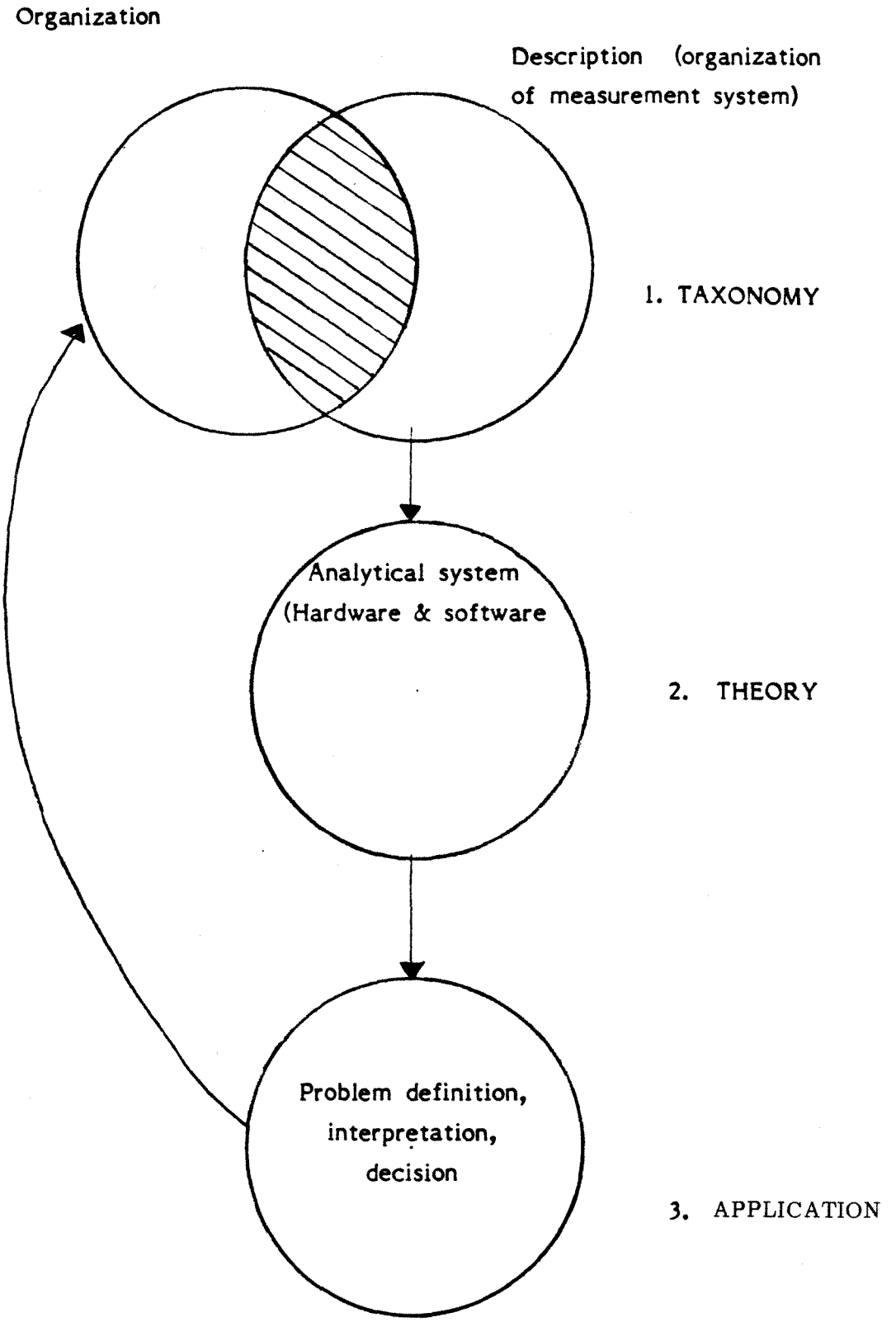
The MOSES model applies the same set of algorithms to a large number of firms. These algorithms mimic the capital budgeting and production planning process of a firm as financially controlled (for levels 0 and 1 in Table I:6) production systems (levels 2, 3, 4, 5). The databases to be described here provide quantitative measurement to specify and initiate these algorithms and to place them in the macro, market framework of the rest of the economy. For details of the model see Eliasson (1976b, 1978, 1985a) and the MOSES codebook (Albrecht et al 1989).

Table I.7 **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

Figure I.2 Integrated information and control system



SUPPLEMENT

This supplement gives a summary of the various surveys together making up the MOSES database, to be presented in the following chapters.

1. Production – planning survey

The core unit of the MOSES firm is the factory establishment. Each firm is represented by one or more such factories or establishments that produce for a particular market. This survey is limited to domestic establishments. Data needed are:

<u>for historic period</u>
– value added
– sales
– profits
– market price
– wages
– investment

<u>for initial period</u>
– employment
– ingoing and outgoing inventories
– unused machinery 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 production planning and a shift function for the production frontier in response to investment. This is described in the next two chapters by Lindberg and by Albrecht – Lindberg (1982).

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 is significantly more detailed data in the database than needed for the MOSES simulations. See further Chapter II by Lindberg.

The group or unit of the financial database is viewed as the theoretical decision unit or basic measurement unit that we have discussed above.

We attempt to have a consolidated group representation with all domestic units of the planning survey above plus a residual up to the domestic total, plus an explicit aggregate foreign establishment unit. There is an elaborate initialization program, presented in Albrecht – Lindberg (1982), that initiates the set of real and artificial firms through which the model is run.

3. Foreign subsidiaries

An extensive database on foreign establishments of Swedish firms exists for the years 1965, 1970, 1974 1978 and 1986. (See Swedenborg, 1979, Swedenborg – Johansson–Grahn – Kinnwall, 1989.)

The database includes data on:
- employment
- value added
- profit margins
- etc.

All data are by country. Investment data have been computed by Bergholm (1983).

Only a minor fraction of this database will (eventually) be used directly as inputs in MOSES simulations. The database will, however, be used as test material for model performance. See Lindberg's and Johansson's chapters.

4. Content of establishments (division activities)

This database is new and not yet ready. It is currently being collected and is not yet integrated in the MOSES model design. The survey was, however, initiated to make it possible for us 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 chapter by Pousette and Lindberg. Also see Eliasson – Fölster – Lindberg – Pousette (1989).

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