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"MOSES" - A Presentation of the Swedish Micro-to-Macro Econometric Model

by

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This is a preliminary paper.
Comments are welcome.

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"MOSES"

(Model of the Swedish Economics System)

– A presentation of the Swedish Micro–to–Macro Econometric Model

by

Gunnar Eliasson

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(1) State space is large and intractable, rather than small, and transparent at negligible costs.

(2) Behavior is characterized by bounded rationality and tacit, non-tradable knowledge.

(3) Access to market opportunities is not regulated.

As a consequence the firm intelligence system is organized to cope with tacit knowledge in a boundedly rational fashion. It is designed for competitive activity in an extremely large, and for all practical purposes unknown state space, or as we prefer to call it; business opportunity set.

Ex ante plans normally fail to match the constraints imposed by the plans of all other actors and the characteristics of the opportunity set. Individual mistakes are frequent and unpredictability at the micro level the normal situation. This makes the realization function the source of dynamics in the MOSES economy; that is the constant failure of ex ante plans to match at the micro level moves the economy and causes a constant ex ante – ex post dichotomy. Firms now have to conceive of themselves as experimentators getting used to making mistakes and becoming specialists in fast identification and effective correction of errors. Out of equilibrium there is of course no way to organize your intelligence system to signal reliably how prices and quantities will move. The equilibrium model will be an entirely unreliable predictive instrument in such an economy. To get any feel for the direction of change, you need a process representation of economic activity in which learning behavior and expectations forming, decision making and the realization process 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 (equilibrium).

The competitive position of each firm is that of a temporary monopoly established through technological process superiority.

The experimental organization of the economy so presented can be said to thrive on different forms of information processing, growth being restricted from above by technology change (in information processing) in a broad sense.

Personally I would say that MOSES puts life into the General Equilibrium Model. Looked at from the perspective of economic doctrines it combines (exogenous) entrepreneurial activities à la the young (1911) Schumpeter, or the Austrian tradition, with Smithian (1776) dynamic coordination in markets, notably the capital market, characterized by a permanent state of Wicksellian (1898) disequilibrium. It allows economies of scale through innovative activities. Concentration is checked by technological competition among all agents in the market. Thus a situation of general monopolistic competition among the few is endogenously maintained, keeping the economy from collapsing into one of the classical extremes; the macro model or atomistic competition.

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 time bounds the feasibility of future states (path dependence). Unexploited business opportunities, hence, are abundantly available to firms willing to engage in risktaking through trial and error (experimentation). Hence, price and profits expectations are sufficient to move the MOSES economy. By exogenously changing the market regime characteristics very different such paths of initial states can be generated.

All theory has to be parsimonious in one way or another. Which way, however, depends on what analytical problem one has in mind. 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. The business idea of the MOSES modeling project has been the frugality of that menu as offered by classical theory, influenced as it has been by the affliction of the static general equilibrium model.

2. Macro Overview of the Micro–to–Macro Model Economy

When seen "from above" the macro mapping of the Swedish micro–to–macro model is a Keynesian–Leontief eleven sector model with a non–linear, Stone type consumption system, wealth creation being treated as a separate "future" consumption category ("saving"), with complete feedback through demand and investment capacity growth. Underneath the macro level, exogenous Schumpeterian innovative activity upgrades the characteristics of new investment of individual firms, à la the "young" Schumpeter (1911). New technology is brought into firms through their individual investment decisions determined by a Wicksellian (1898) micro disequilibrium in the capital market. This 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. 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 complete), through exogenous government, fiscal and monetary policies, and through foreign trade.

The M–M economy is regulated by the interaction of domestic (endogenous) and foreign (exogenous) prices. 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 meet local supply plans. Markets do not clear and stocks and later prices adjust. Disequilibria then feed back into next period decisions. The source of dynamics of the macroeconomy originates in this failure of ex ante plans to match through the realization functions of markets. (Modigliani – Cohen 1958, 1961; Eliasson 1967, 1968.) This notion can be traced to Wicksell and Myrdal (1926, 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

FIGURE 1A MACRO BLOCK STRUCTURE OF SWEDISH MODEL

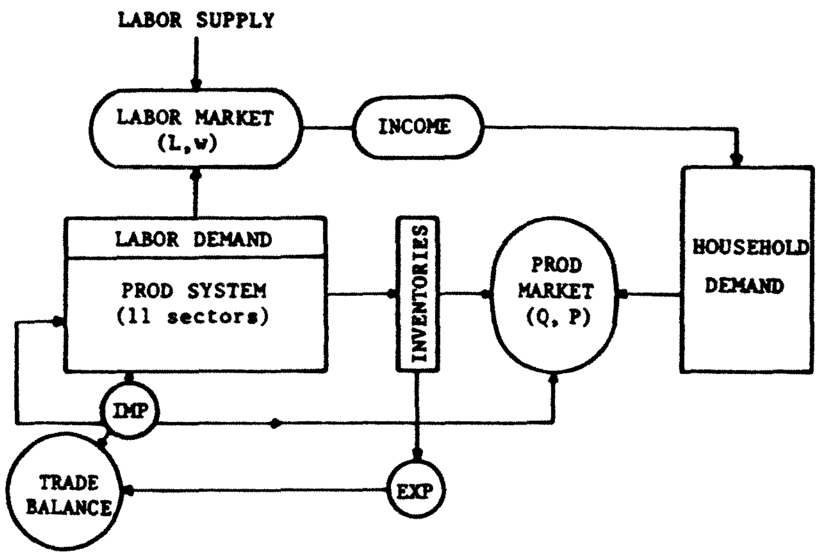


FIGURE 2 BUSINESS DECISION SYSTEM (ONE FIRM)

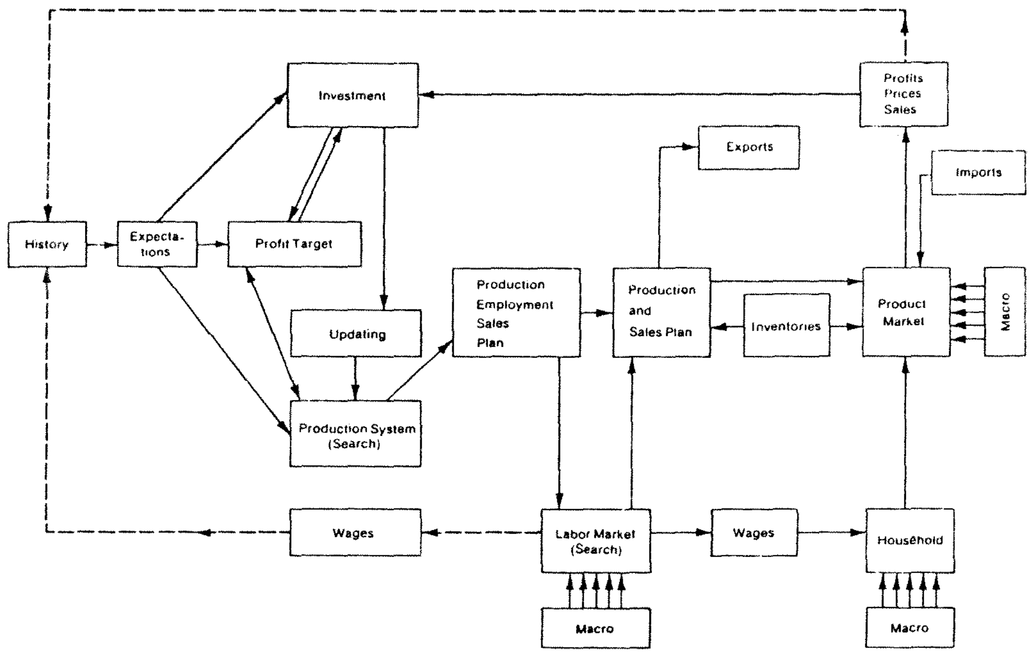


Table 1 The largest Swedish (manufacturing) exporters 1965, 1978, 1981 and 1985

Name of firm Rank by size of exports 1985	Exports (percent of total Swedish goods exported) 1985	1981	1978	1965	Type of activity	Production first started
Volvo	11.5	10.6	9.2	5.0	Automobiles, trucks, etc	1926
Saab–Scania	5.4	4.2	3.8	1.6	Trucks, automobiles, aircraft	1937/1891
Asea	4.1	5.2	3.4	2.6	Heavy electrical, robots	1883
Electrolux	3.0	3.6	2.3	0.8	White goods, etc.	1910
Ericsson	3.0	2.5	4.0	2.3	Telecommunications, computers, etc.	1876
Stora Koppar–berg	2.5	1.5	1.5	1.7	Copper mining, steel	13th century
SSAB	2.2	1.5	1.5	–	Steel	(1978)
Sandvik	1.9	2.6	2.6	2.2	Tungsten carbide, tools	1862
SCA	1.8	2.3	2.1	3.0	Paper and pulp	1929
Boliden	1.5	1.8	1.2	1.4	Metal and mining	1925
Nobel Indu–strier	1.5	1.2	1.3	1.0	Weapons, steel, elec–tronics	–
Papyrus	1.4	1.1	0.9	0.3	Paper	1895
SKF	1.3	1.6	1.5	2.5	Ball bearings, etc.	1907
MoDo	1.1	1.3	1.3	2.4	Pulp and paper	1873
Statens Skogs–industrier	1.1	–	–	–	Pulp and paper	1941
Holmens Bruk	1.1	1.2	1.2	1.0	Paper	1609
LKAB	1.1	1.5	1.8	4.6	Iron ore	1890
Alfa Laval	1.0	1.5	1.6	1.1	Dairy systems, centri–fugal equipment	1878
Södra Skogs–ägarna	1.0	1.5	1.5	0.6	Pulp and paper	1943
Swedish Match	0.8	–	–	–	Wood products, matches, chemical products, etc.	1917

Note: In 1984 Electrolux acquired Zanussi, Italy, in 1986 White Inc., USA.

In 1987 ASEA merged with Brown Bovery, Switzerland.

1988 Stora Kopparberg acquired Swedish Match.

3. The firm – three kinds of boundedly rational behavior

I. The creation of knowledge (innovation and reorganization)

The important innovative and reorganizational activities based on tacit, experience-based knowledge have to be treated as exogenous. They include restructuring of the financial organization of the firm as described above. Also major investment programs, in particular 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, though its investment. If this activity is not somehow explicitly accounted for, the firm is grossly misrepresented and – I claim – 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 this search phenomenon.

II. Learning behavior in markets (coordinated through boundedly rational expectations forming).

Self–coordination in markets is achieved through intelligence gathering and learning behavior. Firms interpret price signals (prices, wages, interests and profits) and transform them into expectations. These transformations include "correction learning" from past mistakes and attitudes to risk). The self-coordinating properties of the entire economy depend significantly on the specification of these intelligence gathering and expectations functions.

The observation unit in the household sector is the extended family including a group bound together by common interests, values and culture, extending over several generations and together providing a synergistic production, income–generation, portfolio management and insurance team. We won't discuss the interior member behavior of the extended family further and how it is affected by external market and policy behavior (see further Eliasson 1982). The main task here is to model family financial behavior that determines savings and consumption, regulated by a utility function of the following kind.

Utility function

$$U = U(C_I, C_{FUTURE}, C_{FAMILY})$$

Savings function

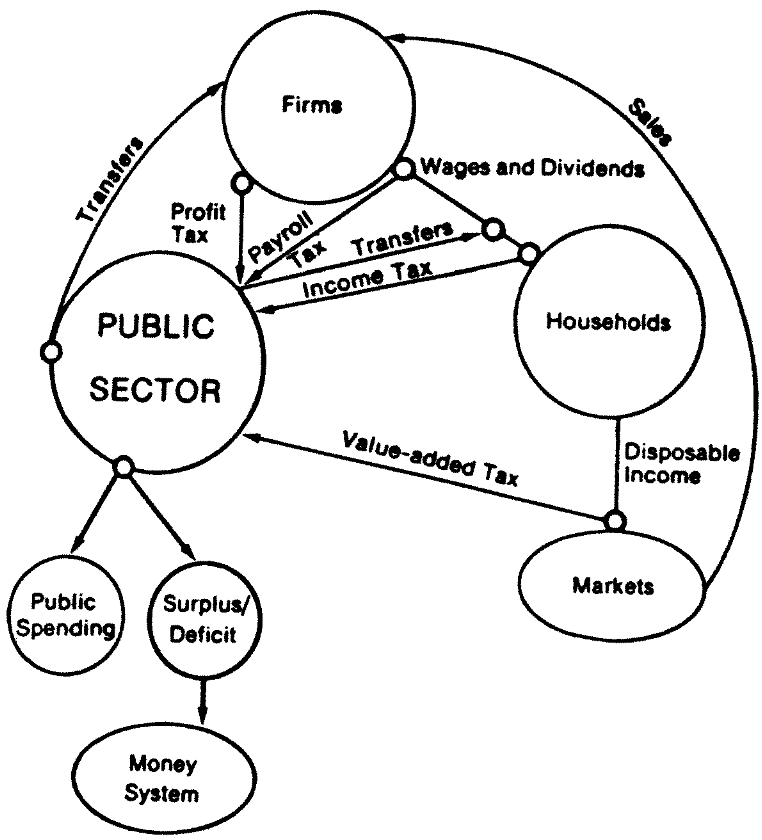
$$SAVH = F(\frac{WH}{DI}, RI - DCPI, RU)$$

The family derives utility today from saving for future consumption for itself and its current and future members, i.e. from savings being a separate artificial "consumption" category, that competes for income with immediate consumption desires.

We expect the family to substitute future consumption for the family for current consumption to achieve a stable family wealth/disposable income relationship. This tradeoff depends on the real (after tax) return to savings. In this sense we have formulated an extended family life cycle hypothesis, meaning that current family savings are targeted to pass on – to future generations – the currently achieved family wealth/disposable income ratio. This long–term savings target is modified by a short–term "insurance" modifier, related to labor market conditions and unemployment risks.

Since the household sector is currently modeled in macro we won't elaborate the microeconomics of households implied further here.

FIGURE 3 THE TAX SYSTEM



Source: Eliasson (1980, p. 63)

In the evolving micro–based economic structure ex ante production, investment, consumption etc. decisions have to be coordinated through market price and quantity adjustments to generate ex post behavior. Together this process is a true – note the ridiculous name – non–tâtonnement process of the invisible hand, as it operates in the market of the micro–to–macro model.

The efficiency of this economy wide coordination function depends on the organizational structure of the economy and how informed each agent is about the same structure at each point in time. Firms constantly strive to learn about the structural fundamentals. Since the organizational structure facing each agent is immensely complex and constantly evolving as a consequence of the ongoing coordination and filtering process involving all agents, agents are constantly grossly misinformed about their market environment. They are, even though we do not invoke strategic behavior. The state of full information is not a feasible one.

7. Technical change in information processing determines the performance characteristics of the economy

The ultimate problem associated with introducing information processing explicitly in economic modeling – and hence in economics – now becomes a matter of how technical change in economic information processing and communication affects the macro economy. Since innovation, coordination, filtering and learning permeate the entire micro–macro fabric of the economy, the leverage effects on macro economic performance of even small shifts in information technology may become enormous, feeding back on the environment of micro agents in a highly unpredictable fashion, and causing, when allowed to occur, the analytical results of mainstream economic theory to change fundamentally. The main changes in coordination technology is a matter of organizational change; within firms and of markets. On the market side we have frequently used the model to study the macro effects of different market regimes.

Coordination technology determines how fast and how fully market and hierarchical signals are transmitted through the economy, and how efficiently

4 The Firm Model

Deriving the Control Function of the Firm

To outline the capital market dynamics of the M–M economy we derive the profit targeting and profit monitoring formulae used for both production and investment decisions.

It guides the firm in its gradient search for a rate of return in excess of the market loan rate. To derive these formulae we decompose total costs (TC) of a business firm, over a one year planning horizon, into:

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

w = wage cost per unit of L
L = units of labor input
p^I = input price (other than w and p^k) per unit of I
I = units of input
r = interest rate
ρ = depreciation factor on $K = p^k \cdot \overline{K}$
p^k = capital goods price, market or cost
$\overline{K}$ = units of capital installed

In principle the various factors (L, I, $\overline{K}$) within a firm can be organized 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 as it is achieved through the dynamic market allocation of resources among firms.

The firm is selling a volume of products ($\overline{S} = p^* \cdot S$) such that there is a surplus revenue, ϵ, over costs, or profit:

$$\epsilon = p^* \cdot \overline{S} - TC \qquad (2)$$

Management of the firm delegates responsibility over the operating departments through (4) and appropriate short–term targets on M (production control) and long–term targets on $\bar{\epsilon}$, that control the investment decision.

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

For any given set of expectations on (w, p^X) in (4) determined through individual firm adaptive error learning functions (see (7) below) a target on means a labor productivity target on $\bar{S}/L$. Hence, the profit margin can be viewed as a price weighted and "inverted" labor productivity measure.

Long–term objective function (investment selection)

The objective function guiding long–term investment behavior is to select investment projects that satisfy (ex ante):

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

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

$$r_i = F(r, \varphi) \qquad \frac{\partial F}{\partial \varphi} > 0 \tag{6}$$

The ϵ of an individual firm is generated through innovative technical improvements at the firm level (Schumpeterian innovative rents) that constitute Wicksellian type capital market disequilibria defined at the micro level. The $\bar{\epsilon}$ drives the rate of investment spending of the individual firm. The standard notion of a Wicksellian capital market equilibrium is that of "average" $\bar{\epsilon} = 0$ across the market[3]. As a rule this state is not achieved. Unused capacity may prevent the firm from expanding capacity even though investment long term is expected to yield $\epsilon > 0$. More importantly, however,

[3] Note distinction $E(\Sigma\epsilon) \pm 0$.

The creation of new technology

A new investment vintage can be regarded as a "new firm" with exogenous capital productivity ($\alpha = \overline{S}/\overline{K}$) and labor productivity ($\beta = \overline{S}/L$) characteristics. A new investment can be seen as a new vintage of capital with these particular technology (α, β, ρ) characteristics in the profit control function (4) that mix with capital installations in existing firms. Technology is exogenous and embodied in new investment vintages. Hence, the international opportunity set introduced earlier is represented by current (α,β,ρ) specifications of new investment vintages, while local competence is defined by the local investment process (and – of course – the short–term production decision) that upgrades the technical specifications (the "frontier") of the firm, under which quarterly production decisions are taken.

The productivity upgrading process can now be seen to take place in four steps (See Eliasson 1985a, pp. 329 f).

(1) Actual, operating labor and capital productivities (α, β) are pushed by competition towards potential productivity (α^*, β^*) on the frontiers. Static efficiency improves.

(2) Potential productivity (α^*, β^*) is increased through more investment (INV $\rightarrow$ ($\Delta\alpha^*$, $\Delta\beta^*$)). Neoclassical efficiency improves.

(3) Innovative reorganizations raise (α^*, β^*). Dynamic allocational efficiency improves.

(4) Innovations create new type (α^*, β^*) $\rightarrow$ (α^{**}, β^{**}) productivity characteristics. Schumpeterian efficiency is achieved.

It is somewhat difficult to distinguish between efficiency categories (2), (3) and (4) in principle. In practice, and in modeling they sort themselves out nicely, once we have defined the unit of measurement.

Fix investment exogenously, and increase competition in the MOSES model and type (1) efficiency improves.

level we are in practice back to the Nelson–Winter (1982) Winter (1984) R&D modeling specification.

My proposed variation is to categorize R&D investments into more or less innovative, in practice into two categories; an innovative category with a low probability of a huge, long–term payoff, and an imitative category with a high probability of low short–term payoffs.

Each firm can be categorized by its relative orientation (R&D strategy).

We can define certain indices, like a relatively large share of highly competent staff, and/or a relatively high productivity as indicators of competence that reduces the risk (or rather transforms uncertainty into calculable risks) associated with innovative research, meaning a high probability of positive outcomes, than if the same R&D money would have been spent in a firm with a lower competence index.

The bench mark for daring, riskwilling innovative activity would be set by new (innovative) entrants, with a high ex–ante perception of payoff but a statistically expected payoff below the market interest rate.

The competence indices of large firms would lower the risk, raise the expected outcome, but instead restrict the applications to uses within the competence of the firm.

In practice, these nuances have to be introduced within the context of the currently specified model. Current best–practice (α, β) characteristics are introduced embodied in new investment. The new procedure would be to exogenize maximum possible (α, β) characteristics, setting a time path of maximum access to the opportunity set.

Firms can never introduce more advanced technology than this maximum best practice technology available in the market. But it can be more or less competent in "achieving" the best practice results. The new investment technology is a drawing from a distribution that offers a spectrum of choices up to the exogenous best practice. Firms reject these choices and try again if

5. Strategic Behavior

There are two principally different types of micro–macro models. In the first kind agents form expectations about all other agents as a group, or attempt to see through all intricate interactions of the micro–macro machinery to aim for a perceived (rational expectations) equilibrium. The MOSES system is mostly of this kind.

The second kind of models involves strategic behavior, each agent attempting to foresee and counter strategies of competing firms. Strategic behavior involves withholding information, becoming a free rider, or showing moral hazard behavior. If agents know that strategic behavior occurs and that it cannot be conceived of as random noise, behavior of the first kind may be self–defeating, non–optimal.

Strategic behavior of firms generally destabilizes markets. The probability of mistakes increases, and new inconsistencies between individual plans arise.

Strategic behavior has to be entered exogenously through profits targeting and expectations forming, and the model allows deviations from the standard procedure of reading market prices and wage signals, and projecting aggregate local market growth to set targets on own performance. The EXPXDP etc factors in (7) and the TARG XM factor in (10) can be tagged on to perceptions of competitor action and be weighted into expectations and targets.

The firm can in fact tag its targets or expectations on any set of signals coming out of the MOSES economy.Thus, for instance, profit targets can be set as profit performance of the best competitor, and wage and price expectations can be derived from information from the highest paying firm, and the lowest price recorded in the market.

It is an empirical question how and how much of such strategic behavior that should be allowed to enter. In the current MOSES version strategic behavior requires that the model be set up as an interactive game, something that we have so far only done in a very simplistic fashion.

7. The Market Organization

The notion of <u>competition among the few</u> is the appropriate conceptualization of the market organization of the micro–macro model.

In its most updated form, with an endogenous entry and exit feature (see section 6 above) the micro-macro model can be seen as a dynamic game among a variable number of players, each aiming for an increased market share as long as rate of return targets are not violated.

Competition is technologically based in the same sense as in modern trade theory (see Krugman 1984). Technological upgrading affects process performance only, and the relative state representation of each firm describes its relative technological capacity ("knowledge") to outperform other firms.

Competition is for a share of total production value, i.e. for what foreign and domestic producers are willing to pay.

Each new technology upgrading, and each reallocation of resources towards relatively better producers (technologies) generate improved economies of scale and more capacity to grow, in the sense that (everything else the same) the best performer by adding new best–practice capacity and hiring new labor at higher wages will eventually be able to force all other firms to exit. The control factor is time.

However, each new technology improvement also means less value to relatively bad producers, reducing the value of their capital. New best practice technology can be invested in any firm taking on an investment program, and superior technology can enter from the outside. Furthermore the highest profit performers do not necessary pay the highest wages. A superior productivity performer setting out on an investment growth and recruiting program may suddenly destroy a favorable factor price situation for a higher profit firm. Finally consumer preferences and foreign markets may change the relative price situation.

8. The Quarterly Production Decision – Short–term Market Behavior of Firm

This decision determines where production occurs underneath the production frontier. The production frontier is moved by the investment decision. Each quarter the firms determine their production volume in two steps. First, they determine their desired production volume, taking into account desired changes in their inventories of finished goods, based on their expected total sales (including exports), which are in turn based on the firms' historical experience.

MIP–targeting – interior information search (inward, bounded rationality)
The production decision is typically boundedly rational in the sense of Simon 1955 and Eliasson 1976a)). Top level management does not know enough to impose the flow structure that maximizes ϵ in (2) through the components of M in (4), given capital installations. It resorts to MIP–targeting. Expected (p,w) are applied to historic data on M, and suggested to lower level management, thus initiating an internal negotiation, called production search, eventually resulting in a preliminary agreement (a plan). The negotiation process continues as long as management believes M will stay above targets without resulting in a lowering of ex ante profits. Convexity is thus preserved, and decisions correspond to a gradient approach to maximum ex ante profits, which will be reached if other environmental conditions remain ceteris paribus. The latter is, however, normally not possible to impose on a dynamic micro–based model of this kind.

This first production plan is revised by the firms with regard to profit targets, capacity utilization, and the expected labor market situation. After this revision, the production plan is executed.

Mathematically, the interior trial and error process of a MOSES firm makes use of a graded search algorithm for an improved position in terms of chosen targets (hill climbing), of a kind that is used in complex mathematical optimization problems to approximate a solution. Search in MOSES is, however, given a time dimension which means that hill–tops are rarely

Hence, corporate management has to proceed by persuasion, exhortation and coaxing.

It is, however, always reasonable to demand a small improvement in performance over and above what was previously achieved and recorded. Exactly there lies the rationale of the MIP principle built on (1), (2) and (3) above.

Note that the first element in (4) is

$$M \cdot \alpha$$

where:

M = (gross operation profits)/(value added)
α = (value added)/(capital stock)

relates directly to the targeted rate of our net worth (R^{EN}), or to the rate of return on total capital. If capital owners demand a rate of return on net worth

$$TARG\ (R^{EN}) \geq r$$

at least equal to their alternative rate of return in the capital market, a minimum profit margin (M) target can be derived using (4), after economic depreciation and capital gains or assets have been determined.

Using:

$$M = 1 - \frac{W}{P} \cdot \frac{1}{Q/L}$$

(see (5) and (7) to determine EXP(W, P)) a minimum productivity (Q/L)) can now be established.

Top management of the firm is "pinched" between two facts. The Board and the share owners are demanding a rate of return on their equity expressed by

This situation occurs rapidly in a firm when the M–target derived through (4) from the market interest rate is far above the M–target established from MIP–targeting, and investment spending is curtailed. On the other hand, a firm earning a return far above the interest rate, investing extensively, and finding small difficulties meeting the MIP–determined M–targets will always find itself in the shaded area without extra trouble.

In the MOSES model firms are characterized by two different modes of behavior operating simultaneously. Easy target satisfactions may make them slow in pushing strongly for upgraded performance, hence gradually eroding the initially favorable situation (see Eliason 1978, pp. 183–184). This occurs since firm management finding itself in a satisfactory profit situation vis–à–vis the market, does not exercise as strong a downward pressure as it would have done in a less favorable situation. However, growing profits also upgrade profit targets, making it increasingly more difficult to satisfy targets. The relative strength of each mode of behavior can be determined exogenously, to characterize the firm. Depending upon various endogenous circumstances affecting the interior performance of the firm and its market environment the one or the other mode can dominate for long periods.

The main specification of interior MOSES firm behavior, however, is that the major vehicle for improvement is through improved productivity. This is especially so if we provisionally – the MOSES system does not – reason as if the firm is a price (p) and wage (w) taker. Then the only variable available to raise the profit margin is labor productivity (Q/L). As is revealed by practically all short–term planning cases studied in Eliasson (1976a), this is also the variable that can, in fact, be improved (!) in the short term as well as in the long term. There are two reasons for that:

<u>First</u>, (mentioned above) there always exists slack of unknown extent in large organizations.

<u>Second</u>, the (a) component in (4) above can always be rewritten as a weighted average of profit margins of all profit centers, product groups and statistically separable production units within the company. This means that productivity improvements (and hence profit margin improvements) cannot only be achieved by raising local productivity rates but also by changing the product

Production Search

Production planning is carried out individually by each firm. Each firm chooses a preliminary, planned output and labor combination (Q,L). The algorithm by which a (Q,L) plan is chosen is intricate. Figures 4 and 5 illustrate the principles.

Each firm faces a set of feasible (Q,L) combinations (a short–run production possibilities set) each quarter that are defined by

$$QFR = QTOP*(1-\exp(-\gamma \cdot L)) \qquad (9)$$

This feasible set shown by the curve in both Figures 4 and 5 is determined by the firm's past investments as they are embodied in QTOP and γ. Investment between quarters pushes this set outward. To the set of feasible (Q,L) combinations of the firm corresponds a set of satisfactory (Q,L) combinations. A quarterly profit margin target (TARGM), defines the satisfying criterion. This target is calculated as defined above. The basic targeting is done on a yearly basis with quarterly adjustments, and profit margin targets adapting gradually as experience on what is possible to achieve is accumulated.

As shown above (see (5)) a profit margin target (TARGM) can be derived from the rate of return target. Bad profit experience can make the firm lower its target in the short term. This will normally affect long–term development negatively; immediately through smaller cash flows and less investment and in the longer term through less investment, and perhaps also less profitable investment, that keeps future cash flows low.

Difficulties to meet short–term profit targets are met by exploiting various forms of slack within the company, in a way that could be called learning or search for better solutions (see below and Eliasson, 1978a, pp. 68–73).

Expectations are of an adaptive error correction – learning type based on the smoothing formula (7). Risk considerations ("aversion") in expectations forming enter through a standardized variance measure in the expectations projection continuing that trend. However, a market turn around of course means that finished goods inventories have been depleted. The firm then adds – to each projected sales plan – what is needed to restore inventories. If the market improvement continues the situation repeats itself until the opposite situation occurs.

Selecting the production plan

The firm now chooses a point within the shaded area of Figure 5 that is both feasible and satisfactory. This is done by specifying an initial set of (Q,L) points and the rules to adjust these points if they do not fall within the feasible and satisfactory lens area. Note that it is labor productivity that is adjusted.

This search for improved productivity is a learning process that is activated and intensified by difficulties of meeting profit targets. This is a well recognized phenomenon in the business world. Firms do not know their feasibility sets well even in the short term. Learning goes on all the time in a piecemeal fashion. This learning is speeded up when the profitability situation deteriorates. Under such circumstances internal resistance to change yields, and improvements often do not have to be associated with more than minor, additional expenditures (Eliasson, 1976a).

Search is guided by a comparison of the productivity ratio to an equally scaled expected price ratio. The initial positioning of L and a corresponding expected sales volume establish an initial activity level of production. The search path into the shaded lens in Figure 5 may, however, lead onto B, and down along it, to a premature collapse of operations. This may be incompatible with rational behavior in the sense that the firm deliberately chooses to lower its expected profits to find a quarterly (Q/L) combination within the shaded area. As mentioned, this is prevented by a supplementary rule that stops further search whenever expected profits begin to decrease.

For each L, there is an interval of output plans that are (1) either both feasible and satisfactory in the lens in Figure 5 and/or (2) feasible but not satisfactory (Region B), or (3) neither feasible nor satisfactory (Region C).

Industries on which the model runs. Each year some firms are operating at full capacity, but most are not. We also know roughly from empirical studies (see for instance Eliasson 1976a) how firms adjust their output plans in a stepwise fashion. Production search has been tailored to mimic such procedures within firms.

When a feasible and satisfactory (Q,L) point in Figure 5 is reached, the firm's preliminary plan is set at the minimum Q such that SAT(Q,L)holds. If SAT(Q,L) does not hold, and if the point is in region A, the firm adjusts by planning to lay off labor. If this does not help, the firm's preliminary plan is to set the minimum feasible Q and L.

Each firm now has a planned employment and output level. At the aggregate level, however, these plans may not be feasible. Firms must confront one another in the labor and product markets to sort out remaining inconsistencies.

9 Multimarket Interaction (Interdependence and Dynamic Coordination)

The ex ante ex post realization processes are modeled as a sequence of market confrontations that sort out ex ante and ex post inconsistencies and lead to the determination of price and quantity distributions.

The production volume is distributed to export and domestic markets according to an export share, which is dependent on that from the previous quarter, but which also depends on the difference during the previous quarter between the export price and the domestic price. If this export price (which is exogenous) is higher than the domestic price, the firms try to increase their export share during the current quarter. However, the adjustment takes place over several quarters, not instantly. If the export price is lower than the domestic price, firms do not try to lower their export share but rather maintain it at a constant level. In spite of this asymmetry concerning the effect of positive or negative price differences between exports and the domestic market, it turns out that the export shares in the various markets can both increase and decrease. It all depends on whether firms with high export shares fare better or worse than other firms in the market. The import share in the four markets is also determined by the difference between the export and domestic prices with a certain time delay. High domestic prices relative to foreign prices lead to increasing import shares.

There is also a capital market in the model where firms compete for investment resources and where the rate of interest is determined. At this given interest rate firms invest as much as they find it profitable to invest, given their profit targets.

Public sector employment is determined exogenously, and the rate of wage increase in the public sector has been set equal to the average wage change in manufacturing, preserving the relative, average salary and wage differential between the two sectors.

This clean setting is brutally disrupted for ever if the assumptions of the MOSES model are allowed in; a large opportunity set, tacit knowledge, bounded rationality and more or less free competitive (technological) entry. This is what I meant by putting life into General Equilibrium Theory.

The markets for finance (the interest determination process) now function as a goal setter (setting rate of return targets) and as an allocation mechanism for "tacit" entrepreneurial competence. The former function is in turn influenced through the savings decision, savers determining de facto the time horizon under which the entire economy operates.

The more or less efficient capital market, hence, dominates the entire economic system. The interest rate and the ex ante competence of firms determines investment and capacity growth in the economy. It can also cool down activities in other markets, for instance the labor market, since the ultimate objective variables is the rate of return (Eliasson 1974, Eliasson–Lindberg (1986).

Labor Market Search

Let us first return to the outcome of the internal firm quarterly production plan of the firm; a planned output, employment level and anticipated price and wage levels, satisfying the rate of return target of the firm.

Each firm now enters the labor market with a planned change CHL in its labor force.

If CHL ≤ 0, the firm begins to lay off workers with the notification delays that are required by Swedish laws.

If CHL ≥ 0, these firms will start looking for additional labor in the pool of unemployed, or more frequently by trying to bid labor away from other firms.

Ideally labor market search should go on from both sides, the relative search intensities being a way of characterizing the labor market. However, if we applied to the pool of unemployed. Raiding can be global across all firms, or be selective and restricted to a particular kind of firms, say in one sector.[9]

Let i index the raider and let j index the target. An attack is successful in $WW > (1 + ö2) \cdot WW_j$, and labor in the amount of MIN>($ö3 \cdot L_j$, CHL_i) is transferred from j to i. If j indexes the pool of unemployed (which is of size LU), then the attack is always successful and MIN($ö3 \cdot LU$, CHL_i) workers become employed in firm i. When an attack succeeds, (CHL_i, CHL_j, L_i, L_j) are adjusted and the firm losing labor increases its wage offer by

$$CHWW_j = ö4 \cdot (WW_i - WW_j).$$

If the attack is not successful, then the attacking firm increases its wage by setting $CHWW_i = ö5 \cdot (WW_j \cdot (1 + ö2) - WW_i)$.

The parameters $ö_i$ are all in the interval (0,1). They determine the speed of response at each confrontation to wage discrepancies in the labor market.

When all firms (which CHL > 0) have gone through this iteration, a predetermined number of times the search process of the quarter has been completed and wage levels are set.

We have learned from repeated numerical analyses of the entire model that the stability of the price system – and hence of structures and growth as well – depends critically on the intensity and scope of this labor market arbitrage.

9 By identifying firms by regions, search can also be confined within actual geographical areas. Such applications, to be meaningful, do, however, require a very large number of firms, more than the 150 firms we currently use in a simulation. For the time being, both access to firm data and prohibitive computer costs prevent such simulations.

$$CHX = F \left| \frac{\mu \cdot PFOR - PDOM}{\mu \cdot PFOR} \right|$$

$F' > 0$

μ is the exchange rate.

There is no other explanatory variable, and it is important to understand that, with the quarterly specification, we should not have any additional explanatory variables. This formulation can be demonstrated to mean (roughly) that the ratio of deliveries to foreign markets and the domestic market slowly changes towards relatively more exports as long as a positive difference persists between profit margins on export and domestic sales for the producing firm (see Eliasson 1978a).

Two additional things should be noted here.

First, the main factor that keeps export ratios from generally converging towards 1 or 0 is that domestic prices respond (through quantity adjustments within the entire model economy) to the diversion (or vice versa) of supplies to foreign markets and hence diminishes the (PFOR–PDOM) difference. This (and the corresponding mechanism on the import side) is the main transmitter of foreign prices into the model economy. One "equilibrium" property of the model is that in the very long term all prices and quantities in the economy will force PDOM to converge to PFOR. The duration of that adjustment is an empirical question. This is also the (only) way foreign business cycles are transmitted to the MOSES economy.

Second, the firm may appear to be a price taker in this formulation. It is in the sense that foreign markets absorb all that the firm can and wants to deliver at the given foreign price (=PFOR). The firm responds to foreign price changes by adjusting foreign deliveries from quarter to quarter. The domestic price, however, responds to the volume of shipments of all firms and from abroad both during the quarter, and from quarter to quarter.

Closing Note on Price Feedback

The micro–macro model briefly introduced above exhibits endogenous price and quantity setting at the micro level and complete price and demand feed back through markets and income determination. Being an empirically implemented model of the Swedish economy it has been placed in an international market environment. Domestic Swedish performance control is excercised through the international capital market (the international interest rate), international product competition through foreign trade and through economic policy. Labor movement in the model is within Swedish borders only.

From an analytical point of view this makes the model more complex than it has to be in order to highlight the problems of this essay. Closing the entire model would mean either making the domestic interest rate an exogenous policy parameter, which is easy as the model stands now[10], or completely determined through micro intermediated demand and supply processes in the markets for finance. We have not yet been successful in integrating this feature in the empirical model.

However, the Swedish micro–macro model is assumed to be interacting with an equilibrium steady state world model. In principle this is traditional. In practice it gives rise to complications, since an environmental steady state situation is very demanding on consistent specification.

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[10] Such experiments have already been carried out. See Eliasson (1984).

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