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PREFACE

This volume consists of the four papers presented in the American Economic Association session titled "Synthesis Through Microanalytic Simulation" held on December 29, 1985 in New York, as well as a discussion of these papers by Steven Caldwell of Cornell University and introductory material by session chairperson Guy Orcutt of Yale University on the history and nature of microanalytic simulation. At the end of the volume we have also included some material about new and forthcoming publications and working papers for those interested in learning more about microanalytic simulation.

Since its inception with the modeling building and publications of Guy Orcutt and his colleagues in the late 1950's and early 1960's, microanalytic simulation modeling efforts have sprung up in a number of countries. The first paper by Heinz P. Galler of the University of Bielefeld describes progress on the Frankfurt Microsimulation Model. The next paper, by Gunnar Eliasson and Kenneth Hanson of the Industrial Institute for Economic and Social Research (IUI) in Stockholm, describes pricing and markets in the Swedish micro-to-macro simulation model MOSES.

Microanalytic simulation models usually contain or use outputs from macroeconometric simulation models. Policy and other considerations suggest that it is important to improve the micro-macro interaction in these model systems. Concerns of this sort are raised in both the first and second papers. In a working paper of Yale's Institution for Social and Policy Studies, Richard Ruggles and Nancy Ruggles explore the question of how we might construct an integrated and coherent data framework that would encompass both the macro and micro data needs of micro-macro systems of models. The final paper by Alice Nakamura and Masao Nakamura of the University of Alberta in Canada deals with methods for bringing sums of micro outputs into line with the values of corresponding macro outputs in micro-macro systems, and examines arguments for and against pursuing alignment of this sort.

Our hope in organizing the session "Synthesis Through Microanalytic Simulation", and in putting together these materials associated with the session, is to stimulate broader professional awareness of progress in this research area and greater professional discussion concerning key aspects of the development of microanalytic simulation models. Microanalytic simulation has always held out the promise of allowing researchers and policy analysts to integrate and see the implications of micro-data-based findings in overlapping areas of individual and family behavior, and of facilitating the use of data at various levels of aggregation. With recent advances in computers and in the software for these computers, the prospects seem bright for further development and more widespread use of microanalytic simulation models. Steven Caldwell deserves thanks for his substantial efforts in helping to organize the session on which this volume is based. Harold Beebout of Mathematica Policy Research, Inc. also participated in the session as a discussant, although we were not able to include his comments in this version of the volume due to delays in getting the papers to him.

Alice Nakamura
Masao Nakamura

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(Hansson/190/KH/Pricing and Markets/1)

PRICING AND MARKETS IN THE SWEDISH MICRO SIMULATION MODEL

by

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In micro-to-macro simulation, macro aggregate dynamics is the accumulated outcome of micro unit adjustment behavior. In this presentation firm price and production responses to unrealized plans in product markets and to exogenously determined foreign prices in the micro-to-macro simulation model "MOSES" is the subject of interest. There are other, related adjustment responses and spillover effects involving labor and both financial and physical capital. With these, we will illustrate how the multimarket behavior of MOSES affects final product pricing and production volume.

1. Firm Behavior and Market Dynamics in the M-M Model

Firms are characterized by principles of boundedly rational planning and adjustment behavior in the production component of MOSES. Those firms competing with one another in a product sector interact through the rules of a dynamic market process. The outcome involves individual firm sales, product prices, and unrealized plans. Exports and imports, being important to an open economy, are also taken into account, given exogenous foreign prices.

To appreciate the rules of interaction let us return to some older conceptualizations of a market. Adam Smith introduced the invisible hand coordinating the pursuit of private interest into a consistent set of demands and supplies. Walras captured this in the adjustment of prices prior to production plans being actualized, allowing supply to equal demand in every product market sector. To attain equilibrium Walras needed an auctioneer, a "supreme price controller", to set the equilibrium prices through a tatonnement process, in no time and at no, or in recent theoretical developments, known costs. Agents (firms) in the markets were price takers. Schumpeter introduced the entrepreneur as a "disturber" of the Walrasian equilibrium, through technological and commercial innovations. Wicksell discussed a "cumulative process" in which expected rates of return differed from market loan rates and generated inflationary or diflationary processes.

In MOSES a tatonnement occursthat differs from that in the Walrasian model. Prices and demand adjust through an iterative bidding-negotiating-bargaining process to the supply offer of firms. The supply offers of firms are based on price expectations that are adjusted both during the period (one quarter), and from period to period in response to market development. At some point during each quarter the transformation of materials into products is occurring, and cannot be stopped while bargaining for sales and price goes on. The more of bargaining, the closer demand to supply, and the Walrasian equilibrium price. However, the closer the price structure to Walrasian market clearing, the stronger the indirect multimarket response, especially through the labor market, and in the longer term through investment, and the stronger the economy pushes away from the initial "equilibrium position". A new set of equilibrium prices has to be found (Eliasson 1985, Ch. VII).

Unrealized excess production results in an accumulation of inventories. Shortages stimulate an inflow of imports. The market in the MOSES economy, hence, is essentially a process of general monopolistic competition in which Schumpeterian innovative behavior creates temporary rents, that are competed away by innovative rate behavior in other firms. Together this fuels an ongoing dis-

equilibrium process in the capital market that moves growth and inflation through the investment process (Eliasson 1984).

Because of multimarket interaction there are no stable equilibrium prices. To understand the market dynamics of MOSES it is important to distinguish between the ongoing adjustment to a "given" set of price signals (or tatonnement in the original French meaning of the term) and multimarket price feedbacks from these quantity adjustments. In MOSES, both kinds of adjustments occur both within a given planning period (a quarter) and over time (from quarter to quarter). Tatonnement is, however, most typical across firms within the planning period, while multi-market feedbacks dominate over time.

How interindustry flows are coordinated during this self-regulatory process deserves some comment. The division of production in MOSES involves ten sectors, four of which are characterized by multifirm competition in product, labor and capital markets. The other six exogenous domestic sectors exist as an input-output tableau and provide what is demanded of them at prices which change over time, at rates given exogenously, according to rates of inflation determined in the four microbased sectors. The specification of activity coefficients is from national accounts data. (This is explained in great detail in Bergholm, 1982.)

The production behavior of firms and market price adjustment in the four multifirm sectors where endogenous market processes are involved will be described first. In addition, we will comment on multimarket feedback effects on price-production planning and adjustment. Following this is an example illustrating some macrodynamics derived from production planning of firms and market price adjustment in endogenous markets.

2. Product Pricing in MOSES

On the basis of past history firms form unique, quarterly expectations as to price, wage, and sales. They also set a profit margin target. There is a short-term production planning, price setting and employment sequence that runs through and between quarters.

With these expectations, last periods (quarter) price, and any disequilibrium between existing inventories and desired levels, a short-term production plan is formulated. Labor market transactions are then negotiated and may require a production plan revision due to the wage and availability of labor.

There is long-term investment spending that controls long-term capacity growth in individual firms.

The long-term plan centers around a profit dependent investment function. When capacity utilization is high, investment expands at a rate proportional to the difference between expected rates of return and the market loan rate. When capacity utilization is low, a larger fraction of the cash flow is deposited in the banking system.

The short-term planning sequence controls pricing and cyclical behavior around the capacity trend.

Given the production plans, quarterly expected sales and desired inventory adjustment, a quarterly target for sales is specified. This target, modified for exports and imports plays a key role in price adjustment, as will be seen below.

An export fraction of the optimal, planned sales is computed as an adjustment from last quarters fraction, on the basis of the difference between last quarters foreign and domestic price. The import share of product purchases is similarly computed.

Adjustment of total demand and supply to domestic demand and supply is made with these export and import fractions. The quarterly sales target is converted to a quarterly domestic sales target by subtracting the export share. Similarly, quarterly purchasing of products is converted to quarterly purchasing of domestic products by subtracting the import share. The product prices on the four endogenous market sectors are determined on the basis of domestic demand and supply.

From a bidding-negotiating-bargaining process, domestic demand, price and sales are determined. Production plans, or supply, remain fixed through this tatonnement market process, and adjustment occurs with price and household final demand. This is analogous to a market where firms produce on the basis of expectations (the production plan) and take the goods to the market. At the initial offer price, if sales targets are not achieved, or do not equate supply to demand, a tatonnement adjustment occurs with price and final demand. This adjustment continues a preset number of iterations at which the offer price is treated as the market price. If demand exceeds supply with inventories reduced to a minimum accepted level, then the discrepancy is made up with extra imports. If supply exceeds demand then the excess goes into inventory.

The adjustment of price and demand prior to transactions proceeds as follows. Firms make an initial price offer as an adjustment from last quarters price, where the adjustment is on the basis of the ratio of quarterly price expectations with last quarters price, which is an average of domestic and foreign price.

Aggregate household final demand depends on habitual consumption-savings behavior, constrained by available disposable income. The interindustry demand for domestic products necessary to meet this final demand for the current quarter is computed.

Price is adjusted in response to the difference between total domestic demand and the domestic sales target. An excess demand price adjustment is made, given a parameter of adjustment. Given the new price offer, a new household final demand is computed and total demand is derived. This iterative process continues a given number of times.

In the following period (quarter) there is a feedback effect from the market outcome. Both expected sales and expected prices are computed as a deviation from the market outcome, where the adjustment is a smoothed trend from past changes. Furthermore, the state of inventories relative to desired levels prompts an adjustment in next quarters production.

3. Multimarket Feedbacks on Prices and Volumes

Firms interact with one another by way of three markets. They compete in domestic product markets as described above and are pricetakers in foreign markets. They compete for labor in the labor market[1] and for funds in the capital markets. In financial transactions across borders, Sweden is a price (interest) taker (Eliasson 1985a, Chapter IV). The multimarket feedbacks significantly influence the stability of relative prices and production in the economy.

In addition, all three market processes are controlled by a technical constraint (exogenous) associated with new investment, the savings investment decision (endogenous) and by consumption spending of households and of the public sector. This is the macro-micro feedback that controls the self-regulating forces in the market.

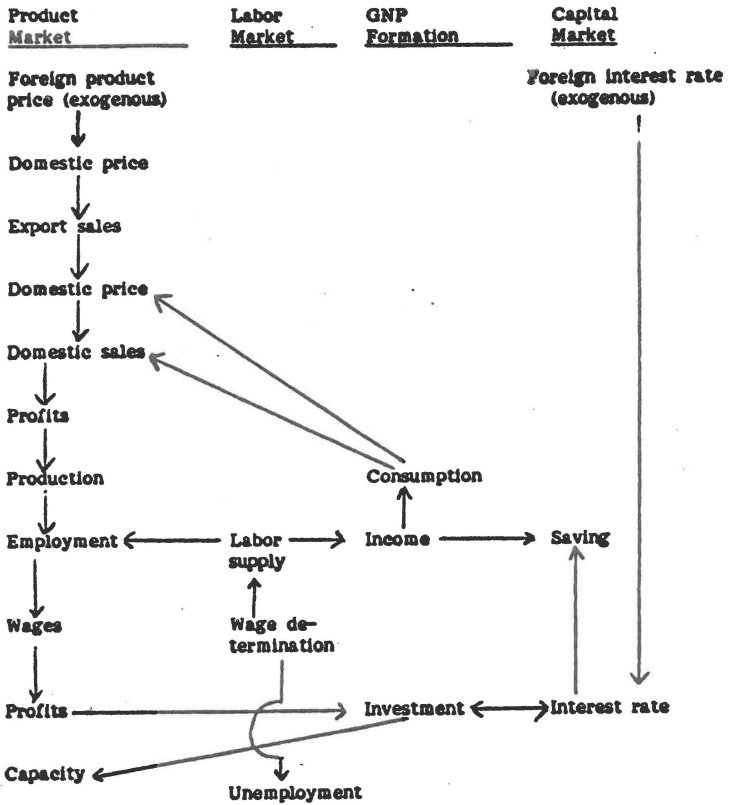
The three parallel market processes are illustrated in Figure 1. The capital market process to the right operates on long-term

[1] For a detailed presentation, see Eliasson 1985a, Chapter III, 1985c.

capacity growth. The short-term product and labor market pricing processes determine short-term swings in output around the long-term growth path of capacity.

The short-term labor allocation process can be made more or less rapid in moving the economy closer to clearing the labor market in terms of employing the pool of unemployed, and in bidding labor out of low-paying firms. We will observe in the experiments that this process - as it is speeded up - generates inflationary and possibly disruptive tendencies in the determination of output (Eliasson 1978, p. 105 ff.). One particular instance of this is wage overshooting, based on erroneous expectations by firms that generate a profit recession that in turn makes firms curtail both employment, output and investment until a balanced product and factor price structure has been restored.

Figure 1 Three parallel market processes



4. Some Macroeconomic Implications of Short-Run Price Adjustment in MOSES - simulation experiments

In MOSES as with other micro simulation models it is not possible to use conventional analytical techniques for comparative dynamic analysis. Aggregate dynamics cannot be expressed as a system of differential/difference equations. Rather it is the accumulated outcome of microunit interactions, guided by rules of markets and principles of behavior.

Comparative dynamics involves carefully designed simulation experiments

The impact of foreign price changes on domestic product markets, domestic prices and sales, provides an example for illustrating how markets function and feedback processes distribute effects through the economy. The reader should remember that all M-M experiments are characterized by identical assumptions as to technology. Technology is exogenously given and associated with new investment. It enters the individual firm through its competence to invest and its ability to finance the new investment.

Also observe that the assumptions as to foreign prices will be identical except in one experiment when zero change in foreign prices is imposed.

Three sets of experiments will be compared. One (called REF) where the change in foreign prices for the products in the four endogenous market sectors, starting in 1982, follow historical patterns through 1985 and are extrapolated into the future for 25 years. REF has a market regime specification which has generated a well behaved macro development over the last 10 years (Eliasson 1985c). The market regime is characterized by a set of parameters that regulate speeds of price and quantity adjustment at the micro level. The market regime is particularly important for multimarket responses. The second (REF(2)) case imposes zero change in these prices. The development of the simulated economy is driven by a changing willingness to pay, or demand a particular price for export products.

The third set (SEMI-FAST, FAST AND FAST(2)) illustrates the effects on product feedback processes, price and production volume of multimarket feedback processes. We speed up both the labor market wage setting and quantity adjustment compared to REF and the price elasticity of exports and imports (FAST (2)). We observe how a faster price adjustment makes the allocation of resources (investment and labor) more efficient. Long-term output expansion becomes faster as we move from the slow via the semi-fast to the fast market processes. We also observe, however, how wage responses, possibly wage overshooting, to faster output growth and higher rates of return eventually begins to destabilize the output expansion path down.[1]

The impact of increasing foreign prices is compared to the case with zero change in foreign prices. In this later case we find that the average change in product prices for the four endogenous market sectors is very small, only a slight upward drift during the twenty year simulation. Similarly, total industrial production and average industrial profit margins stay relatively stable, though a slight fluctuation occurs over the twenty years. The export share has a decreasing trend.

In the case where foreign prices are increasing, the quarterly domestic price starts at a greater level in each of the four markets. In the slow market experiment, domestic producer prices follow a cyclical pattern around foreign prices (Figure 3). Through the workings of the product markets the domestic prices, so to speak, take on the character of foreign prices, since domestic

[1] The current version of the model is based on a new and more richly varied initial database than in other simulation experiments. It has also been enriched with some new entry features. Hence, it seems to take longer for the model to exhibit destabilizing tendencies in price and industrial structures than was earlier the case (see Eliasson 1978, p. 105 ff. 1984). If time permits I may be able to illustrate this further with more experiments at the AEA meeting.

demand to compete must pay the opportunity cost of producers for abstaining from delivering to foreign markets.

The different price transmission profiles and output growth that we can observe in Figures 3 and 5, as we increase multimarket feedback speeds, are particularly interesting. Slow market feedback moves producer prices up to foreign prices after ca 15 years. Semi-fast and fast market feedback mean increasing overshooting. In both cases a significantly larger increase in manufacturing output is achieved. However, most of it is for domestic deliveries and at declining export rates (because of a growing positive domestic foreign price differential, see Figure 3) and a growing trade deficit, that should have had to be "attended to" by policy makers quite early during the simulation. When the market response is speeded up even further, in addition, price signals get disorderly and the growth path shows beginning signs of breaking down (Figure 5)[1]. Beginning instability in domestic prices can be observed already in first fast market feedback experiment (Figure 3). The declining trend in rates of return in manufacturing, here measured by profit margins, as we increase market adjustment speeds, illustrates this further (see Figure 4).

With the increase in average market price, total industrial production is stimulated, as well as industry profit margins and export shares. A spillover effect of this prosperity is an increasing wage rate and, hence, purchases by households. Even though the export share of total production is increasing total growth in production and disposable income of households allow an increasing domestic demand.

The results of this contrived example should not be surprising, in fact, it is only reassuring that product markets in MOSES pass on the influence of increasing export demand prices. The problem has to do with the size of the foreign price impulses[2] and the speed of

[1] As mentioned earlier, "collapselike" behavior takes longer to show in the new micro firm database.

[2] Or the size of the change in the exchange rate.

domestic multimarket feedback. A slow domestic price transmission through product and factor markets creates long-term differences between foreign and domestic price structures, with adverse allocation effects if they persist. A very fast transmission of foreign price impulses, on the other hand, produces price overshooting, especially factor price overshooting and inflation that destabilize production and investment planning, also with adverse allocation effects, but of a different kind.

One particularly interesting question related to these results concerns the effects of devaluations. During the late 60s and the 70s the Finns kept devaluing their currency to improve the market position for export industries and economic growth. Business rates of return to capital were improved by the devaluation. The costs of this policy was inflation. When multimarket feedback had eaten up the initially created rate of return benefit to export industries, growth slowed down and a new devaluation followed. Eventually the market - notably the labor market - learned the trick and speeded up its response in order not to be "cheated". The growth effects diminished, inflation continued and the price system got disruptive. In the 70s the way to control such negative multimarket responses had to be allowing the unemployment rate to increase.[1]

Sweden is currently entering a similar phase of adjustment of the 70s. The extreme, inflationary profit boom in basic industries in 1974/75 created extreme wage overshooting in 1975/76. Rates of return nosedived and the relative price system got jittery. As a consequence, manufacturing output stagnated for 10 years. During the last 8 years, beginning in 1975, several devaluations and one very large one in autumn 1982, have been carried out to restore balance on foreign account and economic growth. Since price stability has not been achieved unemployment has finally been al-

[1] See Economic Growth in a Nordic Perspective, IUI, ETLA etc., Stockholm, Helsinki, Bergen and Copenhagen, 1984 (Ch. I).

lowed to increase to get the supply and demand-mix balanced and wage drift in the labor market under control.

The examples provide a basis for investigating the potentially adverse effect of increasing import prices and competition in the foreign market. In particular, they demonstrate that speeds of adjustment in all integrated markets - or the market regime - matter for allocation and the ability of the economy to realize its long-term growth potential. This is a result that is intuitively adverse to those of static general equilibrium theory - a competing analytical system for thinking about micro-macro economics.

Figure 2

Average domestic producer prices
year 0 through 30
Index: 100 = year 0

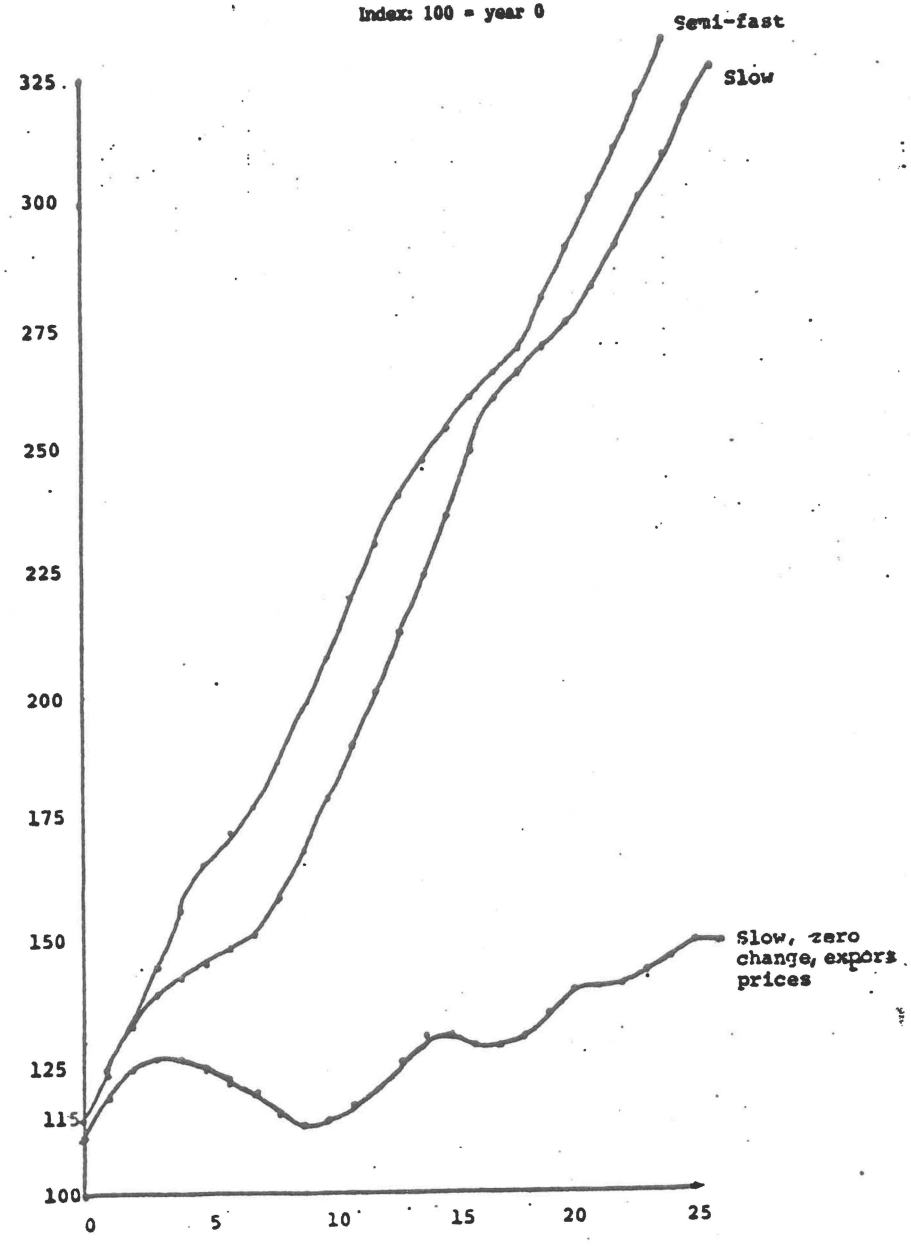


Figure 3 Foreign (PFOR) domestic price differential
Ratio between domestic producer price and PFOR
Index:100 = year 0

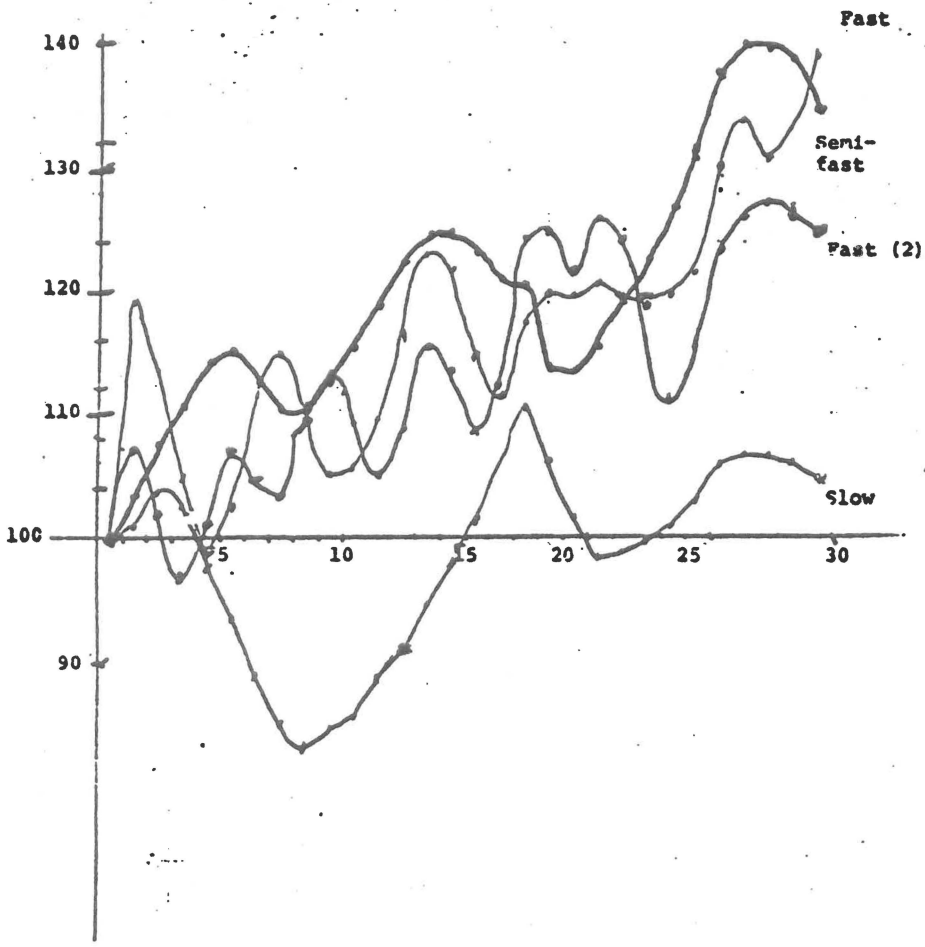


Figure 4 Profit margin in manufacturing

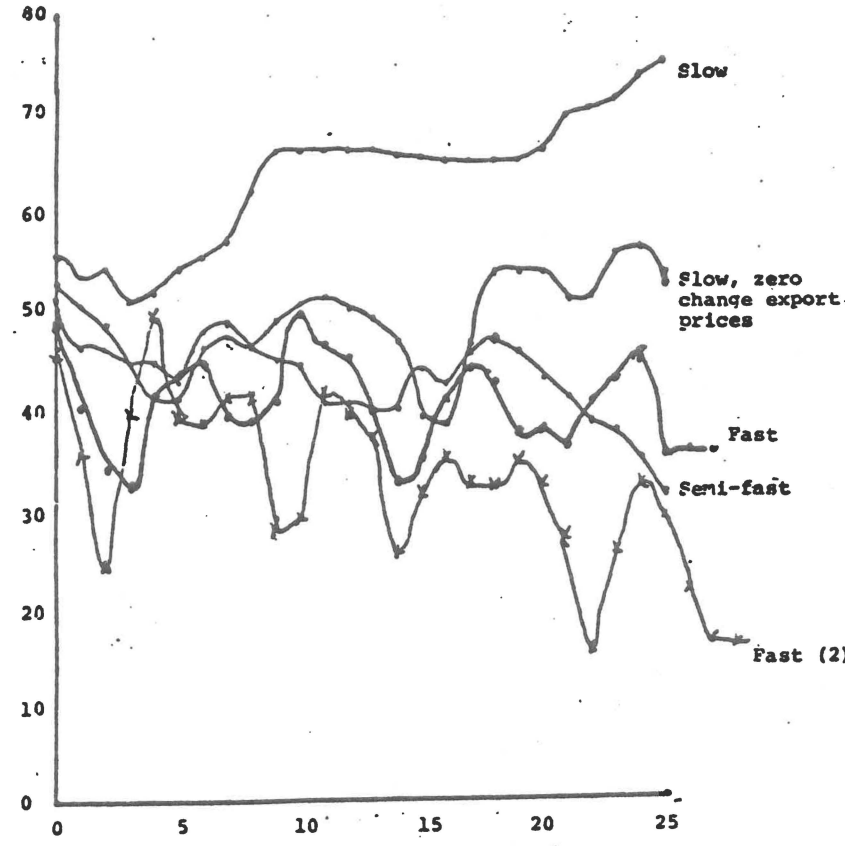
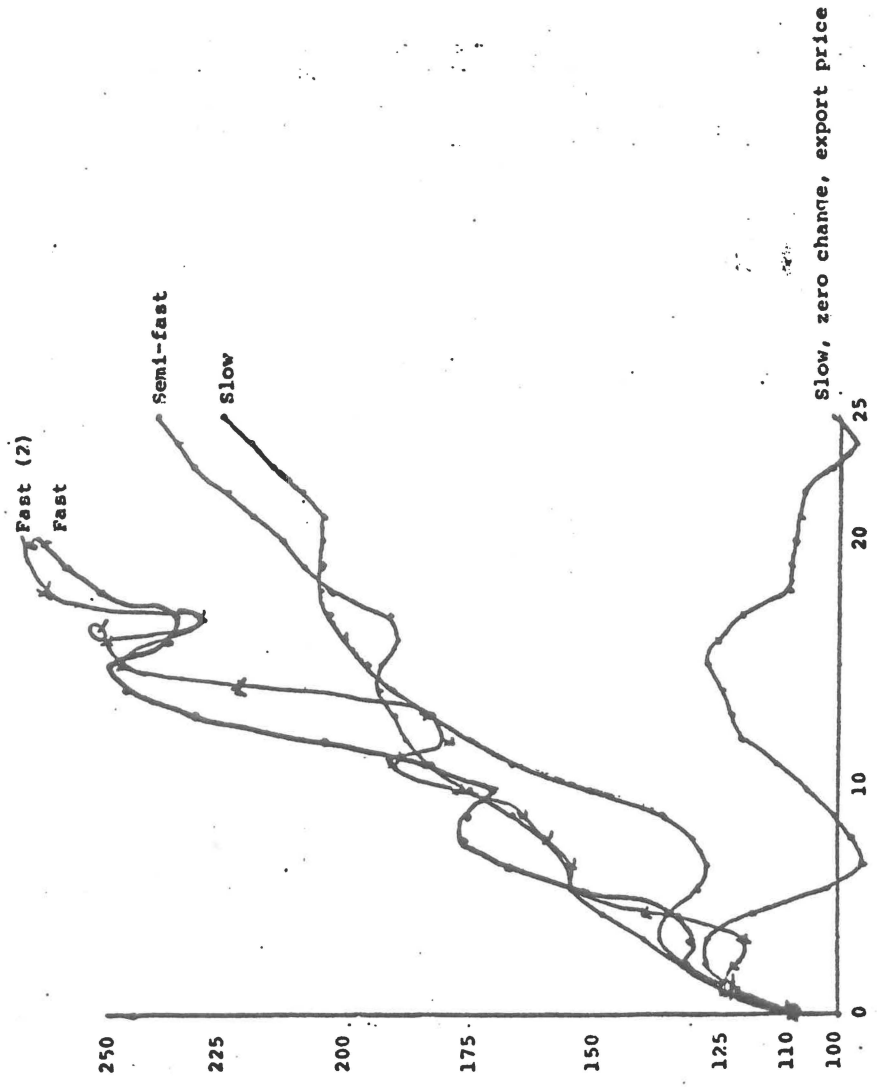


Figure 5 Manufacturing output

Index: 100 = year 0



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