RELATIVE PRICE CHANGE AND INDUSTRIAL STRUCTURE - THE "NORWEGIAN CASE"

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1. INTRODUCTION

Exogenously induced growth stimuli to an economy are not always 100 percent good things if considered within a sufficiently long time horizon. If these stimuli are too strong and/or too sudden, the economy gets overheated and price mechanisms become disorderly. The information content of price signals changes character when interpreted by old (decision) rules of thumb. Important decisions can go wrong at the production level and in the pricing of factors of production, but most importantly on the investment side. Investment takes a long time to be decided on, and takes a long time to affect the economy, and mistaken decisions take an equally long time to be corrected.

This paper was originally conceived as an illustration of what happens to information handling and decision making in the market mashinery of an advanced industrialized economy like Sweden when subjected to a double experience of the Norwegian type; the North Sea oil discovery in conjunction with a later, sudden and very strong, maintained price increase in that same sector.

The North Sea oil discovery -- a tremendous growth impulse -- has also aroused public concern in Norway about the indirect effects of relative price changes (and the consequent wage drift) on other sectors. We will simulate a particular and stronger version of the Norwegian experience on the micro-to-macro model of the Institute loaded with data from a Swedish like economy. The elaborate treatment of the supply side in the short and long runs for each firm that makes total economic growth fully endogenous within an upper technology constraint makes this model particularly useful for the analysis of this kind of problem.

The whole raw material sector of this model version of Sweden will be subjected to both a price and a "technological" shock experience of a kind similar in principle to what the Norwegian economy has been subjected to. This is the reason why we have given the paper the subtitle: The Norwegian Case, even though the numerical data as such do not pertain to the Norwegian economy. Even with this explanation, the title may still be considered somewhat misleading. While the disturbing influence on wage setting was at first expected to originate directly in the fast-expanding oil producing sector,[1] it is now more commonly seen as emanating from an excessively expanding public sector that feeds on the "tax" proceeds from the oil sector. The principal results are, however, the same whichever viewpoint one adopts.

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[1] See e.g. chapters 8 and 9 in Parliamentary Report No.25 (Petroleum Industry in Norwegian Industry), Ministry of Finance,1973-74 and also Norsk industriutveckling och framtid, Norges Industriförbund, debatt- og studieheften, 1975, nr 8.

2. THE MODEL

The model can be most simply presented as a set of individual firm models aggregated to the national accounts level through an explicit labor and product market process, where all prices are endogenously determined, the whole system being encased in a Leontief-Keynesian macro framework. The total model integrates (micro) market theory and income determination theory in an unelaborate but effective way. The theory of the firm upon which the firm model is based was previously developed in Eliasson [1976a], and a fairly complete description of the model is found in Eliasson [1976b].[1] The model is now loaded with numbers to make it represent a Swedish like economy.

It is capable of simulating post war inflation patterns and growth trends for a spectrum of macro variables quite well. The cycles are, however, not well reproduced, and as this is being written (July 1977) a large data base job and much calibration work lie ahead. This means that we will restrict our comments and tabular material to periods not shorter than 5 years and the results to be reported on should be viewed as a numerical analysis of the theoretical properties of a model economy similar to the Swedish economy.

The most important exogenous variables of the Swedish micro-to-macro model are a) the rate of change in labor productivity of new equipment, b) foreign prices (one index for each of four markets), and c) the nominal rate of interest. The rate of industrial growth is therefore endogenous through an endogenous investment function with each firm. Growth is bounded above by the extent of investment and by the new (exogenous) technology brought in by new investment.

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[1] A very compact presentation of the model can also be found in Eliasson [1977]. A report on the new, extended version, to be described below, was under preparation when this paper was read and has now been published in Eliasson (ed.) [1978a].

Investment depends heavily on business profits which in turn depend importantly on how correctly firms interpret current price, wage and profit signals and transform these into expectations. Profit targets of individual firms are set on the basis of past experience. If performance is improving, targets are gradually raised and conversely if performance is declining. Zero production is the lower bound of the activity level.

Total demand is completely endogenized. Wages, as determined in the labor market, feed back through a Friedman (Permanent income)-Stone type expenditure system. Household saving is treated as one expenditure category and durables are entered through a stock demand device.

Export supplies from the Swedish production system respond to relative foreign-domestic price differentials and similarly on the import demand side.

In fact, all business decisions at the firm level are in terms of reactions to expected relative price movements or differentials that are checked against internal profit targets in the firm. This, in combination with the explicit "tâtonnement" process in the labor and product markets, the feedback of total income into demand and the dependence of investment on profit rate gives the total model economy several uniquely dynamic properties. Some of them will be investigated in this paper.

Three properties of the total macro system should be mentioned. First, we met with initial difficulties in finding a parameter specification that generates a growth development similar to experience in Sweden over the post-war period. When fed with the post-war exogenous input trends in foreign prices and productivity growth in new investment vintages we have now managed to make the model reproduce the post-war, long run growth trend in a chosen set of key macro variables such as industrial production, wholesale prices and profit margins. A general property of the system is, however, that this successful growth performance is built upon a quite delicate balance of factors. It is easily disturbed and then results in a downward bend in growth rates. If the simulation is allowed to go on further, growth gradually tapers off.

Second, such long term bends occur even though the underlying exogenous upgrading of technology continues steadily on the same growth trend. We have in fact been able to generate very diverging long run 20-50 year growth trends on the same assumptions as to technical change (in MTEC in (6), (7) and (8) below), using different market performance and cyclical assumptions.

Third, no irregularities occur if exogenous inputs stay within the normal range of variation. However, if the model is subjected to shocks ("positive" or "negative") a strong macro response of expected type follows, but after some more years macro activity levels off inevitably and occasionally falls drastically. This reversal effect à la the Le Chatelier-Braun Principle of thermodynamic systems is everywhere present in the model. One could also say that the model responds with a typical business cycle to exogenously induced shocks. In cases when very strong reversal effects tend to develop, and where we have allowed the simulation to run long enough, activity levels eventually stabilize for a long time on a new, "normal" growth path below the one recorded in the reference run without the "shocks". This is so whether the original shock involved a positive or negative demand stimulus. We have come upon several instances in which a strong positive economic policy stimulant has worse long term effects than a more moderate "negative" policy measure. It all depends on the economic situation when measures are enacted and how they affect (disturb) the reliability of market price signals and the market allocation mechanisms. This is an interesting "asymmetric" property of the model. To my knowledge there is no systematic evidence available to shed light on the question of whether this is an empirically relevant property or not, except ad hoc observations about historical economic shock experiences, of which the present so called "oil crisis" is one.[1]

[1] Cf my paper "How does inflation affect growth?" in Eliasson (ed.) [1978a].

To understand the experiments to be reported on in this paper some features of the firm model have to be explained in some detail: These are a) the concept of international competitiveness used, b) the export and import functions, c) the expectations-profit targeting system and d) the production system.

a) International competitiveness

Competitiveness in the business world is invariably linked semantically to profits. To most people, however, international competitiveness of an economy as a concept would have a welfare implication in terms of the real income growth capabilities of the economy compared to other economies. If the degree of international competitiveness is defined from the welfare side as the capability of an economy to maintain a growth rate above some other country or group of countries the two concepts can be strongly linked together.[1] Ex post competitiveness is measured as an above-normal rate of growth for the country as a whole, and this is often the way the "phenomenon" as such is first observed. The next, natural step is to identify the determinants of this particular growth performance. The key indicators of supreme competitiveness normally listed are costs relative to the rest of the world, technical change, productivity change, etc. All come together by definition as elements in a relative profitability measure, and conventional opinion seems to be that there is a strong and monotonic relationship between profitability and economic growth. This essay will demonstrate that this is not necessarily and evidently true, except in a trivial ex post accounting sense.

b) Export and import determinants

In the model competition from abroad enters through the exogenous world market price level of each sector. Firms in the model (read: country of inquiry) face this price spectrum in domestic and export markets and are successful if they have a product mix

[1] As suggested in Eliasson [1972] pp. 129-133.

and a production structure that gives them a sufficient productivity performance (at the going wage etc., cost levels) to meet set profitability standards. In terms of the above argument the country is successful, or competitive, if these standards are such that a relatively high, sustained economic growth rate can be maintained.

Pratten [1976] has empirically illustrated the non-triviality of this statement. He finds that the Swedish economy has grown faster than the U.K. economy for a long time and that Swedish firms have exhibited substantially higher productivity measures than "matched" U.K. firms. Nevertheless, U.K. exhibits higher rates of return to capital.

Total market behavior in the entire model economy determines all domestic prices, including wages that go into the income and cost accounts of individual firms. Costs are, however, influenced by current productivity which is in turn (for each firm) partly influenced by the exogenously given rate of change in labor productivity (at normal capacity utilization levels) of new vintages of investment. Given this and its rate of return requirements (see below), each firm can calculate an output level that is compatible with profit targets at expected wages. All supply decisions together determine all prices and aggregate income (that enters as an argument of total private demand) and profits (that determine investment and capacity growth, see below), and so we have formed a dynamic link between all of the relevant determinants of profitability and economic growth. By doing so we can analyze the traditional indicators of international competitiveness and see to what extent there is the implied correspondence between their relative movements over time and the welfare indicators, like economic growth, that we are ultimately interested in. We are able, for instance, (in the Swedish micro-to-macro model) to study the somewhat surprising implications of a sudden price or technological upheaval in a large sector of an economy on the degree of competitiveness of individual firms as well as the material welfare of the entire economy. The link comes by way of the direct and indirect effects on all sectors of the economy of a windfall increase in the level of technology and the purchasing power of one sector, that allows the whole economy to draw on resources in foreign markets (at least for a while) on the basis of a temporary "land rent" or a transitory monopoly position.

Export functions (X) relate to each individual firm. Import functions (IMP) relate to markets. They are all expressed as ratios of total sales (exports) or total supplies (imports). Relative foreign-domestic price differentials the quarter before are the sole determinants of changes in these ratios.

$$\Delta X = f_1\left\{\frac{P(FOR) - P(DOM)}{P(FOR)}\right\}, \ f_1' > 0, \ f_1'' < 0 \quad f_1(0) > 0 \qquad (1)$$

$$\Delta IMP = f_2\left\{\frac{P(DOM) - P(FOR)}{P(FOR)}\right\}, \ f_2' > 0, \ f_2'' < 0 \quad f_2(0) > 0 \qquad (2)$$

FOR indicates foreign (exogenous)
DOM indicates domestic (endogenous in system)

The rationale for this simple formulation with no foreign demand factors is that the true decision variable relating to the question of where to sell must be relative profitability. For Swedish-based firms there is no reason to expect product costs to differ significantly between domestic sales and export sales when measured at the border passage. Hence product prices alone enter the decisions. With a long time series of short period (months or quarters) of price, X and IMP data it should be possible to estimate export and import price elasticities in a proper way. When observations refer to longer periods (say years) some of the volume responses to the price changes take place within the measurement period, making it difficult to quantify the importance of relative price changes properly. One obtains a better fit by including foreign demand variables like GNP or industrial production, although price and demand variables are not really compatible in the same formulation.

There is a strong self-regulatory feedback on the entire model economy from the export and import functions that also tends to keep the foreign accounts in balance in the longer term. The larger the gap between foreign and domestic prices the larger the share of domestic output that leaves the country, reducing (to begin with) domestic supplies and forcing up domestic prices to check the outflow. There is a mirror, supporting mechanism on the import side, and the whole process of course works in the other direction if we change the sign of the price gap.

c) Expectations and profit targeting

While foreign trade functions determine how world markets impact the outer surface of the economic system under study, expectations and profit targeting determine how the system responds internally. There is no use introducing formal specifications to explain in this brief context, since it would only detract attention from systems behavior as a whole, which is what matters. For a detailed understanding the reader is referred to Eliasson [1978a] chapter 4.

We will indicate only the main principles involved. Expectations functions of the feedback, error correction type refer to prices, wages and sales. Expectations determine ex ante calculations of profitability that guide the search for a production plan within the production system to be described below.

The profit targeting device is the criterion that indicates when a satisfactory plan has been obtained. Our formulation of the targeting device includes the conventional profit-maximizing device as a special case and hence is a more general criterion. It also has a better empirical foundation (see Eliasson [1976a]). Firms determine (on the basis of their own profit history)[1] what constitutes a feasible profit performance to use as a target. The target variable is the profit margin (frequently used within firms), and this corresponds to a long-run real rate of return

[1] and also by external information, say, by looking at the best performer in the market.

requirement (Eliasson [1978a] pp.58-69). It is complemented by various checks that prevent the firm from implementing this long term requirement too drastically in the short term. Targets can always be set higher and higher under the constraint that expected profits do not decrease, to approximate profit maximization. Since the nominal rate of return-interest rate differential determines the rate of borrowing and since total cash flows move investment spending as long as capacity is insufficient, it is easy to see how disorderly price signals in markets disturb firms' information system through their expectations functions. Erroneous decisions lead to a worsened profit performance to the detriment of growth.

d) The production system

The production system is essential for the supply properties of the entire model. Each period, each firm has its own transitory production frontier that determines the relationship between effective labor input and output. How these functions are estimated is described in Albrecht's paper in this conference volume. The production function is bounded above and marginal labor productivity is monotonically decreasing. It has the following mathematical form (somewhat simplified):[1]

$$Q = QTOP \cdot (1-e^{-\gamma L}) \qquad (3)$$

QTOP is the horizontal asymptote towards which Q moves for unlimited increases in labor input (L). γ determines the bending of the curve (see below). Zero labor input means zero output.

The firm is currently operating on this production frontier or (mostly[2]) somewhere underneath it. If the current operating position does not satisfy profit margin targets at expected prices

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[1] See further Eliasson [1978a] pp. 63-68.

[2] These are our results from the planning surveys of the Federation of Swedish Industries that supply the data needed to estimate the frontier and to position the firm underneath it. See further Albrecht's paper in this volume.

and wages the firm edges itself towards an improved (more productive) position closer to the frontier to the extent this is possible and as long as it does not diminish expected profits.[1]

The production frontier $Q = f(L)$ is a soft surface in the sense that if the profit situation deteriorates enough, firms are capable of "doing better than normal" by a slack activating device (see Eliasson [1978a] pp. 13 and 71).

The reader should note that neither a capital stock nor a flow of capital services enter the momentary production frontier above. This production factor enters through the coefficients of the (Q,L) relationship, and these are supplied at startup time for a model simulation from individual firm data (available from 1975 from the planning survey of the Federation of Swedish Industries) and are updated by investment each period.

This updating takes place in the following manner.
Each period the (Q,L) frontier pivots down around the origin because of a lowering of QTOP due to economic wear and tear of equipment.

$$QTOP(t) = QTOP(t-1)*(1-\rho). \tag{4}$$

The rate of depreciation (ρ) is exogenous.

Second, new investment both pivots (Q,L) in the opposite direction and bends it, due to improved technical qualities of equipment, through the following four equations:

$$\Delta QTOP = \frac{INVESTMENT}{P(DUR)} *INVEFF \tag{5}$$

$$TEC(t) = \frac{QTOP(t-1) + \Delta QTOP(t-1)}{\frac{QTOP(t-1)}{TEC(t-1)} + \frac{\Delta QTOP(t-1)}{MTEC(t-1)}} \tag{6}$$

$$\Upsilon(in(3)) = \frac{TEC}{QTOP} \tag{7}$$

$$\frac{\Delta MTEC}{MTEC} = \text{Exogenous} \tag{8}$$

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[1] This search is quite complex. It is described in full detail for an earlier version of the model in Eliasson [1978a] and (will be) in full detail for this and a more sophisticated version of the total model system in a report currently being prepared.

INVESTMENT is expressed in current prices and allocated to the period when investment becomes operational. To handle this we currently use a third-order exponential delay function. P(DUR) is the appropriate deflator, endogenously determined in the model. INVEFF is a coefficient that determines the potential output (QTOP) yield from a unit of investment. It can be said to represent the marginal capacity-capital ratio. As such it should incorporate some exogenous information as to the qualitative upgrading of investment goods from a capital (not labor) augmenting point of view. For the time being we have not finally decided how to handle the amorphous concept of capital productivity in the model and have settled for a provisional and empirically reasonable approximation. In each quarter we approximate the new marginal output-capital ratio (= INVEFF) with the average ratio of value added in current prices to production equipment measured properly on a current replacement cost basis in the balance sheet. At each point in time this can be thought of as a conventional "technical coefficient". Both the numerator and the denominator are, however, updated in the model as to <u>volume</u> as well as <u>valuation</u> (price) by the events affecting the <u>firm</u> in the model. <u>This</u> means that a different development of product (i.e., the firm's) and investment goods prices affects INVEFF. It is not clear whether this is a desirable property or not. It is partly a technical price index problem.[1] The valuation principle choosen also mimics the way firms think about it in their internal accounting routines. This is important in this model context where measurements stretch all the way down to the production units. The major problem is, however, the approximation of the marginal ratio, with an estimate of the corresponding average ratio. In the future, however, the whole string of problems associated with this provisional approximation should go away, since we plan to estimate INVEFF directly using outside information.[2]

The harmonic average (6) above tells how the average technological position of the firm (TEC) is updated through a new vintage of investment.

The production function hence is of a putty-clay type with no explicit, aggregate capital stock measure. In diagrammatical terms we could say that a new (Q,L) relationship (3) of superior technical quality (MTEC > TEC and correspondingly a new γ) is superimposed on the old relationship, merged and stirred well to produce a new updated (Q,L) relationship. This means that

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[1] An analogous problem is faced when using time series of production volume and capital stock volume data to estimate capital output ratios. If the base year of the two deflators is changed the volume ratios are also changed.

[2] The 1977 Planning Survey of the Federation of Swedish Industry collects an estimate from firms on INVEFF for 1977.

we do not keep each vintage of investment separate in the model.[1]

We have modelled the production system as it normally appears in firm planning and costing systems from which our measurements come, so this is the way we want to have it. The most frequent method in numerical planning in business firms is to bypass the problem of entering an explicit capital stock measurement by working with exogenously updated coefficients taken from the cost accounts (Eliasson [1976a] pp.296-300). The reason is of course the doubtful operational content of capital measures. Those who so desire can envision a shadow production function with aggregate capital stock (K) explicit. In this (Q,L,K) relationship the marginal product of labor approaches zero, and output is everywhere bounded above for unlimited labor inputs, which is a desirable property. In the explicit model of the firm, and as well in total industry, capital equipment enforces an indirect uppertime bound on output because investment goods are endogenously produced by the system.[2] This brings the upper bound back altogether upon labor input in the production process and the efficiency with which all resources are allocated by markets in the entire model economy. Zero labor input means zero output.[3]

To derive the shadow production function from equation (3) to (8) above we obtain a pair of partial differential equations that we have not been able to solve. Their properties can, however, be illustrated through numerical experimentation on the model. We have noted as a curiosity that whenever the model generates a smooth, horizontal trend in the profit share in output, Cobb-Douglas production functions always fit the synthetic time series data well. Not so if there is a sufficiently strong non-horizontal trend and/or if there are large deviations from a horizontal trend.

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[1] The reason is of course the rapidly declining returns to cumbersome specification. Se further Albrecht's paper in this conference volume. When this paper is being finally edited (June 1978) we are working on a more sophisticated specification that will make it possible to approximate the vintage structure under steady state growth assumptions and also to make economic depreciations endogenous, much along the lines suggested by Bentzel in his paper in this conference volume.

[2] Also cf. Färe's paper in this conference volume.

[3] In this sense we have taken out the property of (for instance) the CES function that makes it possible to compensate one factor for the other when the elasticity of substitution is larger than 1 to the extent that output is then not bounded when labor is increased indefinitely, ceteris paribus. See e.g. Ferguson [1975] p. 103.

3. PROBLEM SPECIFICATION

To study the consequences of relative price changes on industrial structure we have performed the following experiments on the micro-to-macro model. We have subjected the raw material sector (14 percent of value added in total manufacturing 1975) to a sudden 40 percent exogenous (foreign) price increase. The relative foreign price change so obtained is maintained through a 20 year simulation, and constitutes the only difference in specification from the reference case.

This is a rather dramatic experience (albeith of a "positive" nature) for such a large sector.

We have repeated the same experiment in a softer mode, namely a 10 percent price change.

These examples have been chosen to illustrate the effect of subjecting an important export sector to a sudden price-induced increase in foreign demand like the oil price hike for oil producing sectors of an economy. We have also wanted to reproduce the case of a sudden discovery of oil. This is technically engineered by a sudden increase in potential output in the raw material sector, also this time by 10 percent. In all three cases the induced change happens in the second year. This is what happens to the model economy.

4. RESULTS FROM EXPERIMENTS - LONG RUN DEVELOPMENT OF MACRO ACTIVITY LEVELS (DESCRIPTION)

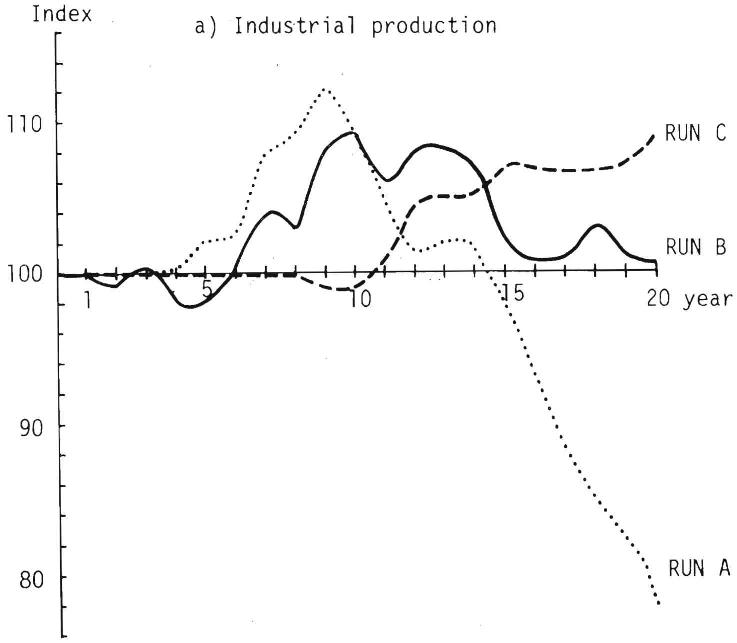
Diagram 1 traces the macro activity effects on industrial output and employment.

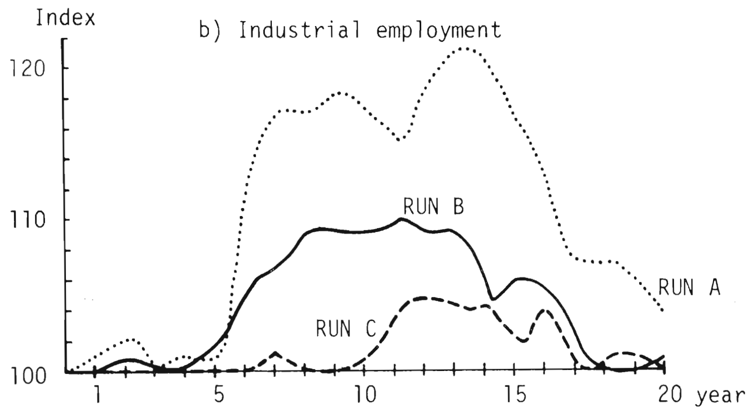
The first, 40 percent case is an induced change of the drastic kind. It spins off a positive (production and employment) effect of the expected kind in the beginning. However, after 10 years the multiplier-accelerator mechanisms at work from micro-to-macro and back again start to reverse themselves and production levels come down dramatically. For the first five years a small overall expansion effect in output and investment (not shown) is recorded. Over the 20 year period it is negative. Only the raw material sector has benefitted. The tendency towards relative decline is still there at the end of the simulation. Previous experience (from runs longer than 20 years) of the properties of the entire system tells us that production levels will not stabilize and start to grow again until employment has been trimmed down enough to restore profit margins and investment incentives. This will take more time since the employment effect is still positive after 20 years, and profit margins are on their way down, indicating a dramatic drop in productivity.

The 10 percent exogenous increase in raw material export prices gives a similar long term time profile, however, without the long term negative effects. The initial total production effect is negative (in sectors other than raw materials. See next section). The ensuing growth impulse, even though somewhat later, is equally strong and more enduring. It is still positive at the 20 year horizon and (NB!) the initial employment effect is just about nullified by then, suggesting a long run positive productivity effect.

However, when we substitute a 10 percent exogenous increase in potential output in the raw material sector for the exogenous price effect, the long term macro development changes. Essentially the two 10 percent changes mean the same to firms in the

Diagram 1





Note: The index measures the respective levels in the experiment in percent of the corresponding levels in a reference case.

For identification of RUN A, B and C, see Table 1.

Table 1 A-E. Effects on subindustry growth patterns from a very strong and a moderately strong (+40 and +10 percent) relative price change in the raw material sector and an exogenous productivity improvement (+10 percent) in the same sector

Identification: RUN A; foreign price up 40% 2nd year in RAW and maintained 20 years.

RUN B; ditto 10%

RUN C; Potential output up 10% 2nd year in RAW and difference maintained 20 years

Note 1: All comparisons are made vis-a-vis a reference case without the indicated, ceteris paribus, A, B and C changes, respectively.

Note 2: All tables except E give effects in percentage points per annum.

	20 years			First 5 years		
	A	B	C	A	B	C
A. Industrial production, percent per annum. Differences						
RAW (1)	4.8	5.8	-0.3(!)	6.4	0.8	2.9(!)
IMED (2)	-0.2	0.9	-0.4	0.8	-0.7	-0.5
DUR (3)	-3.1	-0.1	0.7	-0.5	-1.7	-1.3
CONS (4)	-0.5	0.2	0.3	0.3	-0.5	-0.3
TOT	-1.3	0	0.4	0.5	-1.2	-0.7
B. Labor productivity						
(1)	0.3	-0.7(!)	0.2(!)	1.1	-1.8	0
(2)	1.5	0.4	0	0.3	-0.4	0
(3)	-3.3	0.1	0.5	0.4	0	0
(4)	1.4	0	-0.1	0.4	0.1	0
TOT	-1.3	0.1	0.3	0.5	-0.4	0

Cont.

Table 1, cont.

	20 years			First 5 years		
	A	B	C	A	B	C
C. Wholesale (domestic) prices						
(1)	1.7	1.5	1.0	4.1	3.5	1.5
(2)	-0.5	-0.2	-0.1	-0.3	0.7	0.8
(3)	0.1	0	0.1	-0.1	-0.3	-0.2
(4)	0.1	0.3	0.3	0	-0.2	-0.3
TOT	0.4	0.2	0.2	0.9	0.1	0
D. Wages in industry						
(1)	2.0	1.3	0.5	2.4	-0.2	0.1
(2)	1.1	0.7	0.8	1.0	-0.1	0.1
(3)	1.8	1.5	1.4	0.7	-0.7	0.1
(4)	1.9	3.4	3.5	0.6	0	0.2
TOT	1.7	1.7	1.6	1.0	-0.5	0
E. Profit margins, index 100 = reference case						
(1)	118	96(!)	100	153	112(!)	100
(2)	87	96	100	99	100	100
(3)	45	101	98	89	102	100
(4)	94	100	99	99	101	100
TOT	76	99	99	107	103	100

Sector 1 (RAW) = Raw material production sector
2 (IMED) = Intermediate goods production sector
3 (DUR) = Durable consumption and investment goods sector
4 (CON) = Other goods production sector (for final consumption)

raw material sector in terms of potential profits. A conventional profit maximizing firm with full knowledge of what happened would have responded identically to the two changes. Not so here. The price change operates through external information gathering and on the interpretation sensors of the firm through expectations. Especially the 40 percent price change, but also the 10 percent change, throws previous interpretive mechanisms out of balance for a while and creates expectational mistakes. The increase in potential output is an internal, albeit exogenous, change. It creates a productivity reserve that is not made use of until needed to meet profit targets. That need does not arise for a while (in the simulation). Neither does this change disturb the market information system of the firms. I would argue that this "asymmetric" response pattern of firms is a highly realistic feature of business life.[1]

Hence under the technology shift short term growth performance takes time to improve but speeds up and is still on its way up at the 20 year horizon. The employment effect is only temporarily positive, suggesting again that firms eventually make use of the productivity potential given them from above.

On the macro surface of it it seems as if a too strong relative price change (+40 price case) produces such long term disturbances to the economy as to be undesirable, even though the short term impacts in the affected sectors are positive.

Two post war experiences of the Swedish economy should be recalled here. First, the overall exogenous price shock on Swedish industry in 1973 was between 30 and 40 percent. Two devaluations and an enormous infusion of subsidies were needed in 1977 to prevent a drastic sequence of closedowns in large parts of the manufacturing sector, and as this is being finally edited we do not know to what extent these measures will

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[1] See Eliasson [1976a].

result in a new round of second generation inflation problems. The above price hike experiments on the model have been designed without these countermeasures to dampen structural change, but our contention is that the model simulation describes quite well in principle what has happened. The other experience was the Korean boom in 1951 with a more than 50 percent average price increase, most of it affecting forest industries. Since the price hike was more isolated and (unlike in 1973 to 1977) was strongly reversed in 1952 and 1953 disturbances did not get an opportunity to accumulate in momentum and the negative, secondary effects were much smaller.

The "softer" price stimulus (+10 percent) definitely is to be preferred to the stronger alternative, but also this alternative seems to come second to a stimulus that does not bring disturbances into the market information, interpretation system of firms, but rather lets new potentials dawn upon decision makers when the "need" for them arises.

5. RESULTS - ALLOCATION EFFECTS

As expected the allocation effects are extremely strong in the case with a 40 percent step price increase in the raw material sector. The raw material sector sets off on a happy boom and we see no end to it on the 20 years horizon. The sector that suffers, and especially so when the downward twist sets in, is investment goods industries.

These structural changes are indirectly and endogenously induced. And the prime factor at work is the labor market wage arbitrage function. In order not to loose too many people to the strongly expanding and profitable firms in the raw material sector, other firms, not as lucky, have to increase their wages. Some firms cannot follow suit, especially when (investment) demand starts to taper off. They contract operations and/or reduce investment spending. A very strong flow of labor resources (net) from all other sectors to the raw material sector occurs. While the raw material sector employed 14 percent of industrial (all four sectors) employment at the beginning of the simulation it employed 27 percent at the end, after 20 years. Indeed so strong and so fast has been the reallocation of labor that the ensuing wage drift has brought disturbances into the labor market, causing misinterpretation of price signals that has driven down profit margins in the three non-raw material sectors much below what would have been the case with a slower change.

It is of interest to note from table D how efficiently the labor market transmits the original price-wage effect in the raw material sector to other sectors. There is some spread in wage changes between sectors for the first five years, with relatively higher increases in the durable goods and consumption goods sectors, induced to grow by investment demand from all firms and consumer demand from households (the expansion phase of the multiplier-accelerator). Over the 20 year period, however, wage change is practically equal in all sectors.

Not so price change and productivity change (NB negative in the long run!) producing a tremendous dispersion in profit performance between sectors and firms. The direction of the effects are as expected. There is, however and unfortunately, no evidence around to assess the relevance of the magnitudes of the effects simulated.

The general character of the results are preserved for the softer 10 percent exogenous price change. As before, the change is large enough to distort the market price signalling system. The magnitude of the effects are much smaller. There are, however, some significant differences.

First and foremost, there is no long run "catastrophic" effect in the investment goods industries when the multiplier accelerator mechanisms go into reverse. By and large, however, the raw material sector increases its size measured in output substantially relative to the other three sectors.

The same pattern holds for labor productivity with the difference that the raw material sector takes out part of its exogenous price windfall in the form of a slackening of productivity performance.[1]

Another interesting structural response is that the derived demand for labor from the expanding raw material sector is no longer strong enough to even out wage change as efficiently as in the +40 case. This is, of course, part of the reason for an equally soft profit margin effect. In fact, even though the short term effect is strongly positive, the long term profit effect is negative in the raw material sector -- due to over-

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1 Also a highly realistic response (see Eliasson [1976a]). Also cf Carlsson [1972] who reports that productivity performance (in a technical sense) had been increasing fastest in sectors having a hard time while e.g. pulp & paper industries that at the time (1967) at least were thriving on an abundant raw material base by no means displayed a superior productivity ranking.

optimism and overexpansion.[1]

The 10 percent increase in the productivity potential in the raw material sector finally has a much softer structural as well as macro impact.

The initial (first 5 year) expansion draws resources away from other sectors. In the long (20 year) run, however, there is no real relative change in sizes between the four sectors. Neither is relative profit performance more than marginally affected.

One interesting feature is worth noticing, however. In the two first, price induced simulations, the foreign price change was "duly" transmitted through the economy and ended up in full in the consumer price index.

In the case with an exogenous increase in productivity the initial expansion in the raw material sector means that more people are needed and to get them raw material firms can pay roughly as much more as in the case with a 10 percent price hike without lowering their profit margins. This wage drift is transmitted through the entire economy to other sectors (costpush, perhaps) and to households (demand pull). The final outcome is a long run increase in the wholesale price level, although not as large as in the other two runs. If long run, stable growth is desired, of a kind that does not build up disequilibria that force a reversal after some time and (NB!) that is not associated with excessive inflation -- then the potential output hike is to be preferred to the price hike. Isn't this what Sweden benefitted from during the late 50ies and most of the 60ies between the Korean boom and the oil crisis? A price hike case somewhere in between the two price experiments would probably quite well illustrate the situation we are currently suffering from and what Sweden went through in the early 50ies.

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[1] The 40 percent price hike in case A is so strong as to preserve a positive long term profit margin effect despite substantial overinvestment.

One concluding word about how exactly these results relate to the concept of international competitive advantage discussed earlier is now in place. Our experiments treat both the price hikes and the productivity shift as an initial improvement in the competitive position of our model economy. The price hike corresponds to an improved market position vis-a-vis the rest of the world, the productivity increase to the discovery of a new, non-imitable production technique or raw material resource -- both without effort (investment) on the part of the model economy. The experiments show that if doused too suddenly by too generous benefits from above, firm decision makers get confused, make inefficient decisions and the whole economy may eventually suffer. One may argue that a global price hike in one particular product should have a detrimental impact on that sector if it does not exhibit a comparative advantage in that particular kind of production. More efficient producers would respond by expanding production even more and check the price increase or even drive it back. The less competitive producers would find themselves with an inflated cost structure because of the initial price hike and an even worse competitive position. The experimental design rules out this possibility[1] by assumption. The point was to demonstrate that an initial improvement in the competitive position of a sector may carry reverse long term implications -- a possibility assumed away in most economic model building -- but not in reality.

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[1] It would have to be engineered exogenous through the foreign price assumption.

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