Allocation and Growth Effects of Corporate Income Taxes

– Some Experiments in Quantification on a Micro-to-Macro Model of the Swedish Economy[1]

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1. INTRODUCTION

Taxes can be used directly to affect the composition and volume of demand and supply since they place a wedge between supply and demand prices. This is widely recognized in professional literature.

By affecting supply and demand, prices are also indirectly affected through market feed backs across markets and over time. This has hardly been recognized in proportion to its potential importance in a dynamic market allocation process. To some extent this may depend on the prevalent use of comparative static models in the analysis of allocation effects. A satisfactory analysis of dynamic efficiency requires a disequilibrium specification of the market processes, and an explicit representation of decision-makers' response to changing price signals. Four aspects in particular have to be recognized: (1) How do agents interpret current prices (expectations)? (2) How fast

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[1] This paper is a first step in a more ambitious project, started at the IUI some time ago, entitled: Profitability, Taxation and Growth.

and with (3) how large steps do decision-makers respond to these expectations? (4) How are different markets interlinked?

Misallocation effects may be multiplied by tax wedges when exogenous shocks put the pricing mechanisms substantially out of equilibrium. In a dynamic theoretical setting one may talk about disequilibrium and instability as related concepts. Dynamic allocative efficiency will be interpreted here as "getting on to and staying sufficiently close to the highest possible steady growth path". This is partly discussed in Ysander (III:6), and will be elaborated further in this paper.

The theme of the paper is: How is the structural adjustment process affected by corporate income taxes? To answer this question we have to design a set of relevant market scenarios as well as a set of different tax regimes.

The paper begins with a discussion of the rate of return requirement in the investment allocation process. Do tax benefits drive the required return down with less or more long run growth as a consequence? Section 3 briefly introduces the micro-macro simulation model --the analytical tool. Emphasis is on those parts of the model that are important in this context. As in all empirical research, design of measurements or experiments are crucial --a problem dealt with in section 4.

Lack of space and time made it necessary to limit the market change scenarios to permanent changes in relative prices of varying speed. These were the ones believed to be relevant for the post 1973/74 oil crisis period.[1] Several fiscal depreciation regimes are superimposed on these market scenarios. Hence both taxes and the competitive situation are varied. We will therefore also be able to analyze the consequences of market change during a given tax regime.

Problems related to erratic market prices and unstable supply structures as a consequence of large and fast changes in market conditions are discussed in section 5. The paper finally concludes by returning to the rate of return - rate of growth relationship and how tax wedges affect it. Such a matter cannot be investigated empirically without access to micro firm information. This is where the micro-to-macro model clearly shows a comparative advantage.

The micro to macro model of the Swedish economy[2] developed at the IUI provides a convenient, numerically specified "theory" to analyze dynamic allocation problems in a business taxation context. All

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[1] Recent IUI research indicates that very large and permanent relative price changes between sectors are rare if you allow for a sufficiently long time period. Hence it would be interesting to complement the results reported here with a series of large but transient relative price changes, that return to original positions after a period of varying length.

[2] Eliasson, G., with Olavi, G. and Heiman, M. (1976b) "A Micro-to-Macro Interactive Simulation Model of the Swedish Economy - Preliminary Documentation." Economic Research Report B15, Federation of Swedish Industries. Stockholm, and Eliasson, G., ed. (1978), A Micro-to-Macro Model of the Swedish Economy, IUI Conference Reports, 1978:1. (IUI) Stockholm 1978.

four aspects of stability mentioned above are explicitly covered in the model. As the model stands now it has not been fully calibrated and several tests and estimations remain before one can talk of the simulations as quantified results on the Swedish economy. The important thing is, however, that it forces the investigators to think in dynamic terms when analyzing the allocation problems associated with the corporate income tax system.

As theoretical results from a market based economic system like the Swedish economy they should, however, be considered quite realistic. In this particular model version and experimental setting there is one misspecification that has to be kept in mind. The individual firm dividend decision is not yet fully integrated with the investment decision, an erroneous feature that it shares with much theory on the matter. We will take great care to formulate our results with this in mind.

It will be demonstrated here that the dynamic misallocation effects of the corporate income tax system may be sizable when markets are substantially out of equilibrium and short term relative price movements are unreliable indicators of long term price movements, but the interpretation of these effects may turn out somewhat surprising.

2. TAX DEPRESSED RETURN REQUIREMENTS

One particular price variable affected by the tax wedge, that is studied in our simulations, is the rate of return requirement of the individual firm. The effects on investment from the faster than economically motivated fiscal depreciation scheme now prevalent in most industrial nations can be expressed in at least two different ways. Speeded up fiscal write offs create hidden tax credits that can be regarded as interest free borrowing. Since there is no competitive alternative because of the tax wedge, the cost of capital is lowered. Hence, borrowing and more investment will be economically motivated. Alternatively one can say that the firm lowers its cut off rate on the margin until expected returns to investment meet the marginal supply price of funds. This in turn is dependent on the expected return to the investment itself, since there are no other competing alternatives due to the tax wedge. In a neoclassical, static equilibrium setting the two formulations come to the same, since the rate of return requirement appears in the cost of capital expression and is equal ex ante and ex post. The rate of return is lowered ex post as firms increase investments each period.

Several allocation aspects have to be considered. For each given set of future price rays the lowering of the supply price of funds, through speeded up fiscal depreciations may increase the rate of investment through plough back (a volume effect).

For each given set of future price rays there may also be an alternative allocation of the same volume of investment among firms that creates a larger capacity increment. This allocation is, however, blocked by the tax wedge between the supply price of funds of the firm to the outside market and the indigenous demand price of the firm of its own funds. Figure 1 does not reject the hypothesis that a misallocation of investment resources may have taken place in Sweden during the postwar period.

There is, however, also a third possible source of the misallocation of funds demonstrated in Figure 1, that requires a truly dynamic theory of allocation to capture, namely misinvestment on the basis of erroneous anticipations on the part of the firm about future prices and/or an overly slow phasing out of old capacity made unprofitable through relative price change. If production is maintained at low profit plants or in subsidized loss operations the economy at large loses the extra output that locked in labor could have produced elsewhere.

The micro-to-macro model allows us to analyze these three effects. Some preliminary experiments on this model will add to the discussion in some papers already presented at this meeting, particularly those on the cost of capital effects of corporate income taxation (e.g. Bergström-Södersten; III:5 and III:7). The effects of initial productivity and profitability distributions across firms[1] and their development during the structural adjustment process can be studied during the simulations. The tax change, through rate of return requirements and the resource allocation process between firms, will be explicitly

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[1] As described e.g. in Lindberg, T., "Industrial profits - their importance and evaluation" in IUI 40 years - The Firm in the Market Economy, IUI yearbook 1980/81.

Figure 1. Share of investment, employment, value added and operating profits in percent of total manufacturing for Engineering industries and Raw material[a] based industries

[a] Mining, steel and forest industries.

linked to economic growth over an extended period of time. This is a typical dynamic market allocation problem very suitable for a micro-to-macro analysis with explicit, interlinked market processes, where conventional macro based econometric techniques have their obvious limitations in clarifying what is going on. Complex events within and between firms --through markets-- are not concealed in statistical aggregates in the micro-to-macro approach.

3. THE MICRO-TO-MACRO MODEL

a) A disequilibrium theory

The micro-to-macro model (MOSES[1]) integrates a number of firm decision models through an explicit market process (the micro-to-macro-to-micro link) with the entire economy. Several restrictive (unrealistic) ceteris paribus assumptions can be removed. This is necessary or at least very desirable when studying a "simultaneous" interactive process between firms both across the economy and over time. It allows us to catch and to quantify very complex causal time sequences in the economy. As expected some unexpected results appear.

The model is based on (1) a variable number of individual firm, production planning and investment financing models, that are (2) integrated (and aggregated) through explicitly modelled labor, product and credit markets, all being (3) constrained within a macro model of the rest of the economy. The most important exogenous variables besides a) Government policy parameters, are b) foreign prices (one index for each of the four industrial markets), c) the foreign rate of interest, d) the rate of technical change--embodied in new investment--and e) total labor supply. The model is a disequilibrium one in the sense that markets are not fully cleared and stocks are not

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[1] MOSES for **MO**del for **S**imulating the **E**conomy of **S**weden.

kept at desired levels, and the state of disequilibrium feeds back on total systems behavior through its effects on relative and absolute prices. Markets adjust towards an equilibrium region (or a bounded space) in discrete steps. Once the economy has reached this region it tends to stay there if not subjected to outside shocks. Hence, stability regions would be an appropriate name as well. A business cycle around a steady state growth path, bounded from above and below in a number of relevant variables, would be a case in point. Adjustment steps may be too large, and overshooting of equilibrium can occur, something that in turn unsettles the equilibrium space towards which the next adjustment takes place.[1]

Hence, the model has no unique equilibrium point (solution) any time. Roughly speaking the model system then can be said to be stable in the Liapunov sense.[2] However, with the notion of a "bounded equilibrium region", that is not very small or infinitesimally small, as Arrow-Hahn (1971) tend to make it, stability takes on a truly empirical dimension. How large a part of a production sector can disappear in 10 years before the term instability is warranted? The determination of boundaries is a "political problem".

We will deliberately keep this somewhat "imprecise" definition of stability in relation to an equilibrium region. It seems to us empirically relevant. Furthermore, long run growth is to a large extent endogenous in the model and dependent on its stability properties in this sense. It is as will be seen, very difficult to keep the model economy on a too narrowly bounded equilibrium growth path, and this fact is an essential part of the dynamic efficiency problem, discussed here.

The model has a very elaborately developed short-term and long-term supply side embodied in the

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[1] See Ysander; III:6 in this volume.

[2] See Arrow, K. and Hahn, F.H. General Competitive Analysis. San Francisco, 1971, pp.279-284. Perhaps what La Salle, J. and Lefschetz, S. (Stability by Liapunov's Direct Method with Application, Academic Press, New York, 1961) call "practical stability" is an even better definition of the "stability" concept that is useful for our analysis.

individual firm planning process. There is an explicit link from the price and quantity outcomes in markets, through profit determination and cash flows via the rate of return, the rate of interest and borrowing, to new techniques of production.

Hence productivity at the individual firm level is endogenous and for the whole model system economic growth can be said to be endogenous under an upper technology constraint. There is another complete integration between the monetary sector and the real system across product, labor and financial markets. This makes the model truly dynamic in the sense that structural change is also endogenously determined. The micro model is complete with traditional Leontief input-output and Keynesian aggregate demand systems. Thus, price determination and income generation are combined in a theoretical (albeit numerical) model.[1]

The model project requires substantial data-base work at the micro level. The regular planning survey[2] of the Federation of Swedish Industries has been designed according to the format of the model, and the model is currently loaded with data from the 30 to 40 largest Swedish groups. The idea is to design a measurement system around financial decision units and to use the high quality data that exist at the firm level directly for an improved understanding of what goes on at the macro level.

This is one of the primary purposes of the empirical part of the model project. Direct observation of the units of measurement allows the use of very simple and efficient estimation techniques at the micro level. Some of this has been done and much is under way, but more data-base work has yet to be undertaken before the model has a sufficient empirical footing.

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[1] A complete description of the model as it stood in autumn 1977 is found in Eliasson, G. (1978) op cit. Also see Eliasson, G., "Competition and Market Processes in a Simulation Model of the Swedish Economy", AER 1977:1.

[2] Covering ca 80% of output in Swedish manufacturing.

b) Some properties of the model

Until recently, most analytical work on the model has been concerned with sensitivity analysis aimed at ascertaining the properties of the entire economic system. Even though positive influences on the model economy (like fiscal or monetary stimuli) generate normal short-term or medium-term effects, as in conventional macro-models, reversals take place sooner or later (cf. the Le Chatelier-Brown principle). We have consistently found that if shocks, positive or negative, are large and sudden enough, they disturb the market signalling system and lead to erroneous investment and production decisions which cause lasting damage in the form of lost growth. This has helped to clarify the restrictive nature of traditional equilibrium assumptions. It is interesting to notice that pushing the economy too fast, too far towards short term optimum performance (call it "short term equilibrium") tends to produce instabilities. A conflict between short term (static) allocative efficiency and long term dynamic efficiency clearly exists in the model economy.

Part of the reason for these growth effects is the long transmission times of price disturbances that upset the relative price structure and make it difficult for individual firms to interpret price and wage signals in the markets. Most of the problem has to do with adjustment step size and time frequency of response at the micro level and the across market linkages, notably efficient arbitrage in the labor market. A brief period with high prices and profits easily changes into wage drift and a cost crisis that takes years to correct if the initial disturbance was strong enough. Firms grow cautious and investments are hurt. The model has exhibited good performance in tracking price transmission through the economy and also longer term growth rates.[1] High and irregular inflation rates that split up relative prices in an unpredictable fashion have been shown to affect growth in a decidedly negative way.

c) The investment decision in MOSES

The core process in the experiments is the micro unit (i.e. the individual firm) investment decision.

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[1] See p.71 in Measurement and Economic Theory, IUI Research program 1978/79. Stockholm 1979.

A combined capital budgeting, accelerator model of the Meyer-Kuh (1957), Eliasson (1969)[1] type is used in the planning system of the model firm. The firm calculates its cash inflow net of taxes, interest charges, dividends and mandatory financial requirements from working capital accumulation (inventories, trade credits, etc.). The firm is prepared to add to this cash flow by increasing its leverage if there is a positive gap between its internal, nominal rate of return and the current interest rate. This borrowing function is crucial for the tax experiments below.

Total internal and external cash inflows so calculated determine the upper limits of investment financing available each period. In the individual firm planning process management then checks back at current operating rates. If equipment stands idle new capacity investments are reduced in proportion to the degree of capacity utilization. In the present set up of the MOSES economy,[2] long term expansionary expectations are not allowed to override the short term financing and/or capacity constraints on investment spending.

This paper is concerned with the macro allocation (growth) effects of the investment decision at the firm level. One important set of price variables that guides the allocation process that we are particularly interested in is the market interest, the rate of return requirement in the firm and the ways by which the corporate income tax places a wedge between these price variables and hence affects the investment allocation process. As mentioned, there is one sophisticated and one simple financial investment model at the firm level. The one we use here is simple in comparison with the sophisticated optimization machinery in

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[1] Meyer, J. and Kuh, E., The Investment Decision--An Empirical Study. Cambridge U.S. 1957; Eliasson, G., The Credit Market, Investment Planning and Monetary Policy, (IUI). Uppsala 1969.

[2] There are currently two versions of the investment-financing decision. The simpler model described here and used in the experiments assumes "static expectations" (today is tomorrow for ever) from the traditional investment literature. The more elaborate version (sketched in Eliasson, G., 1976b, op.cit., to be described in a forthcoming volume) allows long range expectations to override short period expectations when investment plans are drawn up.

several other papers in this conference volume, although it has the comparative advantage of explicitly tracking the "price-behavioral response-aggregate market price" sequences throughout the entire economy. We have chosen the simple or naive version for three reasons. Most important, the sophisticated firm model is not yet ready and tested for empirical use and (quite) expensive to run on a full scale. Second, we are interested in the allocation effects on the total economic system of corporate income tax changes. This requires a relevant, dynamic "surface" behavior at the firm level. As long as one can assume approximately that the effects of fine details in the firm decision process cancel at the macro level and/or that the adaptive expectations and search behavior postulated for the MOSES firm constitute good approximations at the firm level, this will be sufficient. There is in fact (and thirdly) no real evidence to the contrary. However, the results reported on have to be judged with a view to these imposed a priori constraints.

For the tax experiments to be carried out below, we need not concern ourselves with the exact formulation of this accelerator component in the cash flow investment function. We only need to remember that in manipulating the corporate income tax system the Government affects not only the cash flows and rate of return characteristics of firms directly but also activity levels in the economy indirectly. This is a typical micro-to-macro and then macro-to-micro feedback. So even though not very large in a short period context, if the parameter change affects first the investment and then the cyclical characteristics of the entire economy, through demand feedback, the accelerator may click in to affect investment and capacity growth again. We know already from sensitivity analysis of the total model system that these feedback effects may cumulate into considerable magnitudes over time.

In its present form the cash flow-accelerator investment function can be said to exhibit some ad hoc features when viewed against the backdrop of current neoclassical investment theory. However, it relates back to earlier, Keynesian type investment functions that have gained empirical support in macro econometric work and also in direct investigations of capital budgeting and planning practices within firms. The latter must naturally be the overriding information base when building a micro firm based model.

d) Corporate income taxes and dividends

The corporate income tax enters the investment decision process critically in two ways:

1) through tax leakage in dividend (or cash) flows,

2) through its effects on rate of return requirements that affect the propensity to borrow.

Fiscal write-off rules in Sweden are relatively generous. Within broad operating limits it is possible to target a long run dividend policy and to report income for taxation accordingly.

It is possible to delay dividend increases substantially until an increase in operating profits is known to be of a more permanent nature. Higher investments in construction, machinery and inventories make this easier in the short term, and also in the long term if new investments also turn out to yield a higher return. Likewise, deteriorating profits do not have to lead to reduced book profits and dividends immediately for the same reasons. Hence, fiscal depreciation rules facilitate short term stability in dividend pay out rates. This feature is supported by reported experience and empirical evidence and has to go into individual firm model specifications. We have thus incorporated the flexibility allowed for in Swedish corporate tax laws without exactly representing all the detailed arrangements provided by investment funds, special deductions etc, which would have made the fabric of the firm model unnecessarily complex for our purposes.[1] More exactly it is assumed that

1. Firms target a dividend that corresponds to an empirically estimated real pay out on equity (as shown in the books).

2. The corporate income tax then is a fraction (somewhat larger than unity) of the dividend, all (1 and 2) provided that

3. the nominal return to total assets is higher than a certain lower limit which most firms pass under normal circumstances. If this return-requirement is not satisfied,

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[1] This is why we used the term "relevant surface" behavior in the section before.

4. no dividends are distributed and taxes are calculated as nominal rates on net taxable income.

(The rate of depreciation used here is the general rate that the law prescribes, a parameter that we can vary in our experiments.)

5. A general constraint that applies throughout is that taxes and dividends paid are always less than or equal to book profits.

6. The tax-dividend relation furthermore, has been made positively dependent upon the nominal tax rate, implying that firms will increase the dividend pay-out rate in response to a lowering of the tax rate (and vice versa).

Implicit behind these specifications is the assumption that, except in extreme situations, the firm never runs out of depreciable assets to the extent that the dividend-tax relationship breaks down. This is probably a quite acceptable approximation and to model more fine detail here would detract attention from our chosen problem and would bring us right into the intricate mess of tax considerations that corporate finance people in most industrialized countries have to spend considerable time on.

These assumptions defining the dividend decision are crude rules of thumb, albeit therefore not in contradiction to observation.[1] There is no reason to expect that these simplifying specifications have biased our experiments. We use them until a better empirical foundation has been obtained.

e) The rate of return requirement

Rate of return requirements appear implicitly in the investment process, although they are very explicit in short term production planning. The propensity to borrow depends on the difference between the nominal after tax return on productive investments in the firm and in alternative financial investment opportunities. Hence, the before tax, ex ante rate of return (requirement) can

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[1] The dividend formula is in fact taken directly from actual practice reported on in a Swedish firm. See Eliasson,G., Business Economic Planning Theory, Practice and Comparison, John Wiley & Sons, London etc., 1976a, pp. 170-174).

always be calculated as well as (of course) the *ex post* rate of return realized.

The after tax nominal rate of return on net worth (valued at replacement costs) of a firm can be shown to be:[1]

$$RNWT=[(1-T)RNW+T\cdot\underbrace{(DP+RHOBOOK-RHO)\frac{K1}{NW}}_{\text{Tax leverage}}]\cdot\frac{NW}{NW-TC} \qquad (1)$$

where (the before tax return)

$$RNW = RN + \underbrace{(RN-RI)\cdot\frac{BW}{NW}}_{\text{financial leverage}} \qquad (2)$$

and

$$RN = (M\cdot\frac{S}{A})-(RHO\cdot\frac{K1}{A})+(DP\cdot\frac{K1}{A}) \qquad (3)$$

M	= Operating gross profit margin in terms of S
S	= Sales
T	= The nominal tax rate
RN	= Nominal rate of return on total assets
RI	= Market interest rate (endogenously determined in the model)
DP	= Price change on investment goods
RHOBOOK	= Fiscal depreciation rate
RHO	= Calculated economic rate of depreciation
K1	= Fixed assets at replacement cost
A	= Total assets valued according to a replacement cost formula
BW	= Total debts
NW	= Net worth = (A - BW)
NWBOOK	= Net worth as it appears in the books, i.e. total capital with the fixed part valued at historic cost, less BW
TC	= T$\cdot$(NW-NWBOOK) = hidden tax credit.

The idea behind (1) is that fiscal write offs (RHOBOOK) do not reflect the economic rate of depreciation (RHO) of assets. Hence hidden reserves are accumulated and figure in the "true" balance sheets of the firm as non-interest bearing tax credits, and are regarded as such by firm

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[1] Expressions (2) and (3)--called the separable additive targeting formula--are derived in Eliasson, G. (1976a), *op. cit.*, pp.292 ff.

management. Tax credits yield a leverage contribution to the return to equity, in the same way, see (2), as does borrowing at an interest rate that is lower than the return to total assets. The firm controls the size of its tax credits through its investment decision and its ability to avoid losses.[1]

While borrowing, and indirectly investment, are in turn driven by _inter alia_ the relationship between RNWT and RI (see further below) the production decision of the individual firm is controlled by an endogenously targeted value on M.[2]

f) The tax leverage

The tax leverage operates by lowering the effective tax rate below the nominal rate T, which essentially means raising the rate of return above that with full taxation (= (1-T) • RNW) for a (NB!) given, before tax rate of return. The last point is the interesting one in this paper. To what extent can the before tax rate of return be assumed given in a total model context, or how does the investment decision, that is affected by rate of return requirements within the firm, and hence taxes, affect the rate of return on investment?

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[1] This way of defining and interpreting RNWT is of course slightly arbitrary. We could alternatively exclude the potential tax burden from the denominator and subtract both the actual and the potential tax each year from profits in the numerator. In the longer term the results should be the same. In the short term, however, this measure could behave erratically during inflationary times. Alternatively one could as well remove the potential tax from the asset measure (the denominator) only, arguing that firms feel no "responsibility" to earn a return on the interest free tax credit. This suggestion is in fact the one most compatible with our hypothesis about before tax rate of return effects of accelerated depreciation, and quite testable.

[2] See Albrecht, J., "Production Frontiers of Individual Firms in Swedish Manufacturing 1975 and 1976" in Carlsson-Eliasson-Nadiri (eds), The Importance of Technology and Permanence of Structure in Industrial Growth, IUI Conference Report 1978:2.

In formula (1) above, the size of the interest free tax credit in proportion to net worth:

$$\frac{NW}{NW - TC}$$

boosts the after tax rate of return by allowing the firm to earn its after tax rate of return net of this tax credit. Each period new such credit is generated to the extent that the inflation in equipment prices plus the rate of fiscal write off allowed exceeds the economically motivated depreciation of equipment (DP + RHOBOOK - RHO). This calculation abstracts of course from the additional leverage that comes from investing at a higher return than the interest rate.

The tax leverage can only be exploited on investments in depreciable goods[1], not on alternative investments in nominal financial assets. For these the after tax rate of return would be:

$$RFAT = (1-T) \cdot RI \quad (4)$$

where RI is the going interest rate.

As the business world is now shaped in the MOSES model the firm borrows to invest, or abstains from lending its cash flows for two reasons:

(a) It earns a real return on these investments that is higher than what it can earn on financial investments.

(b) The tax system allows the corporate income tax to be postponed by extending an interest free tax credit. A tax wedge, so to speak, enters the decision to allocate cash flows.

The two considerations have to be taken simultaneously. For instance it might be remunerable to borrow for investment purposes to exploit the tax credit even if the interest rate is higher than the rate of return realized before tax.

The crucial point now is to allow these considerations to affect the borrowing decision and then

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[1] An inventory accumulation means even more favorable tax credit benefits in Sweden. We abstract from them in this formal context.

the investment decision. In the current version this is done in a fairly crude fashion by simply assuming:

$$DBW = a + b \cdot (RNWT - (1-T) \cdot RI) \quad b > 0 \qquad (5)$$

where DBW is the net rate of change in outstanding debt. Add the net increase in debt so determined to net cash inflow from current operations in the firm less mandatory current capital accumulation, taxes, dividends and interest payments and the investment budget is obtained. This is the upper investment spending limit for the period. The current rate of capacity utilization determines the extent to which it will be used for investment in machinery and equipment or added to liquid assets.[1]

First, (5) represents an _average_ profitability criterion for the entire firm based on returns on already invested capital that determine the rate of borrowing. Note, however, that marginal considerations appear very importantly anyhow, since firms compete with one another for external finance in the _model credit market, determining the interest rate (RI) in the process_.

Second, (as mentioned) long term considerations are not allowed to override short term considerations in the model version used in this paper.

These two objections will be removed in due course. For the time being this is the analytical tool we have and the principal long term results should be the same. It always pays for the firm to invest and to gear up through borrowing as long as (RNWT-(1-T)•RI) is positive even though RN or RNW decreases in the process. In this sense the investment function incorporates marginal rate of return considerations.

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[1] Much along the lines hypothesized and empirically tested in Eliasson, G. (1969), _op. cit_.

4. EXPERIMENTAL DESIGN AND RESULTS

We have subjected the firms to combinations of three different market environments and two fiscal depreciation regimes.

The market environment reference base case is described by historic relative and absolute price change from 1968 to 1976 as shown in Figure 2, and then a continuation of trends through 1987 ("stable market environment").

In one market scenario we pivot relative prices more in favor of investment goods industries (applying a linear transformation during a four year period beginning in 1969) subjecting the raw material sector to stronger competitive pressure from abroad ("slow pivoting"). Throughout this scenario absolute export price change is the same as in the base case above. Only relative export prices change.[1]

In another (volatile) market scenario we pivot relative prices much faster (i.e. the transformation is completed within one year) against raw material producers ("fast pivoting"). The change, however, does not begin until 1974, immediately after the extreme raw materials price hike in Sweden 1973/1974. Again the absolute export price development is kept the same.

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[1] Note from Figure 2 that the improvement in relative prices for engineering (i.e. the investment goods industries) is broken in the 80's. This, of course, only reflects the fact that due to earlier improvements, engineering is now the largest sector, and relative prices should tend towards index 100 as the sector approaches 100 percent of manufacturing.

As for fiscal write-offs, we have assumed the average lifelength of total fixed assets to be 4 and 20 years respectively compared to 7 years on the average in the reference case.

In a first A series of two experiments we accelerate and slow down fiscal depreciation rates around the reference case with a stable relative price environment assumed.

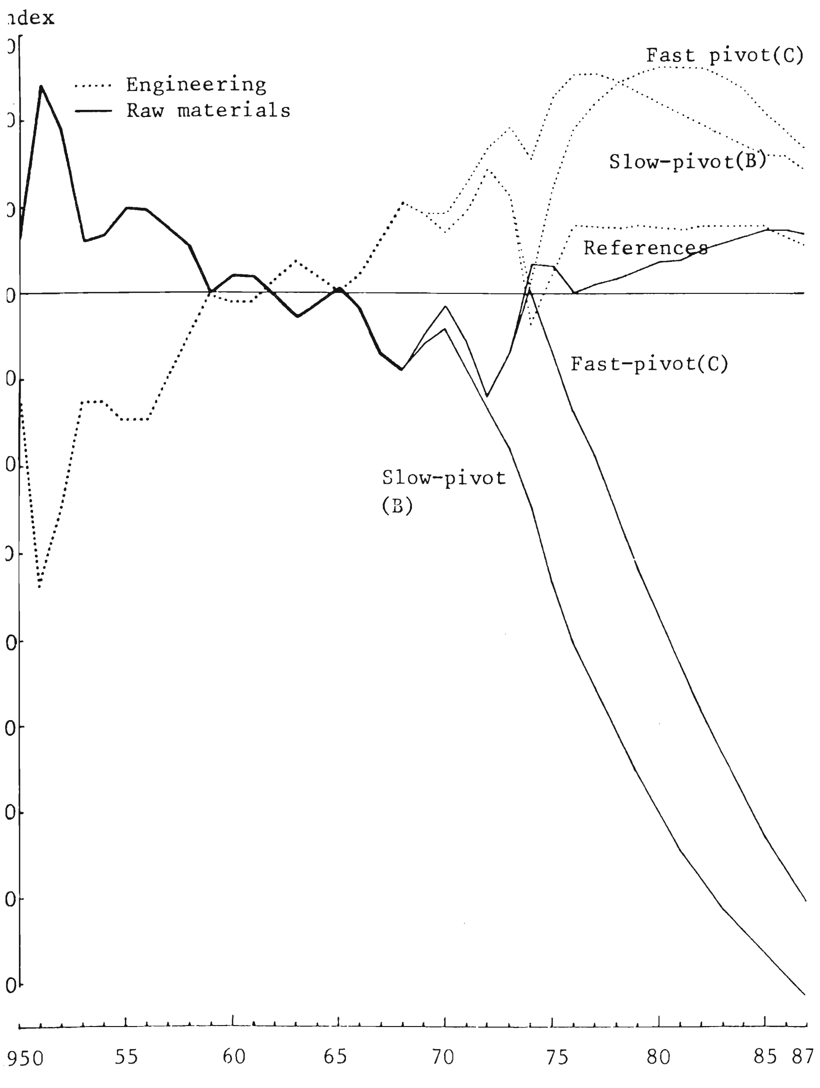
In a second B series of two experiments we do exactly the same for the slow relative price pivoting.

And in a third C series of experiments we do the same for the fast relative price pivoting (the volatile market environment), except that we also add an experiment, combining the fiscal regimes. In the slow depreciation case we repeated the experiment as before during the pivoting up to 1974, but with faster fiscal depreciation after 1974. This was to see whether more generous cash flows in engineering industries with a bright future (and raw materials now basically out of business) would speed up growth.

For the discussion to follow the reader should note that the strong inflationary wave in 1973-74 is followed--as in reality--by a strong but temporary improvement in the relative price trend for raw materials (see Figure 2).

The reference case run used for comparison begins in 1968 and covers a statistical history of 9

Figure 2. Relative export prices 1950-1987
Index 100 = average price for all exports



years before it enters the future. It runs along historically known exogenous data to begin with and then on a trend projection. The model version used (being ready in mid-1978) traces historical trends and inflation rates well, however not so well for cyclical macro behavior. Besides, there are slight differences between actual and simulated intersectoral growth rates that take on sizable proportions towards the end of the 20 year simulations that we perform here.[1]

The set of trend projections of exogenous data does not represent a realistic forecast --the recent IUI medium-term assessment of the Swedish economy (from which Figure 1 has been fetched) projects a rather stronger expansion of engineering industries and a faster contraction of raw materials. Quantified effects from the simulation runs have been scale-adjusted and presented with reference to the above mentioned 1968-1987 base and is shown in Figures 5A to 5G. This allows us

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[1] Because of the logics of the model they most probably depend on inconsistencies between (1) exogenous export prices used and national accounts statistics and/or (2) inconsistencies in the input/output structure and the composition of total demand as calculated by the model and/or in the (3) exogenous assumptions on relative technical change in the various sectors. Since we do not want to tamper with the official macro data bases --put together under frustration and effort-- until we know better, we have chosen to experiment with the technical assumptions arrived at by Carlsson, B. and Olavi, G. ("Technical change and the longevity of capital in a Swedish simulation model" in Eliasson, G. (ed), 1978 op. cit.) So far, however, we have not succeeded in fine tuning sectoral changes to our satisfaction. On this score we are looking forward to the implementation of a new micro-firm data base that should improve things considerably.

to compare simulations with time series material all the way back to 1950.[1] These are our results:

Experiment series A (stable market environment (= REF)):

Lowering the rate of fiscal write off from 7 to 20 years (it is still above the calculated economic rate of some 30 years, used in the model) slows down investment spending in industry considerably (Figure 3A) to approximately 75% of the level in the reference case for some 10 years. Thereafter bottlenecks in the production system, and a general increase in prices generate an investment boom for several years. Accelerating fiscal write-offs from 7 to 4 years increases investment spending somewhat throughout the whole period.

Industrial output, however, is affected quite differently, depending upon which of the two scenarios we play, (Figure 4). For the first 5 to 8 years there is an increase in output compared to the reference case in both runs. In the expansive fiscal case this occurs through a demand effect via increased investment spending, and in the tightened fiscal case through a more efficient utilization (!!!) of existing capacity. Profit mar-

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[1] The assumption implicit in Figures 3 to 7 is that effect time profiles do not depend on the same specifications that produce erroneous cyclical behavior. We do not argue that it is altogether acceptable to do so. Several years of experience with calibrating the micro-to-macro model do, however, suggest this assumption. See for instance the article on estimation by Eliasson, G. and Olavi, G. (pp.95-101) in Eliasson (1978, op.cit.). If we abstain from drawing conclusions from the diagrams on year to year changes but rather look at longer term changes there should be no problem.

gins are coming down but rates of return are maintained because of a more efficient utilization of capacity. More resources are freed for private consumption. This is, however, a transitional phase that reverses itself in the second decade of the simulation (see below).

When we look at the allocation pattern between sectors the process gets more involved and interesting. (See Figures 5A-G).

First of all it is interesting to note how loosely correlated investment spending and production is in the short term at both sector and total industry levels.

Second, the allocation effects from varying write-off times compared to the reference case are as expected on the investment side although they are small. Accelerating fiscal write-offs increase the relative share of investment that goes to raw materials to begin with. In the longer term the effects cancel and vice versa for slowing down fiscal write-offs.

In the slow fiscal write off scenario total investments have been lowered in the first decade. Firms therefore have to cope with less and less modern machinery and somewhat higher wage levels. They respond in the second decade by reducing output to maintain or increase profitability. This is not necessary in the accelerated fiscal write-off case.

We can learn from this that the traditional "static" allocation story holds in the short run (up to 5-7 years) but then has to be modified in several ways.

Experiment series B (SLOW Price PIVOT):

When relative prices are pivoted slowly in favor of engineering industries (compared to the base case) a slight initial, extra investment spending period in the raw material sector can be observed (Figure 5A) due to a temporary raw materials cyclical improvement in 1969/70. The relative cyclical price improvement in 1973/74 is however removed in this case. The deteriorating competitive situation cuts into profits very fast to offset the misallocation effect on investment on the basis of past profits. (Figures 2, 5A and 5E). The raw materials sector then gradually fades away for some 10 years. With a slower fiscal write-off, investment spending in the raw material sector is curtailed somewhat faster. The waste of investment resources in the raw material sector due to generous fiscal write-offs, however, does not seem to mean much - contrary to the traditional view. Generous fiscal write-offs help the expanding engineering sector even more in the longer (beyond 5 year) run and this is most clearly seen in both total and relative investment and output levels (Figures 3A, 4 and 5A).

Hence, while static allocative efficiency seems to have improved in the short run through a tightening of fiscal depreciation rules, bottlenecks in capacity develop after some time, instabilities are generated and a sudden investment boom to replace capacity is started up around years 8 to 10. The very strong differences in the investment cycle generated by the fiscal parameter change are clearly demonstrated in Figure 3A. The interesting thing is, however, that it takes so long (Figure 4) for the effects to show in output in all experiments. Table 1 illustrates this in compact form. In fact, looking at the first 10 years only may suggest a conclusion that is entirely wrong. By tightening up fiscal depreciation rules investment can be reduced by 25% with no loss in output for the first 10 years.

Even more important, however, seems to be that expanding firms in the engineering sector do not grow as fast because of less generous fiscal stimulus. One may perhaps conclude that long run dynamic efficiency has not improved or that a tight fiscal policy vis-a-vis firms has raised the discount rate and shortened the planning horizon, producing less growth in the long run.

As in the A series of experiments, accelerated fiscal write-offs also here lower the real rate of return on total assets in the long run--and vice versa. This is, however, not the whole thing. A most interesting feature of the real world appears when relative prices are pivoted against raw materials. In the early 80's, firms in the raw material sector are beginning to feel the competitive pressure to the extent that several of them close down, since they cannot produce at acceptable profit rates. Earlier, the expanding engineering sector had not been able to employ people at the rate desired without pushing up wages at the expense of its own profitability performance. With several large raw material producing firms leaving the market, labor is freed for employment in the engineering sector. These firms take off at a fast rate and at general wage increases, that are slow enough not to eliminate incentives to invest and grow, as was the case in the A-series. The importance of strong competition between the "old" and the "new" industries in factor markets is vividly illustrated in a quite Schumpeterian fashion. Output shoots above the base case in the second decade of the simulation. (Figures 3a and 4 and Table 1). The total allocation effect hence is very large, and this simulation illustrates that the waste accomplished through mistaken investment decisions themselves may be small or negligible. The real social and private waste occurs when production continues in the relatively inferior production plants. Labor is locked in there at market wages, which the plant is able to pay as it is run down gradually at a slight return above current costs. A somewhat higher overall wage level than otherwise is maintained and expanding firms cannot easily attract labor with generous wage offers without generating wage drift that endangers their own expansion plans. This deprives the entire economic system of a larger output from the same labor elsewhere. If so, a fast deterioration of the competitive position of such firms, to the extent that they are forced to shut down, will produce a higher "social return" than a gradual deterioration that allows inferior firms to keep producing until they fade away, due to dwindling financial resources to invest.

There are three additional qualifications to this conclusion. The <u>first</u> one is political. The govern-

Table 1. Investment and output effects of fiscal experiments in manufacturing
In percent of reference base case (= 100) on the average

	Investment		Output		Raw material output			Number of firms closed down[a]
	1968-77	1968-87	1968-77	1968-87	1974	1977	1987	
A-EXPERIMENTS								
Base case, with fast write-off	110	110	104	103	100	102	110	0
Base case, with slow write-off	73	105	100	97	99	97	128	0
B-EXPERIMENTS								
Slow price pivoting, with fast write-off	123	123	104	109	89	74	81	11
Slow price pivoting, with slow write-off	75	-	100	-	94	76	-	0
C-EXPERIMENTS								
Fast price pivoting with fast write-off	110	102	104	102	100	99	64	12
Fast price pivoting with slow write-off until 1987	73	128	99	102	98	93	58	7
Fast price pivoting with slow write-off through 1973, then fast	87	132	100	104	98	94	50	9

[a] All in raw material sector and after 1980. Initial number of firms in each sector is 15.

ment may step in with a social welfare program for dying firms as it has done in Sweden during the last few years, and in other countries like France and England for many years. Then the beneficial allocation effects will be further delayed (or disappear) and output will be lost in the long run. There has not been time and money for simulating the Swedish government subsidy program on the model yet, but such an experiment is certainly feasible.

Second, if the relative price change is too sudden and too strong, market prices throughout the economy may be thrown out of equilibrium to the extent that instabilities develop that hurt growth more than what is achieved through the improved allocation discussed above. The relative price pivoting in export markets assumed in the B set of the experiments was not enough to force the model economy into such an unstable situation.

Third, it may be argued that labor thrown out of their jobs, nevertheless will not move to the new jobs being offered. Geographical distance, that is not explicit yet in this model, may be one reason. This feature of real life can be said to be covered in a somewhat crude way in the current model version. The labor market search pattern and wage response parameters of labor and firms allow a quite realistic wage level differentiation to develop between firms in those simulations that best capture postwar Swedish economic development. This may be interpreted as partly due to labor immobility because of geographical distance etc. If unemployed labor would be 100 percent deprived of income it certainly would move to a job offered.

Each period, each member of the labor force has a well defined "reservation wage"; when on a job his/her current wage plus a "mobility threshold", that can be varied; when unemployed an unemployment benefit amounting to a fraction (here 60 percent) of the average wage in manufacturing. Labor moves voluntarily when offered a wage higher than his/her reservation wage. The objection then is not really that geographical distance etc. suggests other, higher reservation wages--they can be changed in a new series of experiments if somebody comes up with better empirical information than we have. The point is that if labor does not move to accomplish a more efficient allocation they have been stimulated to stay where they are by a combination of taxes, subsidies and unemployment benefits. The allocation in the experiments reported here has been accomplished on a parameter specification that seems to be quite good for the postwar Swedish economy. The experiments suggest that you can improve that allocation by varying the tax-subsidy and even unemployment benefit parameters that stimulates labor move.

5. STABILITY AND TAXES--THE OPTIMUM SPEED OF STRUCTURAL CHANGE

Profitable firms trying to expand in experiment series A with generous fiscal treatment tended to drive up wages (overshooting) and imperil their own profitability position if expanding too rapidly. The business situation for expansive firms was dramatically improved when relative prices were pivoted in the B series of simulations, favoring engineering firms and forcing several raw material firms out of business, making labor available for expanding firms in the process. Stability in the market price system and of total economic development was increased here. However, a typical characteristic of the micro-macro model[1] is that when price change gets faster and stronger, feed back effects through the entire economy may create a different type of instability. The production structure cannot adjust fast enough, but the speeded up adjustment makes market prices irregular, jumpy and difficult to interpret by the firms. In earlier versions of the model, loaded only with synthetic firms, inter-firm variation in productivity was very small- there was so to speak only a very thin Salter tail of relatively low performance firms--and almost an entire sector could close down in a few years from a sudden relative price change. The curtailed domestic supplies and the new labor market situation that followed kicked the economy into an entirely new state, which in turn changed the price structure drastically, etc.

This time half the data base consisted of real firms, and even though some essential, individual firm information was still of a synthetic nature at the initial year 1967, between firm productivity variation was much larger. Hence the systems effects were not as dramatic as they had been earlier.

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[1] See Eliasson, G., "Experiments with Fiscal Policy Parameters on a Mirco-to-Macro Model of the Swedish Economy" in Haveman-Hollenbeck (eds): Microeconomic Simulation Models for Public Policy Analysis, Academic Press 1980.

Experiment series C (FAST price PIVOT):

The critical stability issue this time has to do with the rate of structural change policy makers are willing to absorb. One may say that the C series is similar to the Swedish policy response during the 1973/74 oil price shock. Raw material prices were allowed to be transmitted through the economy and be followed by a strong surge of wage drift as absolute prices leveled out unexpectedly in 1975 and after, mainly through a strong drop in raw material prices. The effects are dramatic in the model experiments. Raw material producers invest and expand through 1974 and then everything suddenly collapses with the sector (almost all firms) practically disappearing during the 80's. The instability created has to do with the speed of disappearance, of a large sector, employing in 1974 some 20 percent of the entire labor force in industry, to something quite insignificant, a little more than 10 years later (see Figure 5C). The interesting thing is what this means to the rest of manufacturing and what difference depreciation rules make.

The first thing to note is that generous depreciation rules turn out to be a killing experience for the raw material sector. Firms invest (see Figure 5A) and expand too fast, only to go bankrupt when the market price situation suddenly turns around. Only three firms of 15 are left at the end of the simulation. Other sectors benefit from released labor and slower wage increases, but total industry output remains below that in the matching B run, when prices turned against raw materials earlier and at a slower rate. This misallocation due to a too fast adjustment of production structure cannot be made up for in 15 years.

Next, when depreciation rules are tightened up investment slows down in all sectors during the first decade. Obviously, this means very little for output, even though investment is reduced substantially. It saves several raw material producers from overexpansion and close down in the 80's (only seven close down compared to 12 in the earlier run). In this way the raw material sector contributes to growth while other sectors, notably investment goods industries, find time to catch up. Output in total manufacturing, as well as raw material production, throughout the 20 year period is in fact higher than in the scenario with generous fiscal write-offs.

It may be of interest to ask which tax regime gives the best results--the optimum rate of structural adjustment given full knowledge of the market scenario. It appears that results in terms of growth in output are much improved when fiscal depreciation rules are kept tight until the raw material boom is over in 1974 and then accelerated for the rest of the period. However, the extra output gain during the second decade is costly in terms of investment, presumably because of the drastic intersectoral change that takes place. Some further micro detail is worth observing. In the earlier experiments relatively profitable raw material producers locked up labor resources and kept engineering firms from expanding during the first half of the simulation period. Now tight fiscal rules have kept raw material firms from expanding during that period. When the market turns decisively in favor of the engineering sector from 1974 and onwards, there is enough labor for firms in that sector to expand without strong wage drift. With more generous fiscal depreciation rules they expand employment so heavily that they drive up wages to such an extent that two additional raw material producers have to close down. The result is a higher total output throughout the 20 year period than in all other experiments and in particular during the second 10 year period. There obviously cannot be a simple one-to-one correspondence between profitability and growth at the macro level. The reallocation of resources between firms that enhances output reduces rates of return in high performance, rapidly expanding firms and vice versa, leaving very little of stability in a macro relationship.

6. PROFITABILITY AND TAXES

The allocation effects of the fiscal depreciation experiments are also mirrored in the before tax returns to capital (see Section 2).

The individual firm may overinvest, driving down the before tax rate of return, while the after tax rate of return on equity increases because of a more generous fiscal depreciation rule (series A), or it may invest too much in the wrong market for the same reasons, driving down all rate of return measures (series B and C).

An expansive sector being further stimulated by generous fiscal write-offs may drive up the wage level for other sectors and hold rates of return down there. If market conditions are suddenly reversed (C series), the magnitude of the earlier misallocation and the speed with which it is corrected, determines the rate of return consequenses in other sectors and for all industry. The faster low profit firms disappear, the faster overall profitability recovers. On the whole, the complexity of the allocation machinery should warn us not to expect as clear and transparent conclusions on the rate of return side as on the growth side in earlier sections.

We will examine the real rate of return to capital in all industry,[1] and each of the two markets raw materials production (RAW) and engineering (DUR)-- under the two tax regimes; under stable market conditions (series A) as well as when the environment is changing on the price side (series B and C). Finally, we will examine individual firm behavior at the micro level.

a. Macro level

In the stable market environment (= A-series of experiments) an increase or decrease of depreciation allowances leaves profitability almost unaffected, when viewed at the total industry level. (See Figure 6A and Table 2). As would be expected

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[1] The real return to capital has been calculated with a replacement cost valuation of the fixed assets. Nominal capital gains from price increases on goods in stock have not been subtracted. Capital gains due to relative price changes on investment goods have also been disregarded.

from section 2, a more generous depreciation rate lowers the before tax return 2% on a yearly basis through an expansion of investment at lower cut-off rates on the margin, without lowering the after tax return on net worth. A reduction of the fiscal write-off rate yields no discernible long term deviation from the reference case.

With a slowly introduced price disadvantage for the RAW sector in the B-series, the "best" fiscal policy at the total industry level seems to be the generous one. In the long run, a rate of return level 22% above that in the reference case is attained. Over the first ten-year period an improvement of 5% can be compared to a deterioration of 2% in the tight policy alternative.[1] When foreign prices are drastically turned around, in the C series, the situation is reversed. A harsh fiscal policy leaves all industry 18% better off on the rate of return side, instead of 1% as in the generous case.

In the last experiment on the C-scenarios, we start with a fiscal depreciation rate of 5%. Once raw material firms are "safely on the downward side" from 1974 and on, we raise the rate to 25%, with a view towards stimulating investments in profitable growth sectors. One result of this is much more total output (see Figure 4 and Table 1). Compared to the case with generous fiscal rules, the overall allocation of resources has improved a

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[1] Due to practical and cost considerations this latter run was (unfortunately) not carried further than 10 years.

Table 2. Real return to total capital before tax

Index 100 = Reference base case.

Scenario	Foreign price development	Fiscal depreciation rate	Raw materials 1968-1977	Raw materials 1978-1987	Raw materials 1968-1987	Engineering 1968-1977	Engineering 1978-1987	Engineering 1968-1987	Total industry 1968-1977	Total industry 1978-1987	Total industry 1968-1987
A	Neutral	25 %	109	109	109	97	100	99	98	98	98
		5 %	105	153	129	86	89	87	96	105	100
B	Slow pivoting	25 %	68	10	39	122	176	149	105	139	122
		5 %	82	-	-	105	-	-	99	-	-
C	Fast pivoting	25 %	97	23	60	106	164	135	98	105	101
		5 %	97	20	58	91	166	128	97	139	118
		5→25 %	95	21	58	91	168	130	96	121	109

Note: The profitability in the two sectors is expressed in relation to Total industry.

lot through a clever policy arrangement. Both the private and the social benefits from this extra allocation effect are large.

Such action also makes rates of return at the total industry level increase substantially, but not to the level obtained when fiscal depreciation rules were kept tight throughout the entire period and forced the firms to economize on capital account. The other side of this has already been observed in earlier sections. A more generous fiscal policy stimulated investment and growth in engineering. Demand for labor increased as did the wage level, driving down before tax returns to investment slightly throughout industry.

b. Markets and industries

In Figures 5D and 5E the shares of total industry profits represented by the two subindustry groups are shown. In Figures 6B and 6C before tax rate of return variations around the base case are illustrated. It should be noted that in the initial position raw material industries (RAW) are inferior to engineering (DUR) in respect of profitability, yielding only 65% of the manufacturing average.

Speeded up fiscal depreciations in the stable market A-series, improved the relative rate of return position of the depressed raw material producing firms. In the markets for durable goods, profitability stayed at the earlier level. Behind this shift in favor of raw material producing firms, we find an uneven distribution of investment expenses. RAW responded immediately and heavily with investments as well as with increased hiring of labor to the tax incentive. Investments in DUR, on the other hand, were not affected at all during the first years. The different profitability positions at the beginning thus were crucial for the decisions to invest and expand. An investment-boom in DUR did come about, but it was delayed until the second decade of the simulation.

When nominal rates of return on net worth before and after tax are compared with those in the reference case, we find that the generous fiscal write-off rules increase the after tax rate of return relatively more and uniformly in all four industrial markets. This is the typical effect of tax-leverage from the interest free tax-credit (see (1) in section 3 e). This result would have been even more interesting if the model had allowed for a third source of finance, namely new issues of share capital. In the current model version no stock exchange exists. The only investor watching the rate of return development and comparing it with alternative investment opportunities, is the firm itself.

The generous fiscal policy resulted in the expected increase in investments (+10% at the all-industry level). Since the lion's share is directed to the relatively unprofitable raw material sector in the first years, the overall output effect is limited to an increase of 2.5% and the return on total capital to a decrease of 2%.

Under the opposite, tight depreciation regime returns to capital in the raw material sector increases strongly while they decrease in the investment goods industries. The reason is the depressed investment cycle, generated by the fiscal rules, throughout industry. It hurts durable goods producers for some 10 years. Then a strong replacement, investment cycle sets in. The simulation, however, ends with a permanently reduced investment goods producing sector (DUR).

As a consequence of the gradual favoring of DUR in the B-series, profits and cash flows fade away slowly in the raw materials sector. Faster fiscal write-offs mean more investment in that sector than would otherwise have been the case, but the stimulus mostly increases investment in the already expanding DUR-industries. This expansion worsens the relative competitive situation of raw material producers even further. During the second half of the simulation returns to capital in this sector is down to one tenth of that in the base-case. Durable goods industries totally dominate the investment scene. 11 out of 15 raw material firms close down in the 80's and this fact helps somewhat to keep up sector profitability. Most of labor migrates to the engineering sector. In 1968, 22.7 and 36.2% of those employed in industry worked in RAW and DUR respectively. Twenty years later only 4.2% remains with RAW, whereas 78.3% earns their living in the durable goods producing sector.

When relative prices are pivoted more strongly against raw material producers after the temporary profit bonanza in 1973/74 (C-series), the allocation process is disturbed. The redistribution of real resources is not carried out quite as smoothly as in the slow pivoting, (B-series), and this shows most clearly in profitability development, the general level of inflation and the external balance of the country. The restructuring of industry in the generous fiscal case does the most damage to overall profitability (see Table 2), and allocation results, in terms of output, are dismal compared to the other fiscal alternatives (see Figure 4). 12 out of 15 firms in the raw material sector close down. In the tight fiscal case, insufficient investment and capital equipment create, in the first decade, a general run for labor, driving wages and domestic prices sky high. A prolonged profit depression in industry starts due to deteriorating export margins.[1] The economy is on its way back to normal profits and a restored external balance towards the end of the 20 year simulation but at a price level some 40 percent above that in the tight fiscal and/or the base reference case.

c. Micro level

All experiments described in this article were carried out on a model-setting containing 30 real and 30 synthetic firms, equally divided on the four industrial markets. Consolidated accounts of all firms added up to sector national accounts data. We will now take a closer look at these micro-units in the raw materials production and engineering industries.

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[1] This could have been countered with a devaluation and more inflation, at least temporarily.

Figures 8 and 9 show the profitability outcome in two C-simulations on a firm-by-firm basis, namely the one with a tight fiscal policy throughout and the one with a change to a generous policy after six years.

Increased foreign competition (through price-pivoting) led to a decreasing RAW-sector in both experiments. The two scatter-diagrams show only firms that managed to escape bankruptcy. The number of RAW-firms has been reduced to one third.

Returns to total capital 1968 and 1979 have been plotted in Figure 8 for the remaining firms under the two schemes. The arrows indicate the direction of the shift, with the head pointing at the "easy fiscal policy" observation. In general, firms exhibiting a low rate of return in the first case tend to stay at that low level also after the change has taken place (the bottom-left part of the diagram). They seem however (with a couple of exceptions) to be heading upwards. The opposite behavior can be said to hold for the initially highly profitable firms. Their rates of return decline.

This fits our original hypothesis that highly profitable firms increase their investments because of fiscal stimulus, to the extent that they drive down before tax rates of return on the margin. Firms on the edge of ruin, on the other hand, were able to consolidate their positions by contracting output and slowing down investment. The scatter furthermore leaves the impression that good or bad "luck", in terms of profits, seem to stay with firms for a long time in the model, as in reality. The scatter stays rather close to the 45°-line.

Figure 9 reflects the changed relation between before- and after-tax rate of return on net worth in the two experiments. Again, the arrow-heads point in the direction of generous fiscal policy observations.

All firms experience higher after-tax returns as a consequence of tax stimulus. However, the most striking feature is the clustering of firms into two separate groups with entirely different performance characteristics. Almost all high-profit units lower their before-tax rate of return as a result of the more generous depreciation rules, while the low-profit units do the reverse. In fact, we are presented with an explanation to the drop in profitability in engineering industries observed in Figure 8.

The reason is, of course, a combination of reduced slack and a contraction of output growth to a relatively more efficient and profitable production range of the firms as a result of more competition. Part of this is reflected in a movement of labor out of raw material firms into expanding engineering firms. We think that this final conclusion illustrates one important feature of the growth process, namely that growth itself affects factor prices so that they tilt against the growing firms. Endogenous factor price feed back so to speak operates as a "growth cost factor" that increases faster than proportionally to growth. It is then also easy to see that artificial price wedges (like taxes and subsidies) can easily reinforce that mechanism, slowing down both the resource allocation process and growth, through increasing the cost of growth.

These results finally suggest strongly that one needs the dynamic representation of a market economy with endogenous factor prices and structural change of the micro to macro model to conceptualize, think about and quantify these mechanisms.

Figure 3A. Investments in Total Manufacturing, 1968-1987

Index 100 = Reference base case

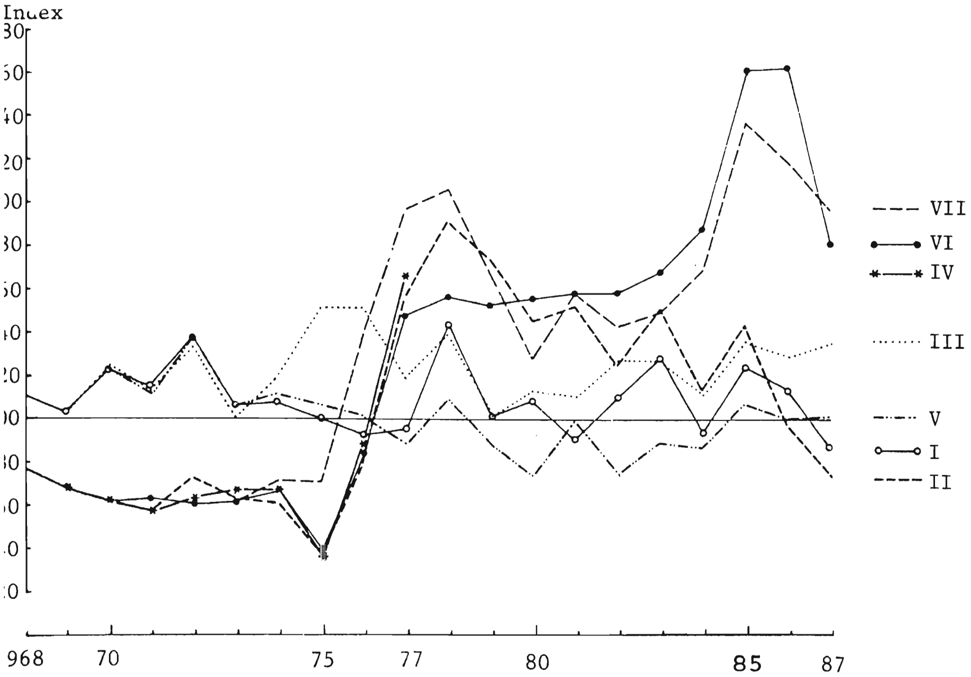
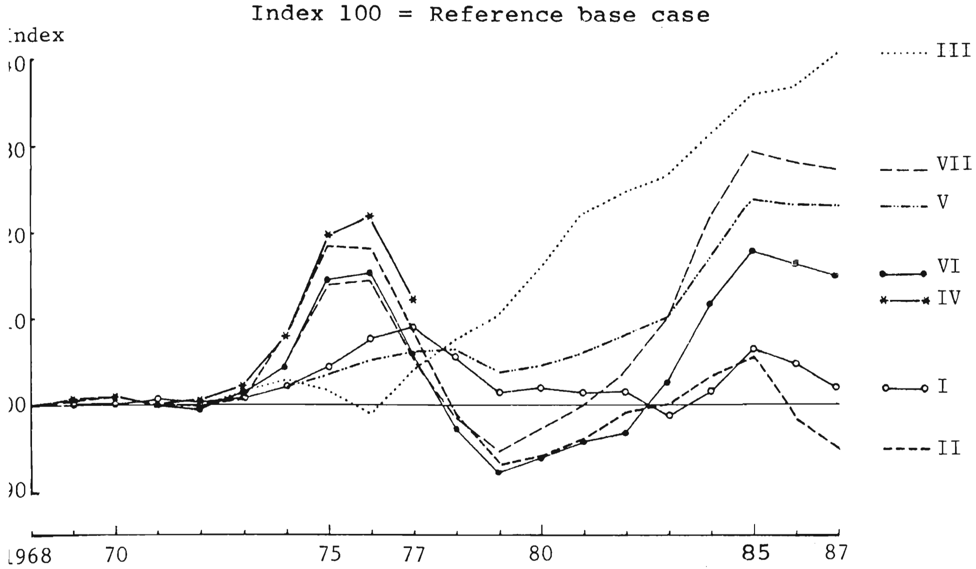


Figure 3B. Private Consumption, 1968-1987

Index 100 = Reference base case



I A-fast depreciation

II A-slow "

III B-fast "

IV B-slow "

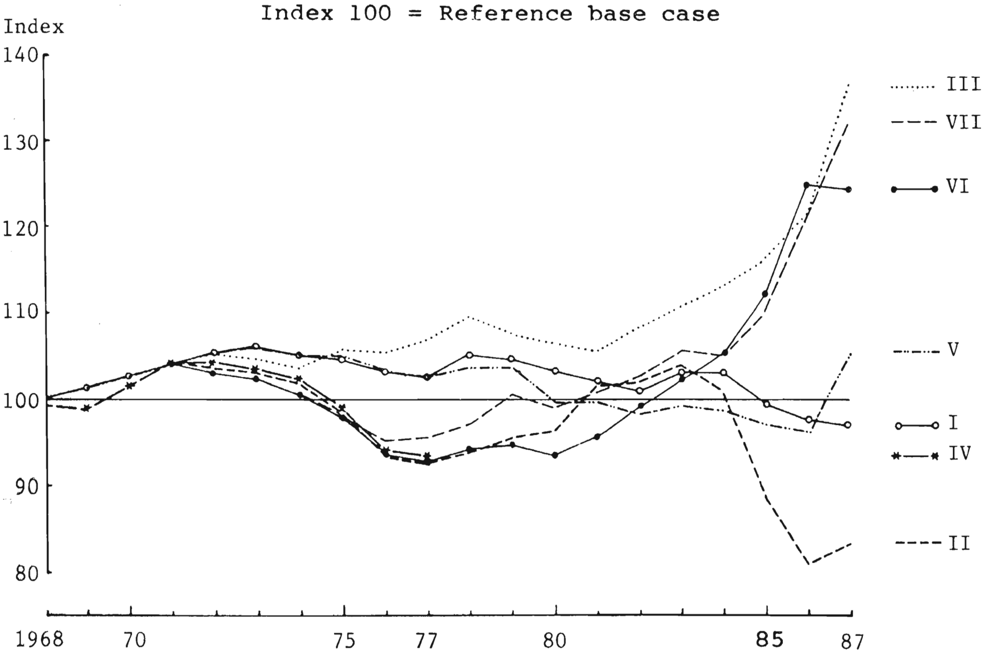
V C-fast depreciation

VI C-slow "

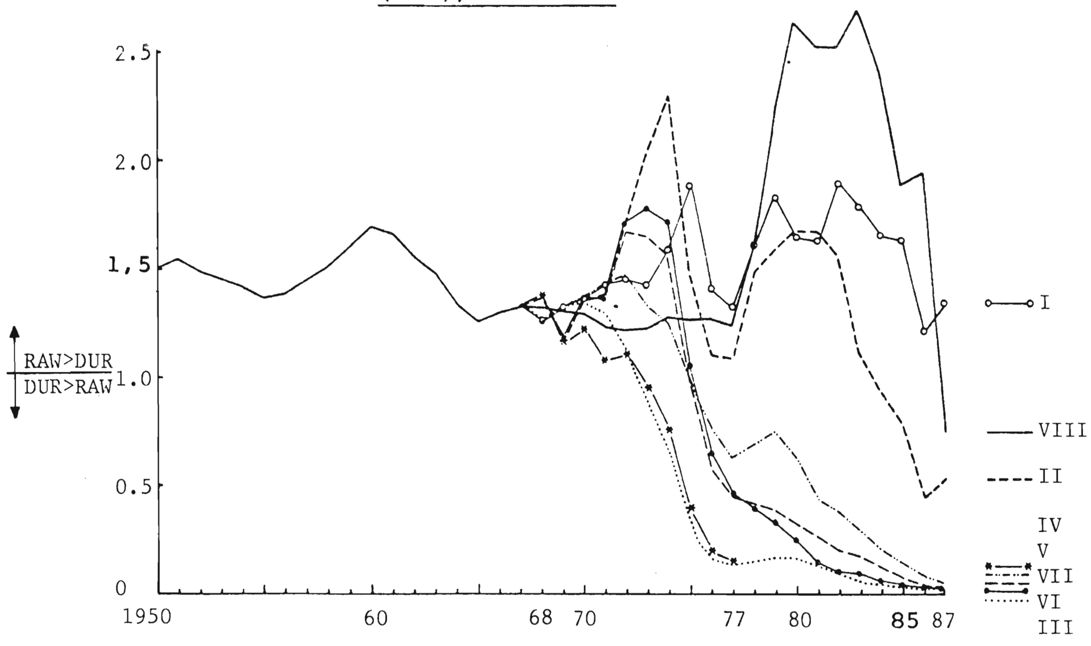
VII C-slow → fast "

Figure 4. Total Manufacturing Output, 1968-1987

Index 100 = Reference base case



Figures 5A. Ratio of Investments in Raw Materials Production (RAW) and in Engineering (DUR), 1950-1987



I A-fast depreciation
II A-slow "
III B-fast "
IV B-slow "
V C-fast depreciation
VI C-slow "
VII C-slow → fast "
VIII Real + ref.

Figure 5B. Employment in Engineering (DUR) in percent of Total Manufacturing Employment, 1950-1987

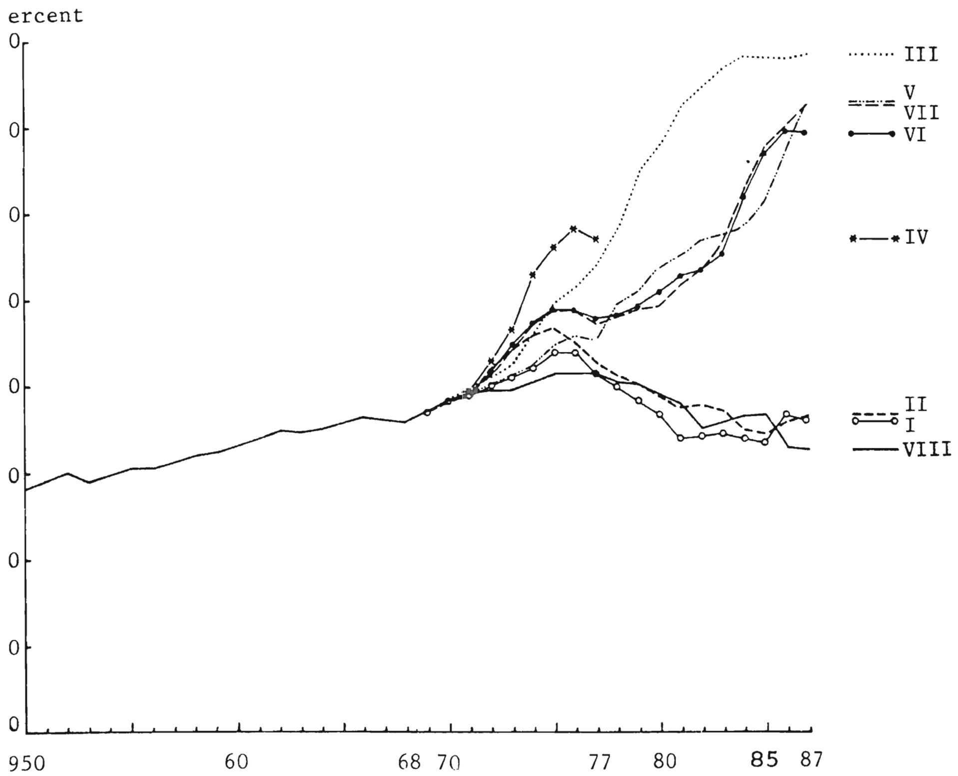
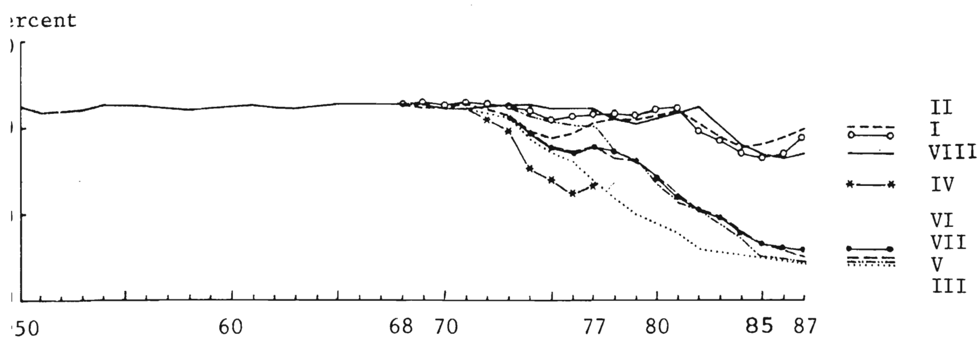


Figure 5C. Employment in Raw Materials Production (RAW) in percent of Total Manufacturing Employment, 1950-1987



I A-fast depreciation
II A-slow "
III B-fast "
IV B-slow "
V C-fast depreciation
VI C-slow "
VII C-slow → fast "
VIII Real + ref.

Figure 5D. Operating Profits in Engineering (DUR) in percent of Profits in Total Manufacturing, 1950-1987

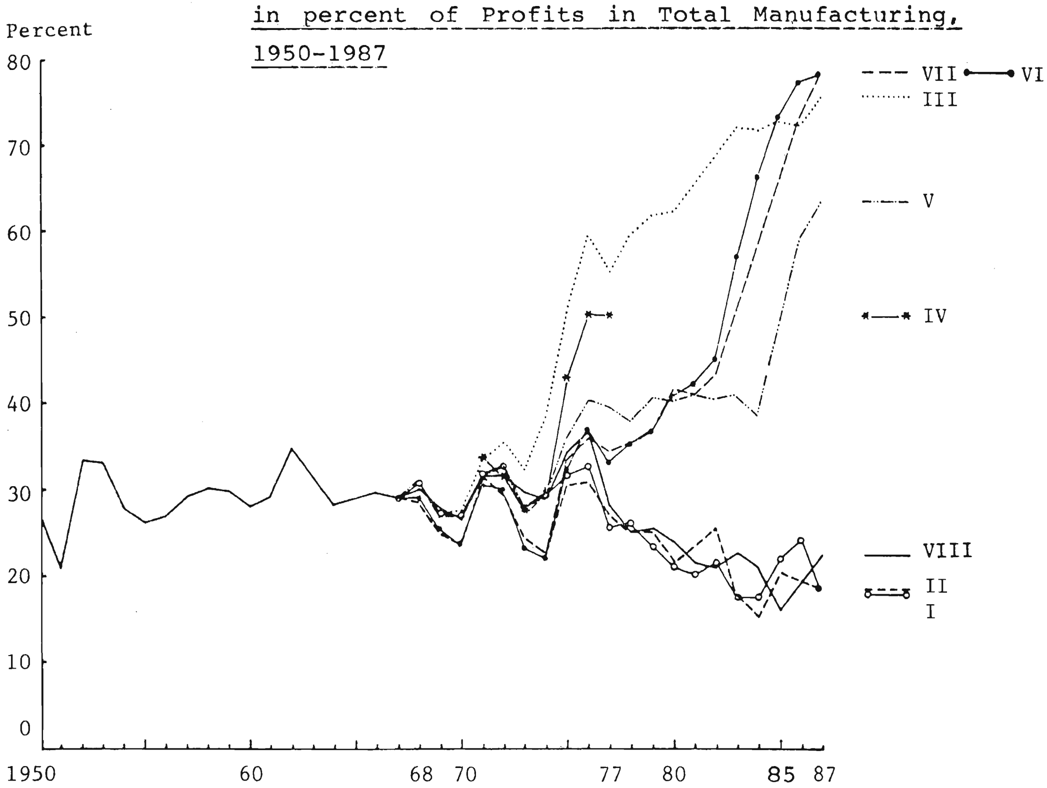
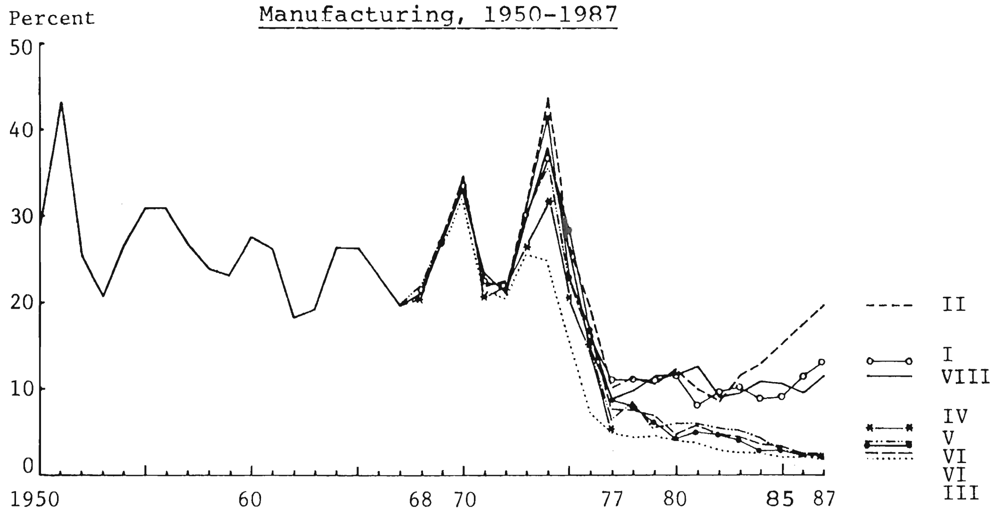


Figure 5E. Operating Profits in Raw Materials Production (RAW) in percent of Profits in Total Manufacturing, 1950-1987



I A-fast depreciation
II A-slow "
III B-fast "
IV B-slow "
V C-fast depreciation
VI C-slow "
VII C-slow → fast "
VIII Real + ref.

Figure 5F. Value Added in Engineering (DUR) in percent of Value Added in Total Manufacturing, 1950-1987

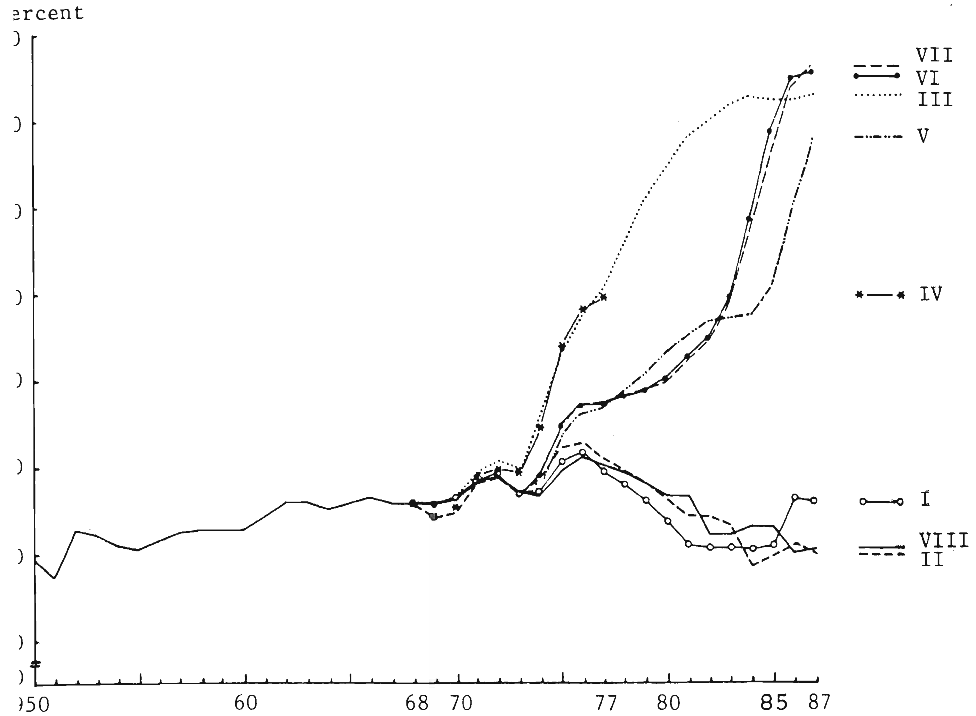
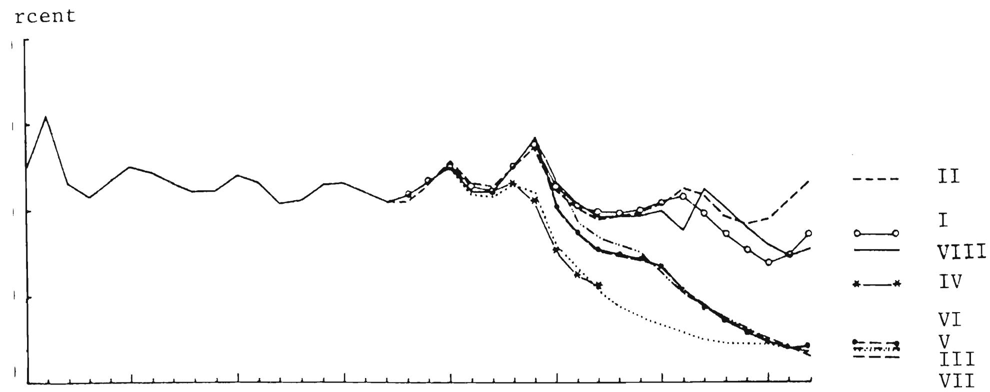


Figure 5G. Value Added in Raw Materials Production (RAW) in percent of Value Added in Total Manufacturing, 1950-1987



I	A-fast depreciation	V	C-fast depreciation
II	A-slow "	VI	C-slow "
III	B-fast "	VII	C-slow → fast "
IV	B-slow "	VIII	Real + ref.

Figure 6A. Rate of Return on Total Assets before Tax, 1968-1987. Total Manufacturing
Index 100 = Reference base case

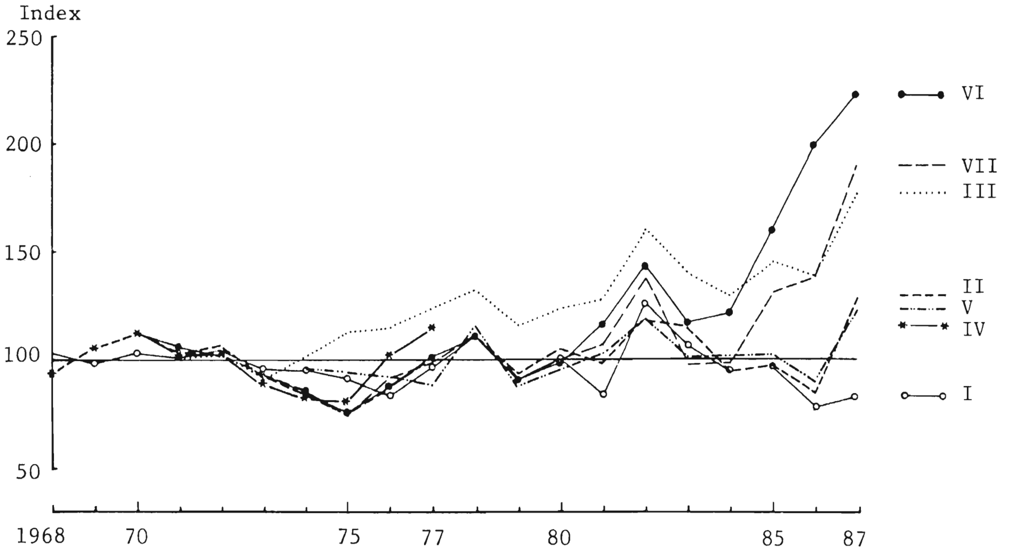
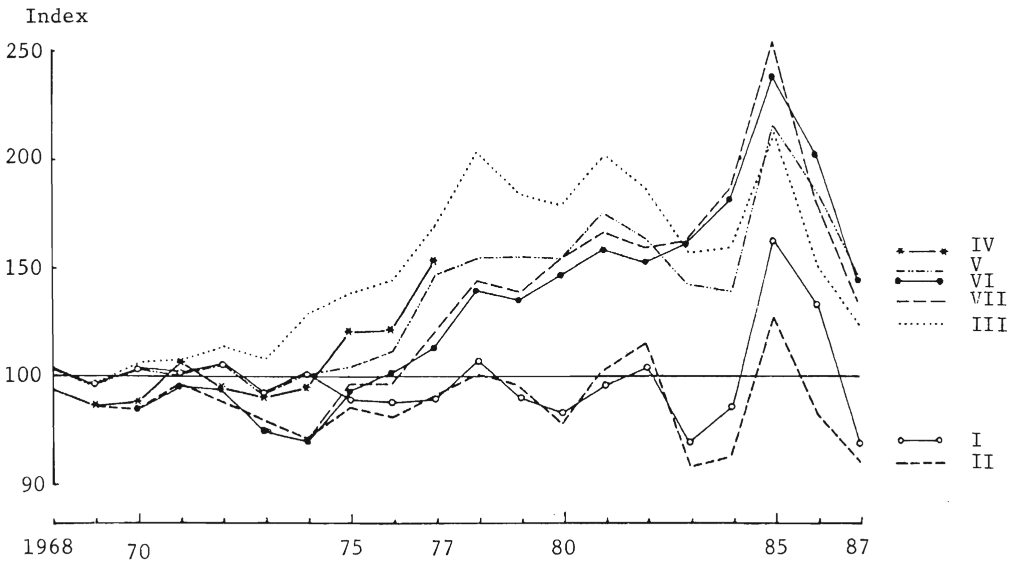
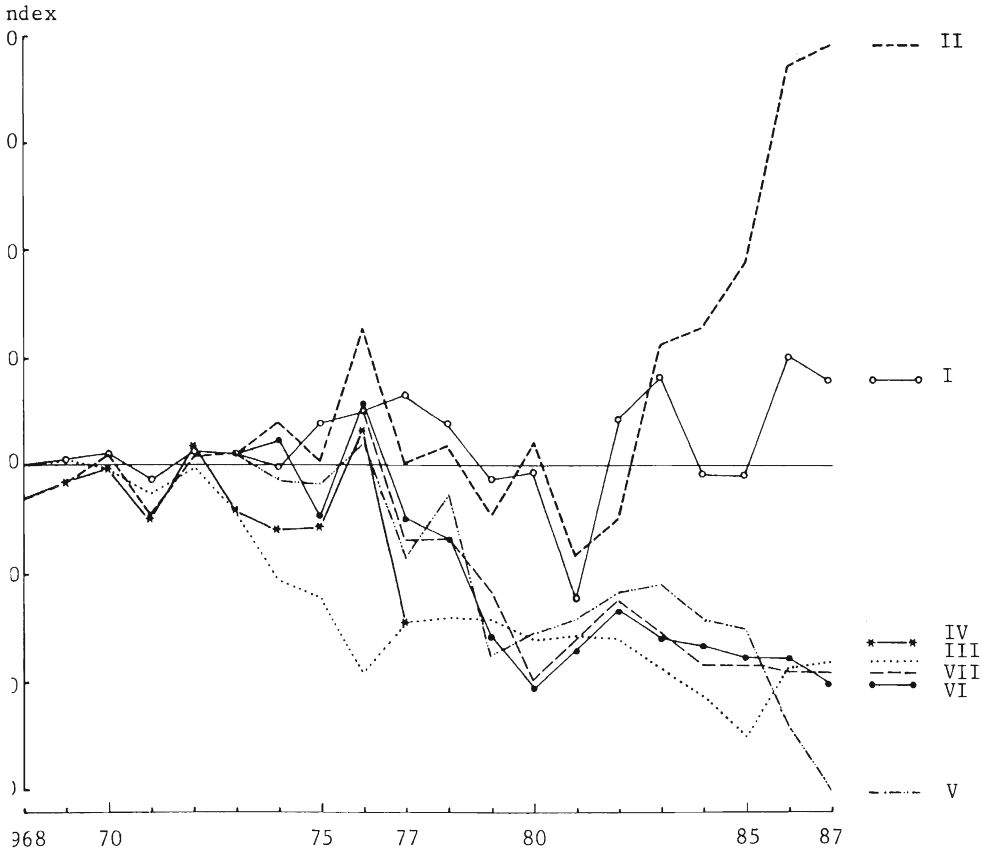


Figure 6B. Rate of Return on Total Assets before Tax, 1968-1987. Engineering (DUR) in Relation to Total Manufacturing
Index 100 = Reference base case



I	A-fast depreciation	V	C-fast depreciation
II	A-slow "	VI	C-slow "
III	B-fast "	VII	C-slow → fast "
IV	B-slow "		

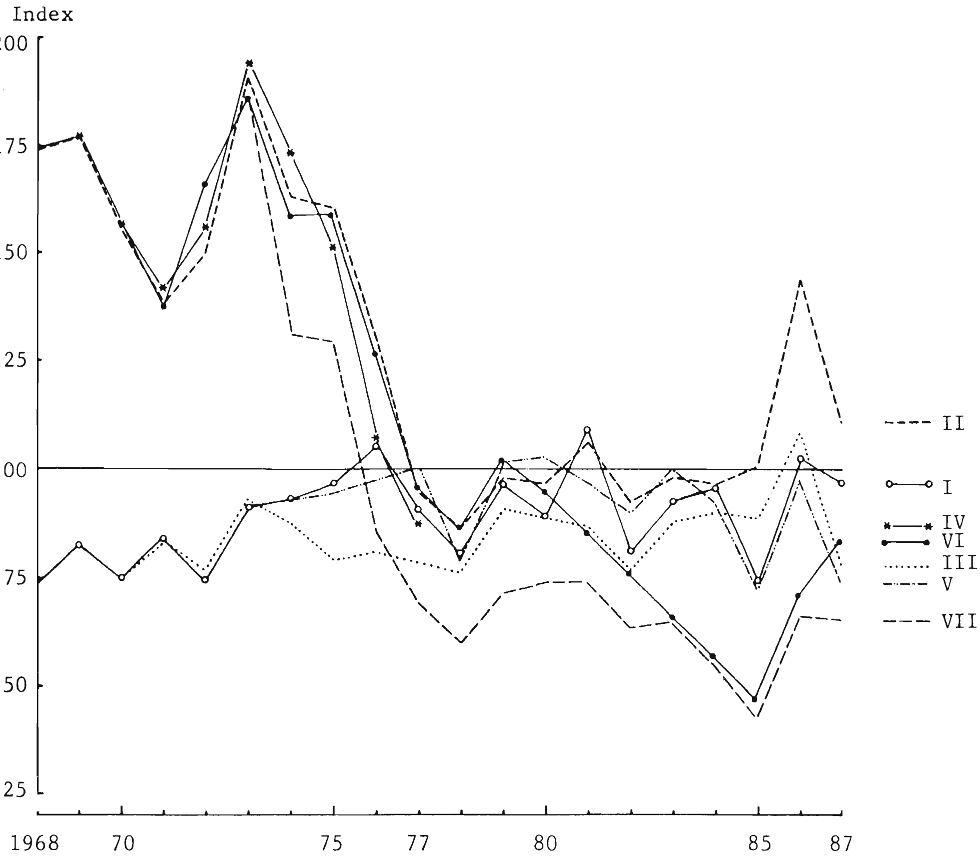
Figure 6C. Rate of Return to Total Assets before Tax, 1968-1987. Raw Materials Production (RAW) in Relation to Total Manufacturing
Index 100 = Reference base case



I A-fast depreciation
II A-slow "
III B-fast "
IV B-slow "
V C-fast depreciation
VI C-slow "
VII C-slow → fast "

Figure 7. Effective Rate of Taxation[a] in Total Manufacturing, 1968-1987

Index 100 = Reference base case



I A-fast depreciation
II A-slow "
III B-fast "
IV B-slow "
V C-fast depreciation
VI C-slow "
VII C-slow → fast "

[a] Effective rate of taxation = Tax bill paid/Operating profits - Calculated depreciation charges.

Figure 8. Rate of Return to total capital before tax
Percent

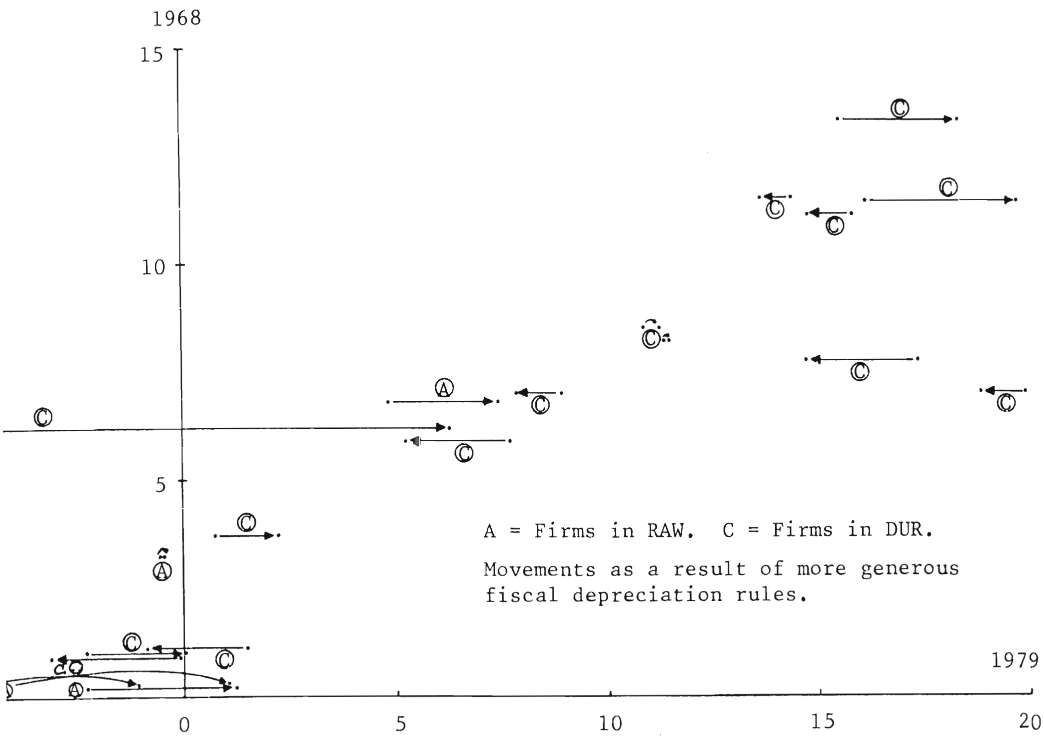


Figure 9. Rate of Return on Net Worth before (RWN) and after(RWNT) Tax 1979
Percent