

Eliasson, Gunnar; Lindberg, Thomas

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Economic Growth and the Dynamics of Wage Determination: A Micro Simulation Study of the Stability Consequences of Deficient Variation in Factor Prices and Micro Structures

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No. 170, 1986

**ECONOMIC GROWTH AND THE DYNAMICS OF
WAGE DETERMINATION**

**- a Micro Simulation Study of the
Stability Consequences of Deficient
Variation in Factor Prices and Micro
Structures**

by

Gunnar Eliasson and Thomas Lindberg

This is a preliminary paper.
Comments are welcome.

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Abstract

Swedish Manufacturing Industry is said to be technologically and commercially in good shape. While Swedish wage levels were higher than in all industrial countries in the mid 70s, wages – expressed in international currencies – have now dropped to a mid position, and real rates of return are back to the average for the postwar period.

Given what empirical research on Swedish labor market behavior tells us, the large devaluation in late 1982 should have been followed by strong wage drift.

However, to understand recruitment and wage setting decisions, one really needs a model in which firm pricing, production and investment decisions are controlled by overriding profitability objectives and where the rate of interest plays a rôle. The Swedish micro-to-macro model is such a model.

Three partial explanations are formulated and tested on panel micro data of firms. We find that:

(1) The relationships between profitability, investment, output growth and increases in employment have been gradually weakened. Firms increasing their employment tend to offer relatively high wages, but they are not necessarily the most profitable firms.

(2) Wage costs per unit of labor appears to be evenly distributed across the population of production establishments in manufacturing, not being above average in profitable firms and above average in distressed basic industries. A distorted wage and reservation wage distribution, hence, may force such strong wage demands on high rate of return industries if they want to expand employment, that they rather abstain.

(3) The high real interest rates appear to increase profit margin requirements in firms such that they have held back recruitment and wage expansion.

The combined impact of these partial mechanisms are simultaneously explored in a dynamic, multimarket setting through the Swedish micro-to-macro model. Simulations suggest;

a) that if expectations and adjustment speeds are changed to mimic the situation in the 60s sudden wage overshooting may easily produce a cost crisis collapse in output from which the economy has not recovered 20 years later, compared to a less inflationary reference scenario

b) that if the initial wage distortion is not corrected long-term growth in the profitable end of the firm distribution will permanently be held back through wage drift.

The latter conclusion can be given two alternative interpretations, not discriminated between in the model.

Either an inert wage reservation structure forces an inefficient allocation of labor over firms. Alternatively new recruitment requires knowledge and skill qualities that are not available in the market in sufficient "quantities".

1. DIVERSITY OF PRICES AND MICRO STRUCTURES¹

– A Description

This paper addresses two indirectly related issues. First, we study several partial problems, one at a time. We look at the micro–economic effects of various mismatches in the ways relative prices clear various markets in the economy. We particularly ask whether a distorted wage structure is pricing certain labor groups out of the market. We also inquire into the consequences of changing wage setting practices when increased real interest rates from a deregulated credit market force higher margin requirements on producers. All policy questions asked, however, relate to the simultaneous, multimarket price and quantity setting processes of a dynamic economy. Hence, second, we ask what pricing behavior, notably the stability of the price system means for the stability of long–term macro–economic growth. In this analysis we use the Swedish micro–to–macro model.

Factor prices and factor use – is labor compensation perverse?

Standard economic theory presumes factors to be paid at rates corresponding to their marginal productivities. We have the problem whether homogeneous labor – all individuals being equally productive in any occupation – should be differently paid because of an incomplete adjustment (search) process. We also ask the related question whether a labor market equilibrium, all labor being adjusted to the same wage is at all compatible with an equilibrium credit market, all firms earning equal returns to capital.

Figure 1 gives data on marginal value product of labor, and wages in Swedish manufacturing by year, 1976 through 1983. Value productivities are "marginal" in the sense of relating to the average of each of 250 manufacturing divisions or firms, together accounting for about 75 percent of total Swedish manufacturing employment. In the figure data (on firms and divisions) have been ranked by productivity from the top down.

¹ We want to thank Bo Axell, Anders Björklund, Harald Lang, Erik Mellander and Nils Henrik Schager, all at IUI, for many comments on earlier versions of this paper.

For an industry in the midst of a structural adjustment process one would expect profitable firms to plan expansion of investment, output and employment and hence generate a tilting of the wage cost structure towards high (profit) performance firms.

We find a distribution of actual marginal value products (in nominal terms) that moves very little through the "crisis years" of 1976–79, and then starts shifting upwards, notably in the upper left performance spectrum, and even more notably in 1983, the year after a 16 percent devaluation (in October), and in 1985.

However, more spectacular is the result that the wage cost distributions² in Figure 1 for firms ranked by value productivity (1) are horizontal throughout the years, and (2) do move very little, even in nominal terms. The average, nominal wage cost level in 1983 was about 50 percent higher than in 1976, and barely above the same level in 1985, two years after the 1984 devaluation. Some "breaking up" of the distribution towards the end of the period can be observed. It does not change the "horizontal trend", but some erratic dispersion of wage costs does occur.

Do profitable firms invest, grow and pay higher wages?

We have no matching data set on the distribution of labor qualities. A standard guess would be that labor quality is correlated with labor value productivity and that labor productivity is strongly, positively correlated with capital intensity of production or the capital coefficient. If a positive relationship between labor quality and measured labor productivity can be assumed, Figure 1 exhibits the perverse relationship that labor remuneration per unit of labor input decreases with "marginal" labor product. The explanation that first comes to mind is that the dispersion of surplus value over labor

² This is not what one normally means by a "distribution". For lack of a more adequate term we will still call it a "distribution", except in contexts where the term can be misunderstood.

costs is related to capital coefficients, or capital productivity. When the difference between labor productivity and wage costs has been corrected for capital intensity the two graphs will picture the relative distributions of profitability and wage costs.

For one year (1979) we have a matching data set on capital coefficients, capital being measured by cumulated machinery and construction investments net of depreciation at reproduction value. When we plot profit margins³ against capital (value) coefficients in Figure 2, we do not even find a positive correlation. It is negative, even though weakly so. Obviously, the remaining, low performing, basic industries with large installations of hardware capital per employee, when measured on a replacement value basis, produce this perverse result. Obviously, again, wages are not at all positively correlated with profitability, an inference also suggested by Figures 3, on a different set of data. There is only a weak positive correlation between profits per employee and the relative wage level.

Somehow available data on wage cost distributions in Swedish manufacturing exhibit a perverse factor price structure in the labor market.⁴ Low productivity labor appears to be systematically overpaid, while high productivity labor appears to be underpaid, and there appears as well to be no relationship among firms between returns to capital and their wage cost level.

There are several ways to interpret these figures.⁵ First of all the explicit ambition of Swedish egalitarian policies and union ambitions have been to

³ Profit Margins (M) in Figure 2 are defined as gross operating profits in percent of value added. The differences between the two curves in Figure 1 show gross operating profits per employee, or $X = PQ/L - W = (PQ - WL)/L = (\text{Profits}/PQ)(PQ/L) = M(PQ/L)$. Q is value added in constant prices and P the value added deflator. W is the wage cost level per unit of labor (=L) input. The difference X should be correlated with M.

⁴ An independent data set for Swedish industrial statistics put together for the years 1977 and 1983 by the National Industrial Board yields the same result as does a similar data set for Norwegian manufacturing. See Lönsamhet och kostnader – en strukturstudie av svensk och nordisk industri, SIND Data, Statens Industriverk, Stockholm, November 1985.

⁵ Note that even though the wage cost distributions across establishments are consistently flat, a considerable spread of wage costs over individuals within each establishment is still possible.

push for the same pay for the same kind and quality of job ("solidaric wage policies"), and even the same pay irrespective of job. In an abstract setting this could be interpreted as aiming for a perfect labor market arbitrage. The hitch is that one would not expect this to be a sustainable state in a dynamic labor market and an industry subjected to rapid structural reorganization.

On the other hand, the observed labor compensation structure appears to be the reverse as compared with U.S. manufacturing experience since the early 70s (Lawrence–Lawrence 1985). The interesting question is whether this difference reflects a corresponding difference in labor market flexibility, that also explains the relatively lower rate of manufacturing growth in Sweden through the observation period and the relatively much faster growth in manufacturing employment in the U.S. during the same period.⁶

⁶ Cf. OECD Employment Outlook, Paris, September 1984, pp. 13–20, Holmlund (1984) and Björklund (1986b).

2. PARTIAL DYNAMIC RELATIONSHIPS – HYPOTHESES

For a company in the higher performance, upper left end of Figure 1, the wage structure shown means a favored position. As long as it can stay there the horizontal and rigid wage structure provides it with a "subsidy", or an above average return to assets. The opposite holds for the low end of the performance spectrum. Economic theory would predict the profitable firms to invest and expand. Offering higher wages and/or lowering prices, hence driving down rates of return until they are all equal on the margin. Expansion would then push up the wage level thus forcing the low end of the manufacturing firm population into a distressed profit situation. Firms would lose labor or exit. Labor would quit or be laid off, and move to growing industries. One would hence expect a dynamic growth process to create a downward tilted wage cost schedule. The question is to what extent the downward sloping productivity schedules can be interpreted as demand curves for labor in a nearly perfect labor market, where all "low wage producers" have been driven out of business. For at least the years 1976–81 the (profit) margin between survival and exit has been extremely slim for the bulk of manufacturing activity (see Figure 1). Through 1981 a rapid expansion of the average wage cost level would suddenly have reduced the profit margins for the bulk of Swedish manufacturing to – after capital charges – loss operations. The suppressed average wage cost level hence, has saved a large number of firms. Has this been the effect of policies, or of endogenous economic forces?

Swedish manufacturing industry being dominated by export firms, the suppressed wage cost level also has had to hold in international currencies. The slim margin between value productivity and the wage cost level thus was established for more than 6 years after a couple of years of extreme wage overshooting, following an extreme, nominal profit boom in manufacturing in 1974, notably in basic industries. A suppressed wage cost level was maintained through the devaluation in October 1982 (see Figure 6) until at least 1985. Until then wages apparently had not caught up.

From the micro–macro analysis reported in Section 3, we observe that wage overshooting in model simulations for these years depends entirely upon how the labor market process is specified. The most realistic simulations taken

from a recent IUI long-term survey of the Swedish economy, suggest that the propensity to wage overshoot during the 70s has been lower than during the 60s (cf. Schager 1985). The explanation could be explicit policies, or central union agreements, a general and realistic fear among the employees for a rapidly rising unemployment, or increased employer resistance to wage escalation. All three factors might have checked wage and salary demands during these years.

Two questions, hence, remain for this paper.

First, why had rapid growth in output not started by 1985 despite the improvement in profitability, and/or why had wages not begun to increase faster?

Second, what would the macroeconomic consequences be of a different wage policy, allowing for much wider wage dispersion on identical jobs?

Why no growth and no wage drift?

Why do not firms in the thin, but very profitable left part of the performance distribution in Figure 1 pull off a general wage expansion, and even more so, why did this not happen in 1983, the year after the extreme devaluation in 1982, when the profitability level of all firms was raised? This would have been the normal outcome in the 50s and the 60s of a situation as that pictured on the diagrams for 1982 and 1983. However, Schager (1985) observes that the pricing process in the labor market has changed for a slower mode since the late 60s. At least he finds little evidence of a pull effect on wages from profits.

Should not high rates of return, nevertheless, stimulate expansion and new recruitment?

There are at least five possible answers to the apparent absence of a strong surge in manufacturing growth, new recruitment and, hence, wage drift. First, firms may simply sense that the current situation is a disequilibrium situation. Current price and profit signals, hence, are not reliable indicators of

the future. Hence, the mode of the labor market has at least temporarily changed for a slower pace. Uncertainty about the future is high. Firms, furthermore, have not yet recovered and re consolidated after the loss years after the oil price shock, at least in an ex ante sense. They dare not set out on a rapid investment expansion path, bidding up wages to recruit labor to man the new plants. (This statement is for all manufacturing. Many firms are still lingering on as semi crisis industries, after having been saved by industrial subsidies in the 70s. During the "old policy regime" they would have been gone by now (Eliasson 1986b). Even though some high performance firms are expanding output quite rapidly this is not sufficient to pull the whole average along at a rapid rate.)

Second, firms do not expand "structurally" as they did in earlier days. Hardware processing is no longer the profitable activity. Firms expand their marketing network, mostly internationally and they concentrate resources on improving product quality, which is not measured properly in statistics on output. Hence, expansion may in fact be occurring but not in such a fashion as to generate more blue collar jobs.

Since expanding firms do not employ the same kind of people as those released from stagnating, contracting or shut-down firms, expansion may be held back due to lack of skilled people. There is a human capital barrier to expansion.

Third, initial conditions, like unused capacity and labor hoarding may make even profitable firms temporarily hold back investment and recruitment.

Furthermore, a not completed restructuring of manufacturing and downward rigidity of wages may mean that relative labor compensation is out of tune with labor productivity, creating reservation wages that drive up the supply price of labor, especially on the margin. For instance, while technical change is moving profitable firms and employment structures away from simple factory production towards more human capital demanding service production (Eliasson 1985b) relative labor compensation of those groups have been declining (see Figure 5 and Deiacio 1986). This seems to have been the case for wage compensation to skills in general (see Björklund 1986b). This is

the classical example of how to create a situation of scarcity through keeping the price "too low".

While compensation to human capital in demand has declined relatively, compensation to labor carrying on close to "worthless production" has been maintained relatively very high through government subsidies (Table 1) such that crisis industries have been capable of paying the highest wages in manufacturing.⁷

High interest rates may hold back wage escalation

Fourth, high real interest rates make it difficult for firms to maintain targeted returns on net worth, earlier subsidized by a positive contribution from cheap borrowing (see Figure 6). Hence, firms have been forced to increase profit margin requirements to meet rate of return targets, imposed in the capital market. This hypothesis is reinforced by the observation that labor, because of Swedish labor market laws, compared to the U.S. situation is very much to be regarded as a fixed cost. Higher interest rates cool down wage increases partly through holding back investments partly through forcing stiffer profit margin requirements on companies.

If the average wage cost level was constantly, somehow, suppressed such that an average rate of return significantly higher than the market loan rate could be maintained, we would have created an inflation prone macro disequilibrium situation in the capital market, resembling the cumulative process of Wicksell (1898). By this interpretation temporarily suppressed wages have created an average return in excess of the market interest. However, this is not currently the situation. The average return to capital is currently equal to, or lower than the market loan rate. (See Figure 6.) To maintain the same

⁷ Policy experiments in the micro-to-macro model (see next section) support the hypothesis that subsidies was the major reason behind stagnation in Swedish manufacturing, and that the distorted wage cost structure was an important part of the explanation (see Carlsson–Bergholm–Lindberg 1981, Carlsson 1983, Eliasson–Lindberg 1981).

real rate of return on equity as before, rate of return requirements on total capital – and hence also profit margins⁸ – have to be raised. Rather than being inflation prone and unstable the high interest rates set in global markets – in a Wicksellian sense – appear to have exercised a derived check on domestic wage escalation. However, if rate of return distributions are very skewed – as in the diagrams – and if relative reservation wages are not flexible enough to accommodate a transfer of manpower (new entrants, unemployed, or employed in low performing firms) to the growth industries at a low level of average wage drift, a micro disequilibrium situation might still exist, that will manifest itself as soon as the economy starts to grow, and a reallocation of labor is needed. The tricky question is why firms in the high performance end of industry have not expanded faster, driving up wages in the process, and the low performance firms out of business.

Answering the original question requires that all these partial mechanisms, the slower labor market model, the new supply demand structure in the labor market, special initial conditions and the Wicksellian disequilibrium be simultaneously evaluated. This is beyond standard econometric modeling and testing techniques. However, micro simulation analysis on an estimated micro-based macro model with dynamic, multimarket price and quantity interactions makes up a good substitute. A write up of the model, specially organized to highlight the relationships we have just discussed, is found in the supplement. In the next section we proceed with the simultaneous testing problem.

⁸ See the margin targeting process so common among firms, as represented in the Swedish micro-to-macro model (Eliasson 1985a, p. 57 ff. Also see Model supplement).

3. WAGE SETTING AS A POTENTIALLY DESTABILIZING PROCESS – Policy Analysis on the Swedish Micro–Macro Simulation Model

Various policy solutions to the Swedish growth problem are discussed and the micro and macro consequences of some of them are studied on the Swedish micro–to–macro (M–M) model. We look particularly on wage determination as the combined outcome (in a multimarket setting) of many partial price and quantity interactions at the micro level. The dynamics of micro–macro interaction may occasionally destabilize the macro economy. A short presentation of the model and the experimental setting follows in the supplement. For more complete presentations the reader is referred to Eliasson (1976, 1977, 1978, 1985a, 1986a). In all experiments firms are assumed to be price and interest takers in foreign markets; prices abroad being the same in all experiments, as are the assumptions about technical change associated with new investments in individual firms.

Do distorted relative factor prices block expansion in profitable firms?

– Formulation of a simultaneous hypothesis

Figures 1 to 5 suggest that rates of change in wages are not correlated with rates of change in profits, as they should not be according to Schager (1985). Since wage change is strongly and positively correlated with change in employment, this implies a weak relationship at the firm level between growth in output, on the one hand, and both profitability and change in employment on the other. This is supported by the diagrams, even though the rate of return measures are not the ones we would prefer to use. Hence, something has held back growth in the profitable firms during the period 1976 to 1985.

As a consequence, reservation wages for blue collar workers on the average – and even more so on the margin, and in particular after Swedish income taxes – have been kept high, and probably above the offered wages of many firms planning to expand factory production. This conclusion is compatible with Schager's (1985) UV–curve analysis, which shows that it takes an open unemployment rate of some 4–5 percent to keep vacancy times for blue collar

workers in manufacturing at around 2 weeks, compared to 2 percent in the 60s. These results are also compatible with Holmlund's (1984) results that those few who have moved have gained an increase in the yearly wage growth rate by more than 2 percentage points, while those who have decided to stay have foregone wage gains of some 2 percentage points per annum.

The hypothesis proposed is that expected profitability has been too low for manufacturing firms to plan expansion of volume production and to hire people, notably blue collar workers. It has been too low because capital costs and taxes together have made reservation wages so steep on the margin, that the expansion of profitable firms has been effectively blocked.

One might even carry the interpretation one step further and ask whether the relative work compensation structures maintained in Sweden might mean that policies and unions are forcing simple blue collar jobs out of the market faster than technology alone – pushing the employment structure in the same direction – would suggest.

This in addition should add to the worries of a possible wage cost explosion, despite the fact that the average wage compensation level has so far been kept very low. If relative wage conserving policies of unions, so typical of Sweden (Björklund 1986a, b) cannot be broken, a rapid expansion of demand and relative wages for engineers, management personal and skilled workers might generate a compensating wage movement at the lower end of the labor force and exactly what is feared might occur; inflation, stagnation of output and low skilled jobs being priced out of the market at an increased rate. This is perfectly compatible with a continued downgrading of the relative wage level of the Swedish economy in international currencies through further devaluations.

The test of the hypothesis will soon be provided by reality. However, preliminary tests of some of the hypotheses can be run prior to that on the Swedish micro-to-macro model.

Are classical alternatives viable policy options?

The exact question asked to the M–M model is whether the classical policy of more flexible factor prices is efficient in engineering the labor reallocation needed to set the economy on a growth path.

If high wage firms are the most profitable and the most expansive firms, a more flexible labor market pricing should mean a wage distribution, tilted in favor of the high profit, fast growing firms during the growth process. The wage consequences for the low performance firms would be more complex. There is the pull effect from the expanding sector, pulling up wages everywhere. But since wages are flexible, those who prefer to stay can stay at lower relative wages. However, if the labor market pricing process were efficient, the wage level would nevertheless increase also in the low performance end, since there would always be many people in a firm that would otherwise leave, and it is close to impossible to have different wages for the same job in the same workshop. These firms which cannot take the higher wage level would exit. This leveling of the wage level across firms – if needed through forced exit – was the aim of the so-called solidaric wage policy of the old Swedish labor market policy model (see Björklund 1986b, Lundberg 1985).

However, if reservation wages and/or actual wages are high, or higher in the low performing or ailing firms, compared to the high performing potential growth firms, the price mechanism would not stimulate the transfer of people away from low performance to high performance industries. These questions are much too complex to be tested simultaneously by standard econometric methods. Micro simulation on a dynamic multimarket model is the only practical approach. The Swedish M–M model can be set up to mimic a more or less fast and efficient simultaneous arbitrage process in the product, labor and capital markets, with particular attention being paid to the dynamic mechanisms of the labor market. Endogenous, forced exit of firms is a standard feature of the model. The initial state upon which the model experiment starts running includes a fairly complete distribution of profit rates, actual wages, reservation wages, production capacity, utilization of production capacity, labor hoarding, etc. in 1982. The model firm computes its own offering wage every quarter during a simulation. High profitability

firms, furthermore, should begin to expand, since investment in the model is directly related to the ability of the individual firm to earn a return over the loan rate, provided capacity utilization is not too low. However, there is a complete demand feedback in the model, and export and import trade depends – in a classical fashion – on relative returns over costs on deliveries in different markets.

As a consequence a set of carefully designed experiments should be capable of capturing the balancing forces involved and also indicates the intermediate balance that is optimal for long–run growth in output (Eliasson 1983). The model has been set up for the year 1982 on (inter alia) the data exhibited in Figure 1. We will then compare the macro outcome for different labor market pricing processes.

(To begin with we will carry on the argument as if labor were homogeneous – as in the model. This argument will produce one explanation. We will then round off the discussion, and hypothetically reason in terms of heterogeneous labor, to see if the interpretations are affected.)

Manipulating the Wage Determination Process – 20 year model experiments beginning 1982

To investigate the influence of the wage determination process on long–term growth in manufacturing output we have run three experiments on the M–M model. The first experiment (Reference Case) has a parameter specification that relatively well tracks macro performance during the 70s and the early 80s.⁹

The performance of the Reference case is illustrated in Figure 8 that compares the simulated wage cost and value productivity distributions 1985 with the real, nominal distributions 1985 according to the most recent data

⁹ This parameter specification was used as a base case in the recent long–term survey of the IUI published in November 1985. See Att rätt värdera 90-talet (Evaluating the 90s), IUI, Stockholm, 1985. Also see Eliasson, 1985a, Chapter VIII.

from the IUI – Federation of Swedish Industries long-term survey. The simulation started on the initial distributions of 1982, also shown in the diagram. The large devaluation in the late autumn of 1982 has shifted and tilted the value productivity distributions almost identically in reality and in the model (see Figure 8). The same holds for the wage cost distribution which has not overshot in the model, because of the slow labor market model specified. This is comforting for the simulation analysis to follow.

We believe that the parameter setting for the labor market relatively well pictures the slow mobility established since the early 70s, as compared with the 50s and 60s (cf. Schager 1985). In experiment No. 2, everything is the same, except that firms only look for, and accept labor from the same industry. We call this the case of a Restricted Labor Market. Only new entrants into the labor market are free to go anywhere for a job. The "second hand" market is tied down completely by either human capital constraints to mobility and/or restrictive union practices.

Experiment No. 3 (Fast Labor Market), finally, is parameterized as the base case No. 1, except that the labor market process is very fast and price transmission from abroad into Sweden, through export trade is also very fast.¹⁰ One could say that the respecifications put the 60s back into the labor market.

One could also say that experiment No. 3 takes the economy closer to the situation of static efficiency each period (quarter) than the other two, through rapidly reallocating labor across the entire firm population. The outcome is also a much more rapid exit of firms through bankruptcy, than in the other runs, because of a wage "cost crisis" generated during the first few years, that in turn generates an "output collapse" in 1987 (see Figure 7).

Policy experiment No. 3 also illustrates the initial factor price shock sensitivity of the Swedish economy, positioned initially, as partially shown for

¹⁰ A principal presentation of the experiments is found in the supplement and more detailed presentation in Chapter VIII in Eliasson 1985a. The parameter setting is that of "classical policies" in Figure VIII:6 (p. 400) or the FAST market regime in Table VIII:1D (p. 390).

1982 in Figure 1. The endogenously generated wage overshooting drove a significant number of firms out of business. The remaining firms were on the average much more productive than the firms in the other experiments, but a higher wage level had been established in the economy, and even though unemployment went sky high, the remaining 10 year period was not enough to drive real wages back to the levels of the other two experiments. As a consequence, output growth in the "statistically more efficient" policy experiment No. 3, never catches up. It is still lagging behind after year 2000 because of a slow investment process and because of a relatively lower profitability level. It should be recalled that when a similar situation occurred in the mid 70s the government saved the firms and kept unemployment low through subsidizing existing high wage, crisis firms, thus preserving their relative wages (see Table 1) and forcing manufacturing output to a standstill for about a decade.¹¹

Manufacturing output growth in the other two experiments is parallel and smooth (see Figure 7). Profitability gradually improves, investment increases in the most profitable firms, no wage cost overshooting disturbs development and productivity increases at increasing real wages and declining inflation.

We observe that a segmented labor market (experiment No. 2) hurts real wages and benefits industry through allowing a somewhat higher profit margin than would have been possible with a more complete wage arbitrage. Productivity is, hence (!!!!), slightly lowered in the segmented labor market experiments, but this is partly made up for in the form of a larger number of labor hours on the job. This technically explains the slightly lower rate of output growth in the segmented labor market case.

Perhaps the Swedish labor force was so badly entrenched through an inoperative pricing system to begin with, that more or less segmentation did not make any difference for the allocation of labor. What was needed to move people was extreme wage overshooting and rapid shut down of inefficient firms, with no protection for people thrown into the market. But even that did not help growth in output because of the overkill associated with the wage cost overshooting. Let us therefore take a look at the micro structures generated in the simulations.

¹¹ See Carlsson 1983, Eliasson–Lindberg 1981.

Does more wage spread give more or less growth in output?

The two hypotheses associated with the growth experiments were, (1) that expansion would tilt the wage cost distribution leftwards in the same direction as the productivity distribution, and (2) that the wage distribution would widen during the reallocation process, but then narrow down again in the rapid, steady growth scenario with a steady profit margin, widen in the disorderly, fast market regime and stay fairly widened, with a large profit margin but a lower growth rate in the restricted labor market allocation case.

Hypothesis (1) was not confirmed in the experiments. Wage cost distributions stayed horizontal throughout the experiments in all three experiments. The reason was – simple enough – that despite homogeneous labor, diverging reservation wages preserved a measure of heterogeneity in the labor market when it came to supply price elasticities of labor. In terms of the micro–macro model both the sticky wages and the preserved wage distributions can be said to be due to imperfect information on the part of labor and/or firms – as discussed by Stiglitz (1985)¹² – a state of imperfection that persists or can be reinforced through multimarket interaction over time.

High wage (crisis) industries were instrumental in checking labor reallocation during the first few years through holding back output and employment expansion in profitable industries, very much as illustrated with historic data in Figure 1. The devaluation, and later the export upswing supported the old wage structure for many years. This effect was, of course, even more reinforced in the restricted labor market experiment. Reservation wages kept labor from moving between firms as long as firms were not shut down, since relatively high wage firms were in trouble and relatively more medium wage firms were expanding. Hence, fast expansion of employment was not profitable and growth slowed down. New recruitment in growing firms was predominantly coming out of new entrants in the labor force, and the horizontal distribution was preserved.

¹² Note, however, that the Swedish micro–macro model represents an ongoing micro market process. It is not an equilibrium model.

Why a slower labor market mode?

Also Schager (1985) reports a low sensitivity of wages to profits, a result that is supported by Figure 3 but which runs somewhat against results from estimating profit functions on data from the 50s and 60s (Eliasson 1974). One can think of three explanations to this. The labor market may have changed between the 60s and 70s. This is supported by Schager's analysis. If so, the results are compatible. Then, however, one has to explain why the mode has changed. There is no expansion mechanism through investment at the firm level directly linked to profit rates. If so, Eliasson (1974) was wrong. There may, however, be a direct link between profit rates, expected profits, capacity utilization, investment, growth in output and employment growth at the firm level as in Eliasson (1974) and in the M–M model. If relative ex ante supply and demand prices in the labor market are all distorted such that expansion of the most profitable firms is stopped, then this profitability, recruitment and wage drift relationship will not be observable from empirical data for those years. This is so because the common factor, growth in output and employment, is not present. This explanation is compatible with both Schager (1985), Eliasson (1974) and with all simulation experiments, although Schager's results depend on particular data characteristics for his sample period. A dynamic micro–macro analysis is needed to sort out what has happened.

This appears to be the reason why a rapid output growth and wage drift phase did not begin after the drastic devaluation in the autumn of 1982. Reservation wages on the margin before tax, were too high for the relatively low paying growth industries to be willing to pull high wage labor out of stagnant or crisis industries. Since new entrants and unemployed were not available in sufficient numbers "growth firms" chose not to expand, and hence did not generate wage drift, as they did in the 50s and 60s. High wage industries, on the other hand, were not profitable. They did not recruit people. (They were more inclined to lay off people, or to exit. Laid off, high wage people from crisis industries had to accept lower unemployment benefits, or be employed by expanding industries at lower wages. Both mechanisms kept the wage distributions from tilting.)

However, why did firms abstain from raiding each other for labor as in the 60s to be able to expand faster? The explanation nearest at hand is that expectations have changed from over-optimism to pessimism, or simply that firm management recognized the favorable, post devaluation profit situation as temporary, and no predictor of the future. Furthermore, the stiffer profit margin requirements that the high real interest rate imposed forced firms to raise their profit margin requirements to maintain an acceptable return on equity (see Figure 6 and formulae (4) and (5) in the supplement). With product prices and wages more or less fully arbitrated, there is little else for firms to do than to compete with productivity (β in formula (5)) through diminishing slack, shutting down low profit operations, or upgrading performance through investment. This is the way wage setting is affected by interest rates in the M–M model. All of this is making for less volume expansion and less recruitment, and, hence, no excess demand in the labor market.

What happens in the longer term?

A significant part of the profit potential created by the 1982 devaluation remained in 1985 both in reality, and in the reference simulation, because of the slow labor market (see Figure 8). It was more than gone in 1985 in the fast labor market experiment (No. 3), mimicking the pre-oil crisis organization of a wage drift prone wage setting process. With the fast labor market mode of the 60s turned on the model continues to create strong wage overshooting and an output collapse in 1987, despite the fact that considerable wage dispersion occurs.

Few distributional differences are recorded between the reference scenario and the restricted wage market setting by 1992 (hence not shown). However, the collapse in output and increased unemployment has stopped wage expansion in the fast market scenario. Profitability and growth have been restored and a significantly increased spread in real wages has been achieved (see Figure 9).

Summing up

While there are several dynamic micro-to-macro explanations of the current Swedish labor market paradox, at least the following two conclusions are consistent with both data and policy simulations on the Swedish micro-to-macro model.

(1) Inflexible relative wages, still reflecting previous relative profitability and price structures figure as important explanations behind output stagnation in the 70s and the absence of resumed rapid growth in the 80s.

(2) The high real interest has checked wage escalation through imposing tougher rate of return and profit margin standards in firms, thus posting a warning for a return of inflationary conditions if the real interest rate is allowed to come down.

However, a perhaps more principal and important observation is that some of the paradoxical disequilibrium situations that we have frequently observed since the mid-70s require dynamic micro-macro models to be understood.

4. SUPPLEMENT ON MICRO SIMULATION METHOD

Micro simulation substitutes for standard econometric testing when it comes to complex empirical analysis. For the analysis of this paper we have used a dynamic, multimarket micro–macro model econometrically estimated or calibrated on panel data on firms for the 70s and 80s. We refer to other publications for further information on the model.¹³

Micro simulation analysis, to which we now turn, is a statistical method of evaluating certain complex hypotheses using the model specification and initial and exogenous data as prior assumptions. One could say that the method allows enormous amounts of evidence bearing on a particular problem to be condensed on an interpretable format. This interpretation includes the facts and the ways facts are organized (the estimated model) as priors.

Contrary to standard econometric testing procedure, micro–simulation analysis, because of the richness of the model, is very demanding on prior experimental design. Hypotheses are easily rejected if someone comes up with an alternative, possible suggestion. In principle, a new experimental design is the same thing as to ask somebody to reestimate all his regressions on a new model, using different priors. In this particular analysis, dealing with a politically very sensitive subject matter, we have gone very far in responding with new simulation experiments and checks on all kinds of alternative interpretations, many of which originate in unfamiliarity with this kind of modeling technique.

The supplement begins with a brief, verbal presentation of the model, then goes on to detail some of the relationships that are particularly important for the empirical subject matter at hand.

The M–M model economy of Sweden

When seen "from above" the macro mapping of the micro–to–macro model is a Keynesian–Leontief, eleven sector model with a non–linear, Stone type consumption system, wealth creation being treated as one separate consumption category, with complete dynamic feedback through demand, through prices and through profits, investment and capacity growth.

Underneath the macro level exogenous Schumpeterian innovative activity upgrades the characteristics of new investment of individual firms. Pricing behavior is interdependent through the product, labor and capital markets. Rate of return criteria imposed through the capital market dominate long–term dynamics in the model and check wage setting in the labor market. Investment in individual firms is determined by a Wicksellian disequilibrium in the capital market, related to the innovative activity in individual firms

¹³ Also called the MOSES model. Both the micro–macro model used and the experimental designs are too complex to be fully described in this paper. For more detail, we refer to Eliasson (1976, 1977, 1978, 1985a, 1986a). For a short presentation of the labor market process, see Eliasson (1983). Albrecht–Lindberg (1982) and Bergholm (1983) include technical presentations of the model.

(see Eliasson 1986c), productivity and wages. A Smithian invisible hand coordinates the whole economy dynamically through monopolistic competition in the product, labor and capital markets. The competitive situation of a firm is based on "technological" process superiority. Foreign prices, the foreign interest rate and technical change in new investment are exogenous. Profit margins on foreign trade affect domestic supply and demand conditions and, hence, domestic prices. With the exception of parameters regulating speed and scanning range of search in the labor market all exogenous assumptions are identical in all experiments reported in this paper.

Model Overview¹⁴ – verbal presentation

The M–M model has been designed to analyze industrial growth processes. Therefore, the manufacturing sector is the most detailed in the model. Manufacturing is divided into four markets (raw materials, semi-manufactures, durable goods, and consumer non-durables). Each market is populated by a number of firms, some of which are real (with data supplied mainly through an annual survey) and some of which are synthetic. Together, the synthetic firms in each industry make up the differences between the real firms and the industry totals in the national accounts. The 250 real firms, or divisions, in the model cover 70–75 percent of industrial employment and production in the base year, 1982. The model is based on a quarterly time specification.

The Labor Market

Firms in the model constitute short–run and long–run planning systems for production and investment. Each quarter they decide on their desired production, employment and investment. Armed with these plans they go into the labor market where their employment plans confront those of other firms as well as labor supply.¹⁵ The labor force is treated as homogeneous in the model in the sense that individuals generate the same productivity on the same job. Productivity is job (firm) specific. Labor is recruited from a common "pool" or from other firms. A search process initiated by the firms through the signaling of vacancies determines the wage level, which is thus endogenous in the model. Even though labor is homogeneous, wages vary among firms, because the market is imperfectly informed about the earnings capacity of firms. This holds both for labor and for firms about competing firms. Information is gathered during the labor market growth process, but the outcome of the search process in terms of firm specific employment and wages in turn determines the earnings capacity of firms and so on. Tendencies of wages to converge to "one price" depend on the speed of markets and the degree of interdependency between markets. The closer wages get to the "one price"

¹⁴ This "Model overview" paragraph is a slightly modified version of Bo Carlsson's presentation in "Industrial Subsidies in Sweden: Simulations on a Micro–to–Macro Model", in Microeconometrics, IUI Yearbook 1982–1983, Stockholm, 1983.

¹⁵ Eliasson (1985a, Chapter II, and 1986a) includes a rather detailed account of the labor market pricing process.

situation the more unstable the macro economy becomes.¹⁶ Since the labor market is subdivided into industries, not regions, mobility in the labor market is probably overestimated. This is important in interpreting simulation results.

The micro-to-macro model features an endogenous firm entry and exit device. Exits occur when net worth of a firm goes below a certain minimum level in percent of total assets (bankruptcy) and/or when the firm runs out of cash (liquidity crisis). The firm, of course, gradually fades away through lack of investment if its cash flow diminishes and if it cannot borrow in the capital market at the going interest rate.

Domestic product prices and the production volume in the four product markets are determined through a similar process. The output volume of the individual firm is determined endogenously in the following way.

The Production Decision

Each quarter the firm determines its production volume in two steps; desired production volume is first determined taking into account desired changes in inventories of finished goods, based on expected total sales (including exports) which are in turn based on the firms' historical experience. This first production plan is revised by the firm with regard to its profit target, capacity utilization, and the expected labor market situation. The production plan is then executed. Production volume is distributed to export and domestic markets according to relative profit margins. (If the export price (exogenous) is higher than the domestic price, the firm tries to increase its export share and vice versa. However, the adjustment takes place over several quarters, not instantly. If the export price is lower than the domestic price, the firms do not try to lower their export share but rather maintain it at a constant level. In spite of this asymmetry concerning the effect of positive or negative price differences between exports and the domestic market, it turns out that the export shares in the various markets can both increase and decrease. This depends on whether firms with high export shares fare better or worse than other firms in the market. The import share in the four markets is also determined by the difference between the export and domestic prices with a certain time delay. High domestic prices relative to foreign prices lead to increasing import shares.)

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

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

¹⁶ This dynamic property of the model has been elaborated at length in Eliasson (1983, 1985a, Chapter VII).

The exogenous variables (besides government policies) which drive the model are the rate of technical change (which is specific to each sector and raises the labor productivity associated with new, best practice investment in each firm), the rate of change of prices in export markets, and the rate of new entrants in the labor market.

Endogenous Pricing Decisions in a Multimarket Setting

In contrast to most econometric macro models, domestic prices and wages are determined endogenously in MOSES through price feedback via income formation and market demand. Firms operate simultaneously in product, labor and capital markets, making price determination in the three markets interdependent. Firms read off the market prices and reinterpret them into expectations that in turn influence the firms' expected profits and therefore their production plans, the allocation of sales to domestic and export markets, their investments, and therefore their productivity. This is the main mechanism through which resource allocation is determined in the model. These features make the model especially suited for analyzing the effects of policy measures, which can be expected to influence the expectations and plans of firms and which influence the development of prices and wages. The advantage of a micro-based simulation model is, that one can introduce various policy measures affecting individual firms rather than industries and analyze the effects. In a more traditional macro model one is usually forced to make assumptions regarding the resource allocation effects, i.e. one has to assume a large portion of the results.

The Control Function of a MOSES Firm – Mathematical Presentation

Capital market dynamics of the M–M economy derives from the profit targeting formula that monitors both production and investment decisions. It guides the firm in its gradient search for a rate of return in excess of the market loan rate. To derive these formulae we decompose total costs of a business firm over a one year planning horizon, into:

$$TC = wL + p^I \cdot I + \left(r + \rho - \frac{\Delta p^k}{p^k} \right) p^k \cdot \bar{K} \quad (1)$$

w = wage cost per unit of L

L = unit of labor input

p^I = input price (other than w and p^k) per unit of I

I = units of input

r = interest rate

ρ = depreciation factor on $K = p^k \bar{K}$

p^k = capital goods price, market or cost

\bar{K} = units of capital installed

In principle the various factors (L , I , \bar{K}) within a firm can be organized differently, yet achieving the same total output. Depending upon the nature of this allocation the firm experiences higher or lower capital and labor productivity, as defined and measured below. We investigate the

capital–labor mix achieved through the market allocation of resources between firms.

The firm sells a volume of products (\bar{S}) at a price p^X ($S = p^X \cdot \bar{S}$) such that there is a surplus revenue, ϵ , over costs, the profit:

$$\epsilon = p^X \cdot \bar{S} - TC \quad (2)$$

The profit per unit of capital is the rate of return¹⁷ on capital in excess of the loan rate:

$$\bar{\epsilon} = \frac{\epsilon}{K} = R^N - r \quad (3)$$

K has been valued at current reproduction costs. Hence, ϵ/K expresses a real excess return over the loan rate. r is a nominal interest rate.

Using (1), (2) and (3) the fundamental control function of a MOSES firm then can be derived as¹⁸:

$$R^{EN} = M \cdot \alpha - \rho + \frac{\Delta p^k}{p^k} + \epsilon \cdot \phi = R^N + \bar{\epsilon} \cdot \phi \quad (4)$$

$$M = 1 - \frac{w}{p^X} \cdot \frac{1}{\beta} \quad (5)$$

M = the gross profit margin , i.e., value added less wage costs in percent of \bar{S}

R^{EN} = $(p^X \bar{S} - TC - \rho K - r \cdot (\text{Debt})) / E$ the nominal return to net worth
($E = K - \text{debt}$)

α = \bar{S} / \bar{K}

β = \bar{S} / L

ϕ = $\text{Debt} / E = K - E / E$

ϵ = $(R^N - r)K$

The investment decision

In the MOSES M–M model firm owners and top management control the firm by applying targets on R^{EN} , the return on equity. This is the same as to say that they apply profit targets in terms of ϵ . Hence, (4) and (5) establish a direct connection between the goal (target) structure of the firm and its operating characteristics in terms of its various cost items.

¹⁷ The rate of return is then defined as

$$R^N = (p^X \cdot \bar{S} - TC - \rho \cdot K) / K.$$

¹⁸ For proof of (4) and (5), see Eliasson (1976, 1985a, p. 110 ff.).

The ϵ and the rate of capacity utilization determine the volume of investment of the individual firm.

A high interest rate raises profit margin targets in the production decision and imposes a squeeze on wages

Management of the firm delegates responsibility over the operating departments through (4) and appropriate short-term targets on M (production control) and long-term targets on ϵ , that control the investment decision.

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

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

Product market conditions determine to what extent a firm can compete through lowering its price. Labor market conditions, including reservation wages in the market and the activities of all other firms, determine what the firm has to pay its labor. Hence, profitability performance depends on the ability of the firm to upgrade its productivity, or β in (5). This is particularly important for the theme of this paper. Figure 6 shows that the average (industry) ϵ disappeared completely after 1975. By 1975, however, real rates of interest were above those before 1975. The contribution to the rate of return on equity from a too low, distorted market rate of interest was all but gone. Rate of return requirements on equity, nevertheless, were as high, or higher than before 1975. To perform up to capital market requirements firms had to increase profit margin requirements in their recruitment decisions. With prices more or less given in world markets, and productivity (β in (5)) restricted by technical facts and investment, the firm has only one way (see (5)) to raise margins (M) to meet rate of return requirements on equity, namely to be very tight in offering higher wages. If labor is not forthcoming at a slow wage change, there is no new recruitment.

Technological competition through innovative behavior – closing the model

The ϵ of an individual firm is generated through innovative technical improvements at the firm level (Schumpeterian innovative rents) that constitute Wicksellian type capital market disequilibria defined at the micro level. The expected ϵ drives the rate of investment spending of the individual firm. The standard notion of a capital market equilibrium is that of all $\epsilon_i = 0$.

A new investment vintage can be regarded as a "new firm" with exogenous capital productivity ($\alpha = \bar{S}/\bar{K}$) and labor productivity ($\beta = \bar{S}/L$) characteristics. A new investment can be seen as a new vintage of capital with its particular (α, β, ρ) characteristics in the profit control function (4) that mixes with existing capital installations in existing firms.

Firms set prices and quantities and compete freely in all markets, thereby competing Schumpeterian innovative rents ϵ away from each other, if they cannot be maintained through some innovative process, that generates new ϵ 's all the time. Part of competition takes place in the capital market, where high ϵ performers attract relatively more funds for investment than low performers. This process can be said to be a long-term micro version of Wicksell's (1898) "cumulative process", at the time regarded as an inflation theory (see Eliasson 1984).

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Table 1 **Relative wages in crisis industries**
Index 100 = other industries

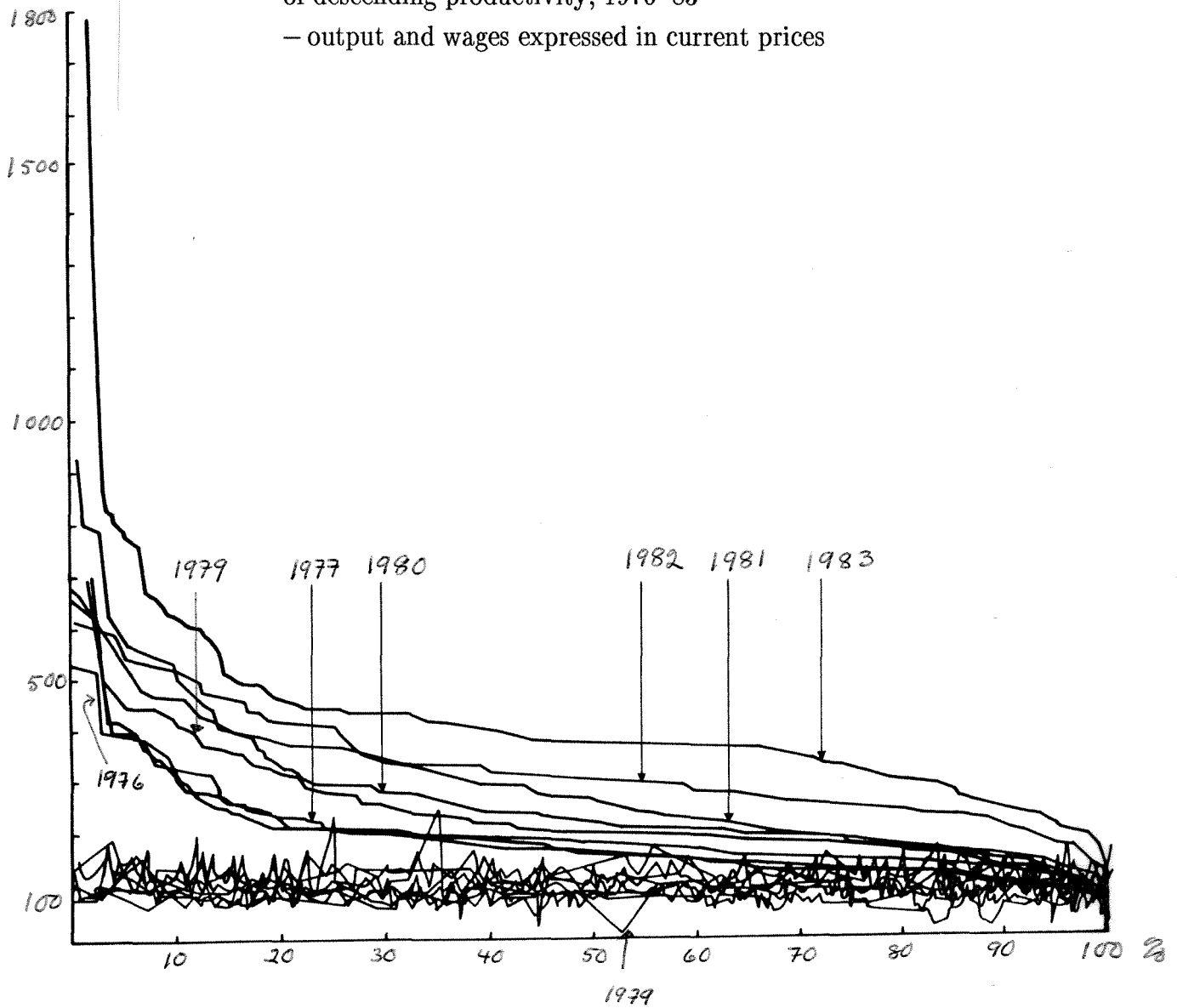
	1970/72	1974/76	1980/82
Iron ore	119	127	125
Steel	114	122	114
Shipyards	109	109	106
Other industry	100	100	100

Source: Örtengren (1988).

Table 2 **Wage and price increases, profit margins and open unemployment in policy experiments**

	Experiment	First 10 year period 1982–1992	Second 10 year period 1992–2002
<u>Wages, average nominal increase percent per year</u>	No. 1 (60)Ref	7.1	9.3
	No. 2 (61)Restricted	5.7	7.8
	No. 3 (62)Fast	18.6	7.2
<u>Producer prices ditto</u>	No. 1	6.9	5.9
	No. 2	6.9	5.6
	No. 3	8.5	4.6
<u>Profit margins percent of value added</u>	No. 1	56.1	65.5
	No. 2	59.1	70.8
	No. 3	34.5	40.6
<u>Unemployment percent</u>	No. 1	3.2	1.8
	No. 2	2.4	1.2
	No. 3	15.2	18.3

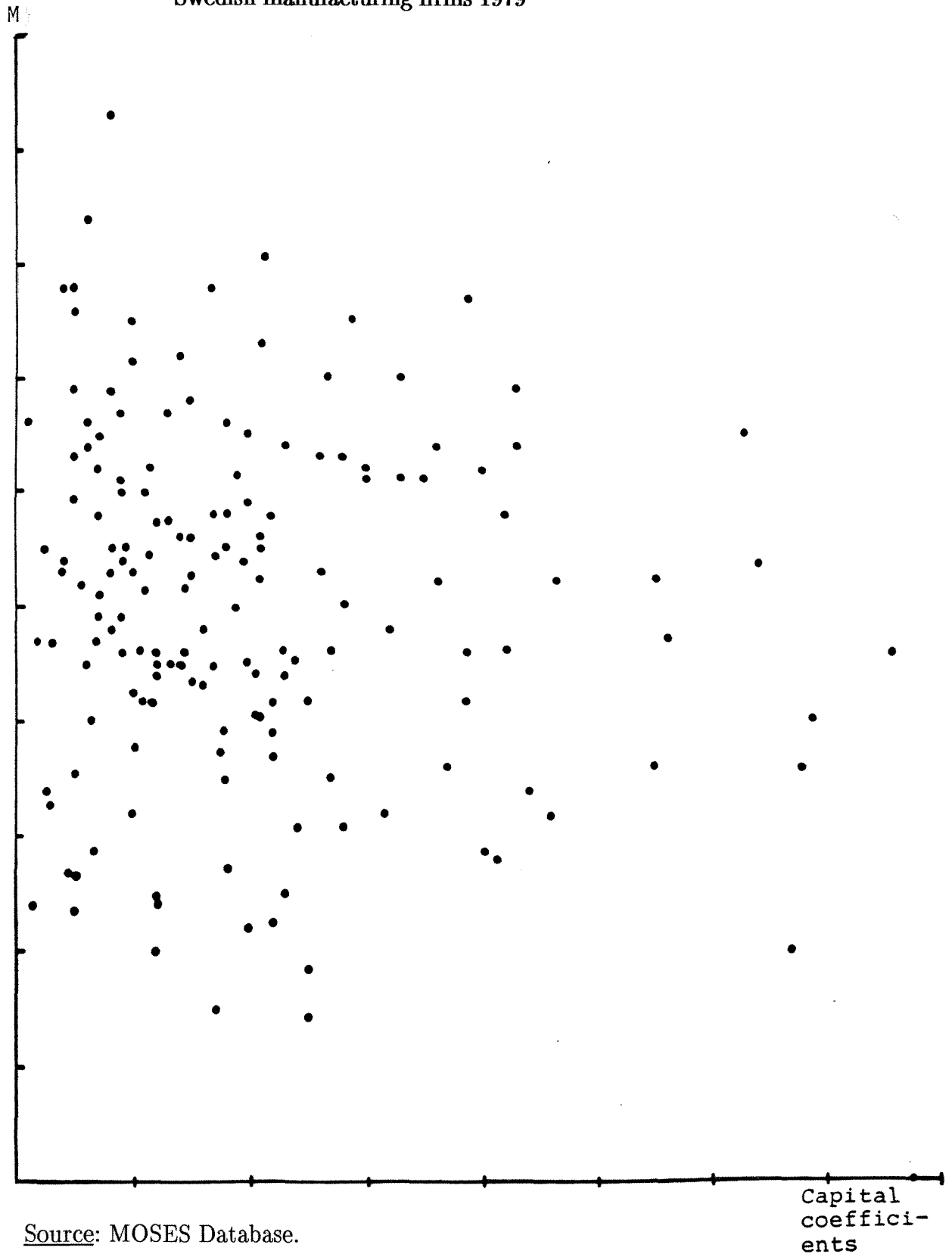
Figure 1 Distributions of labor value productivity and wage costs
- distributions over firms in Swedish manufacturing in order
of descending productivity, 1976-83
- output and wages expressed in current prices



Explanation: Individual firms or divisions have been ranked by falling marginal value productivity (thousand SEK per effective man year). This is the upper schedule. The matching wage cost schedule is shown below. A vertical line combines value productivity and wage cost of the same firm. Since averages for firms have been used the time representation should be discrete; one column for each firm or division, its step length indicating the size of the firm in terms of percent of total value added in manufacturing industry. The large number of units makes this representation graphically impossible.

Source: MOSES Database.

Figure 2 Profit margins (M) and capital (value) coefficients (K/PQ) in Swedish manufacturing firms 1979

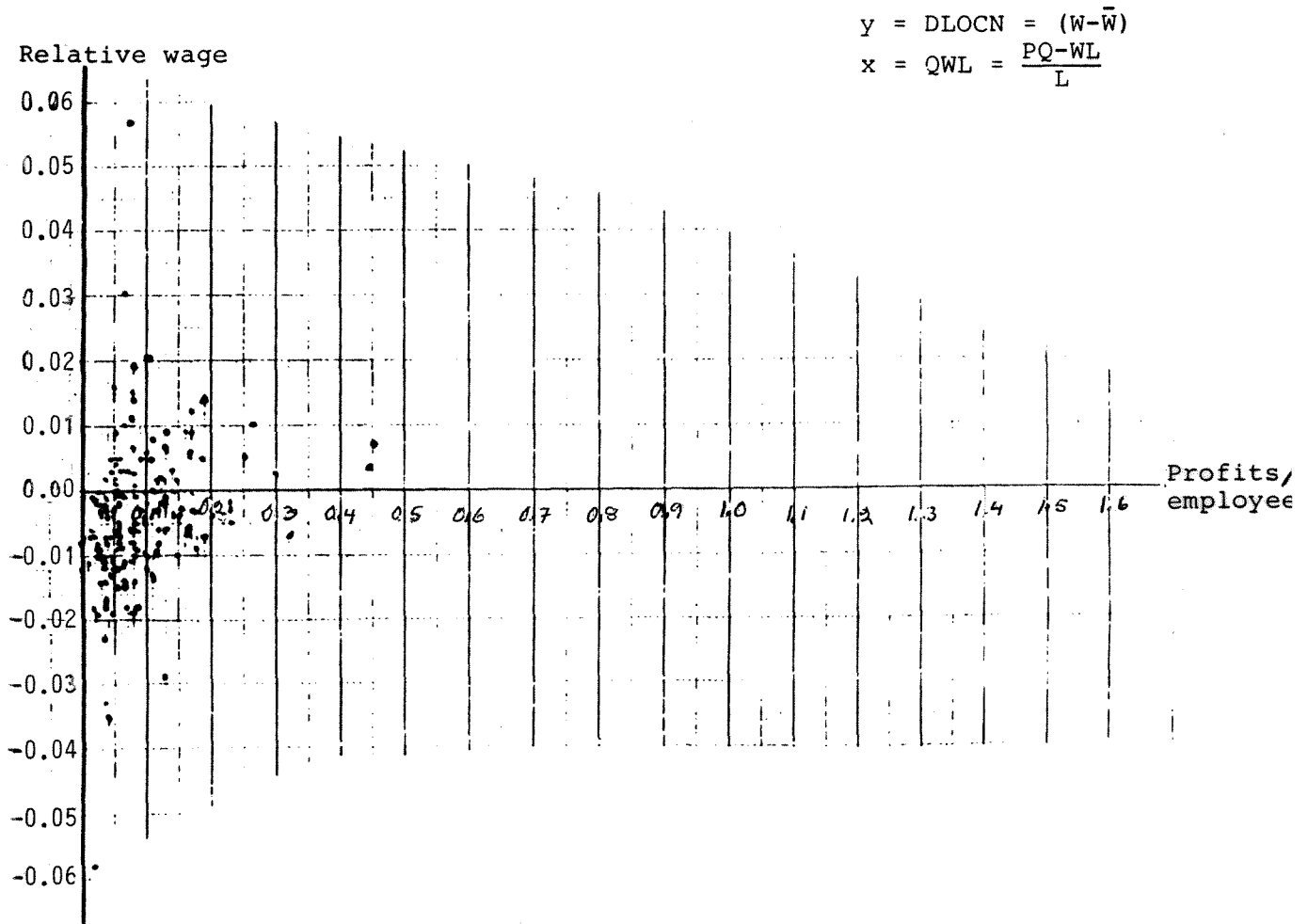


Source: MOSES Database.

Capital
coeffici-
ents

Figure 3 Profits per employee and relative wage (RW) in Swedish manufacturing firms 1976 and 1983

3 A. 1976

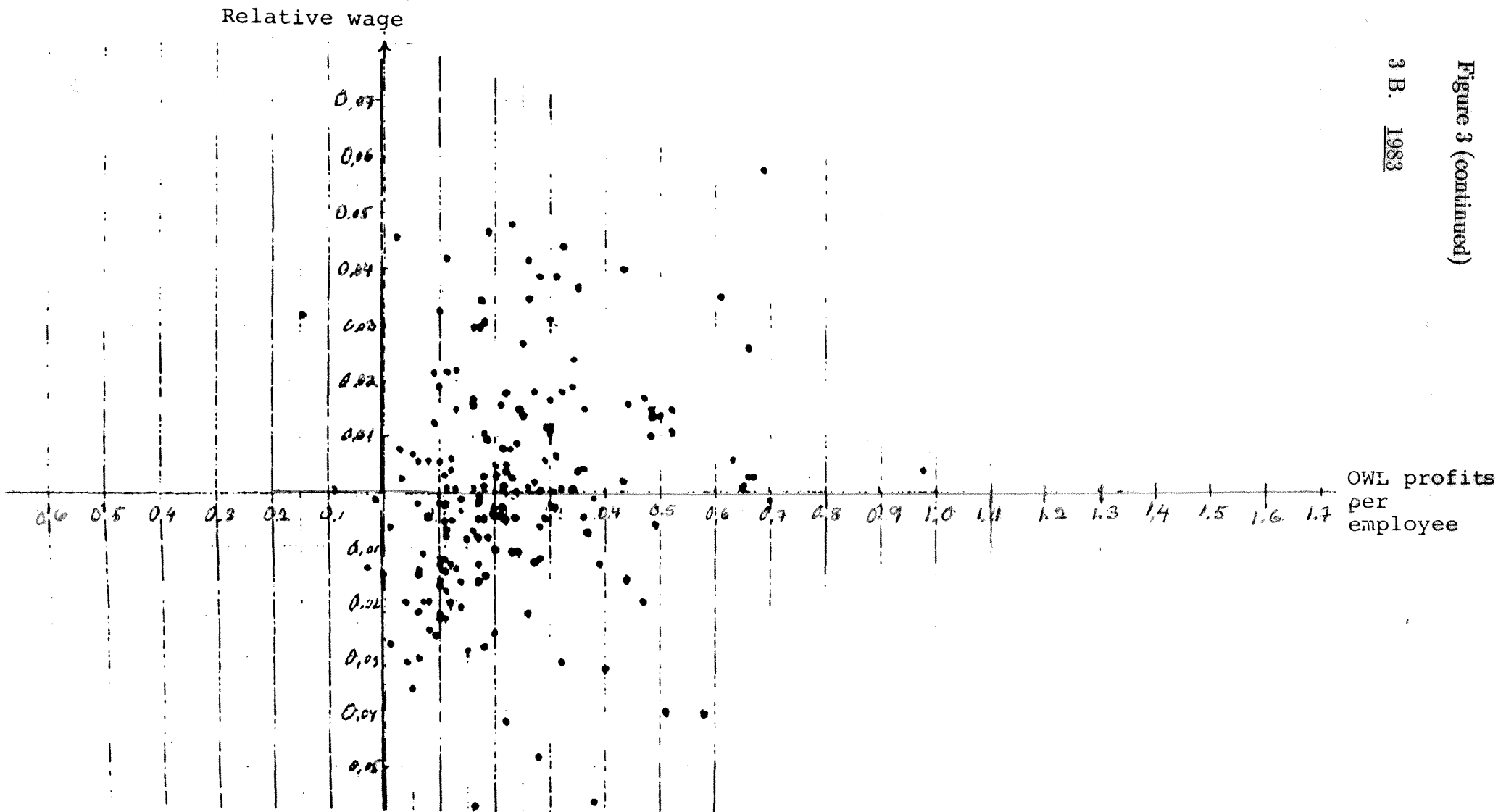


Note: Relative wages (RW) are defined as percentage wage difference from industry average.

Source: MOSES Database.

Figure 3 (continued)

3 B. 1983

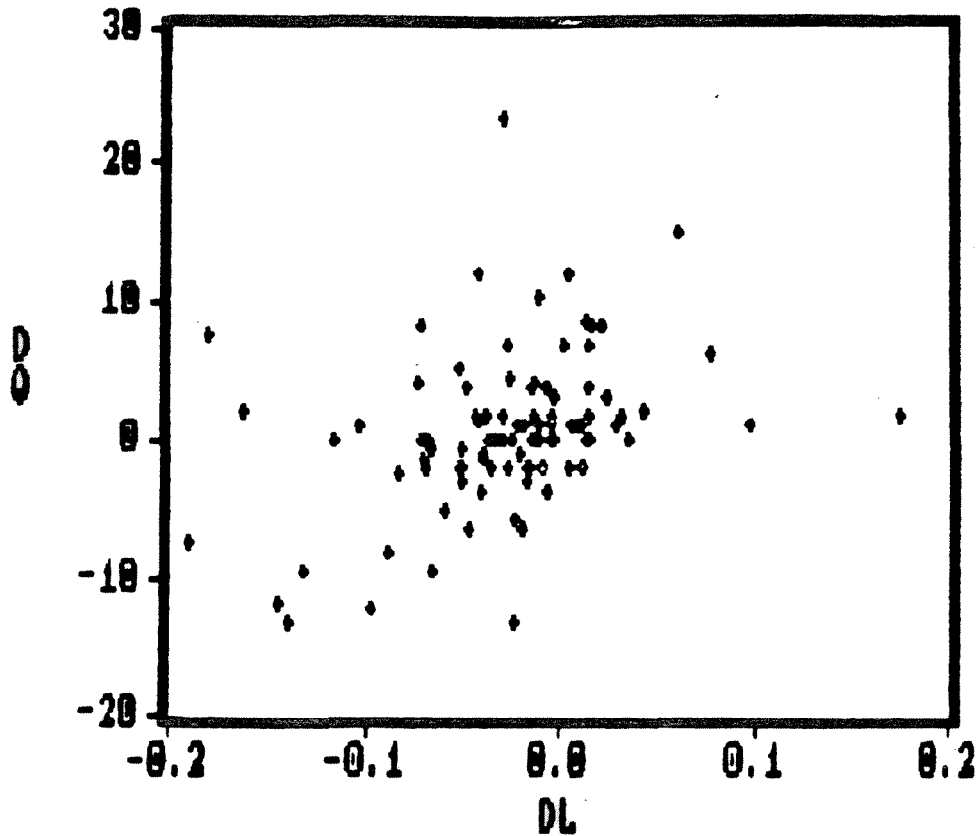


Note: Relative wages (RW) are defined as percentage wage difference from industry average.

Source: MOSES Database.

Figure 4 Relative wages, relative change in profit margins, and relative wage, employment and output change in manufacturing establishments

4 A. Relative output (DQ) and employment (DL) change 1980-83.



$$DQ = 1.7 + 37.7 DL, \quad R^2 = 0.13$$

(3.8)

DL = Relative change in employment

DQ = Relative change in deflated value added

DW = Relative change in wage costs per unit of labor input

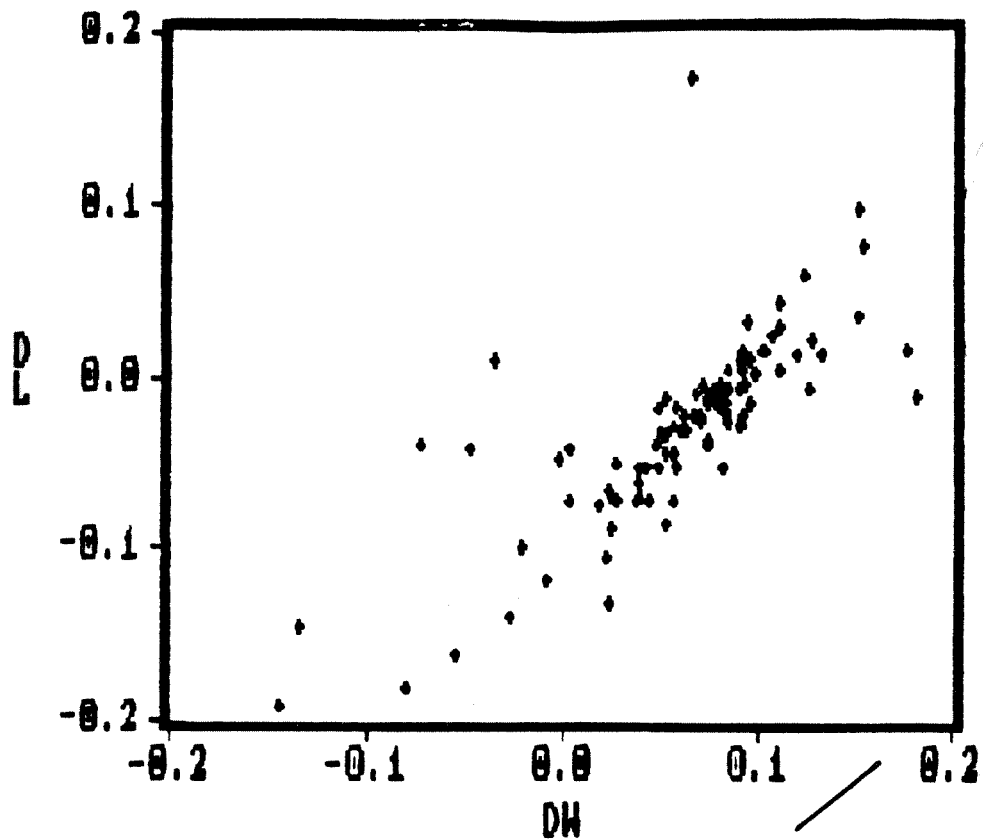
DM = Change in profit margins (percentage points)

RW = Rate of deviation from average wage in manufacturing (percent)

Source: MOSES Database.

Figure 4 (continued)

4 B. Relative employment (DL) and wage (DW) change 1980–83.



Source: MOSES Data Base.

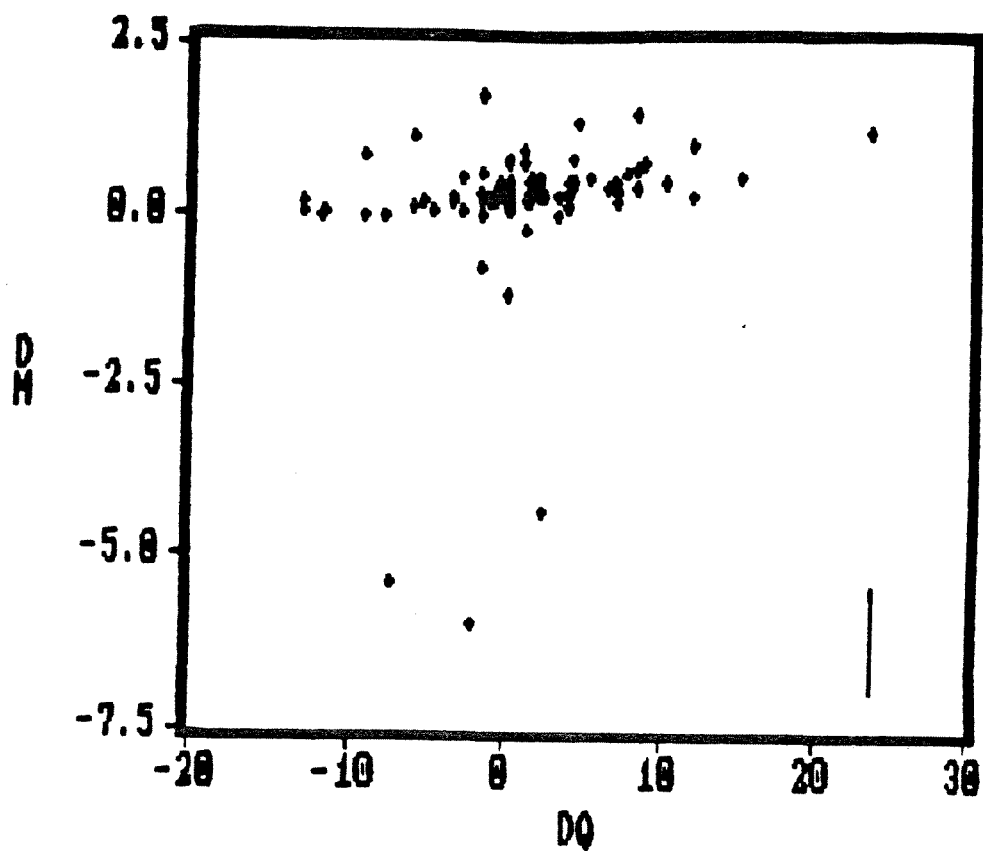
$$DW = 0.1 + 1.4 DL, \quad R^2 = 0.58$$

(11.4)

Source: MOSES Database.

Figure 4 (continued)

4 C. Relative change in output (DQ) and in profit margins (DM) 1980-83.

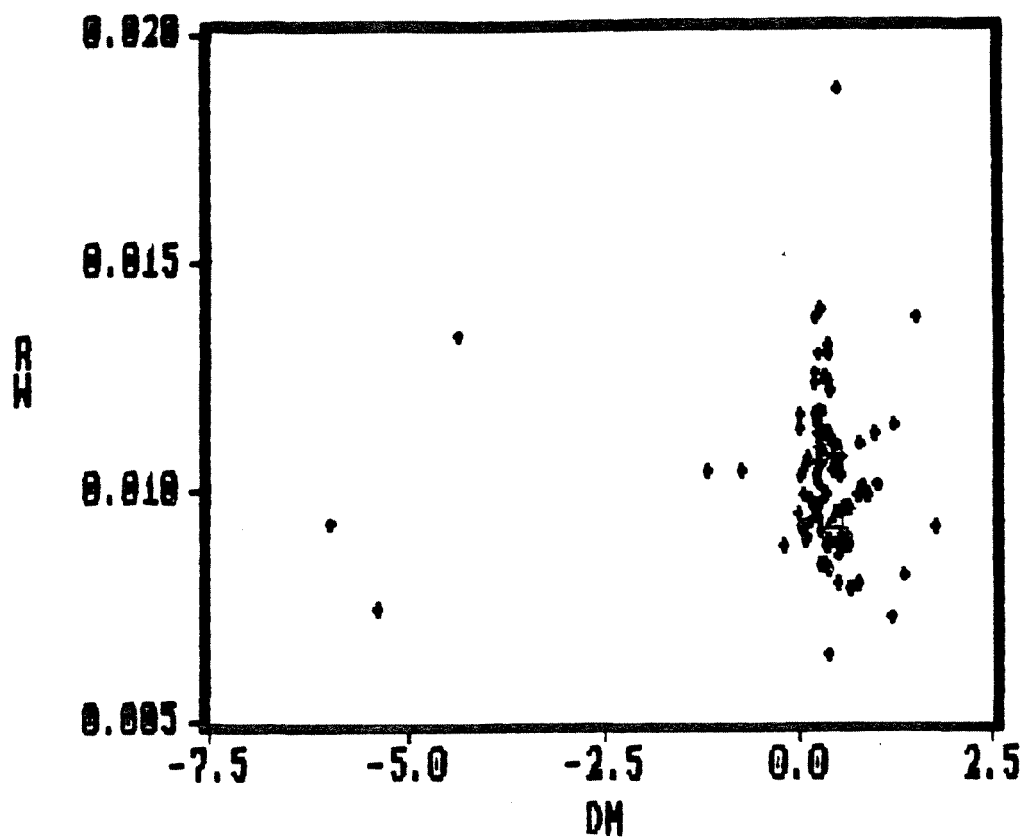


Note that DM measures change in profit margin expressed in percentage points.

Source: MOSES Database.

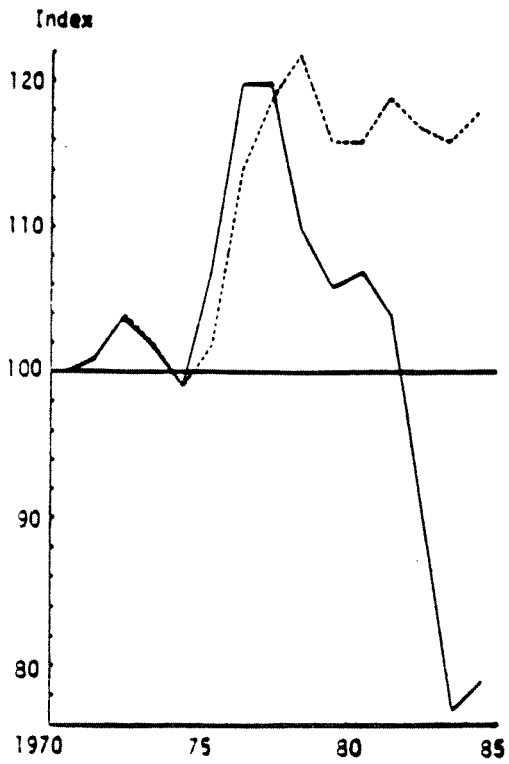
Figure 4 (continued)

4 D. Relative change in profit margins (DM) and relative wages (RW), 1980-83



Source: MOSES Database.

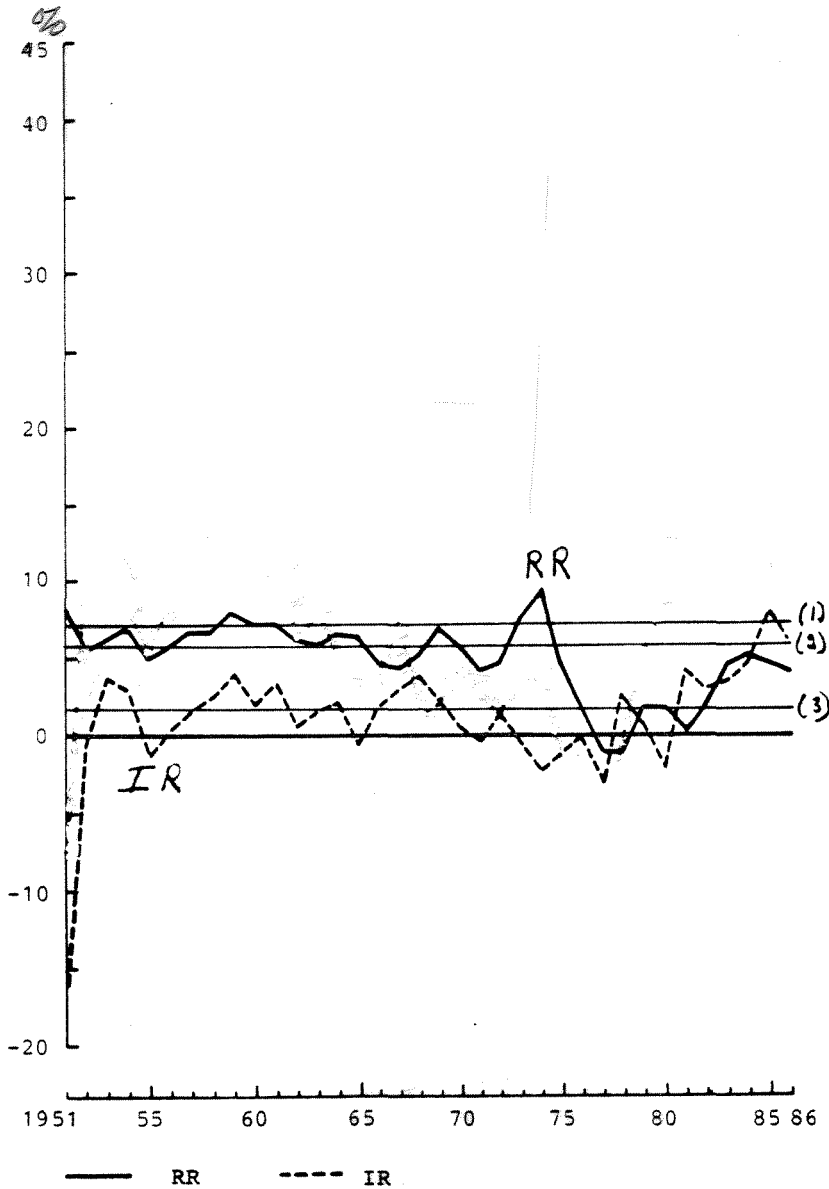
Figure 5 Relative labor cost per unit produced, domestic and foreign currency. Swedish manufacturing 1970-84
Index 1970 = 100



----- domestic currency
———— foreign currency

Source: Schager (1985).

Figure 6 Real rate of return in Swedish manufacturing (RR) and the Swedish real interest rate (IR), 1951-86
Index 1975 = 100



Note: Real rate of return (RRT) on total assets (machinery, buildings and inventories) in the manufacturing industry 1951-85 and real rate of interest (IR) on long-term industrial bonds.

Source: Expansion, avveckling och företagsvärdering i svensk industri, IUI, Stockholm, 1988.

Figure 7 Manufacturing output in the three policy experiments
1982-2002
Index 1983 = 100

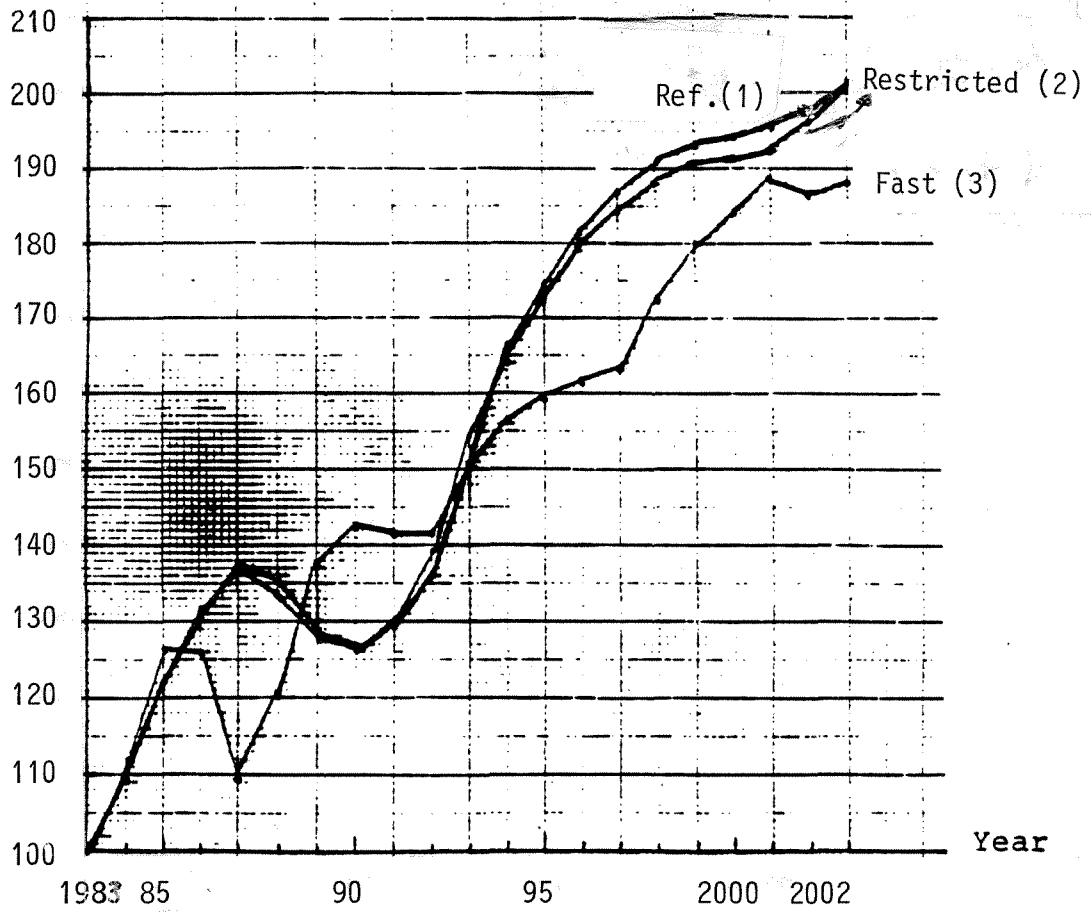
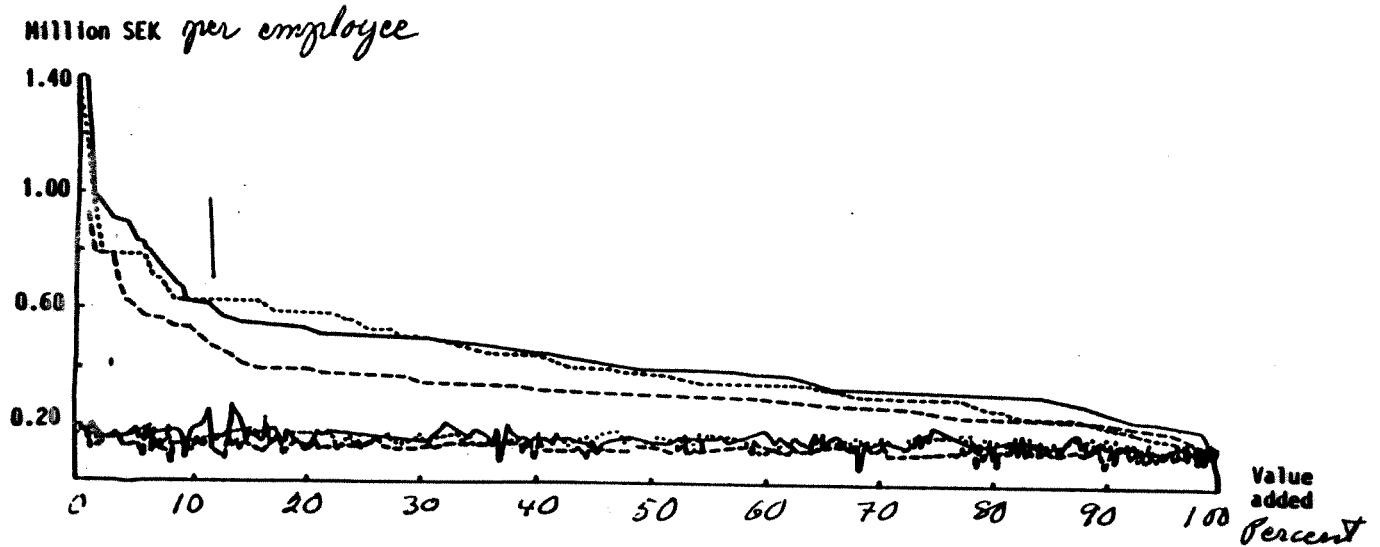


Figure 8 Productivity and wage distributions 1982 and 1985
and simulated distributions 1985



Note: The upper curves show distributions of value productivities, ranked in decreasing order over firms and weighted by value added. The lower curves show the matching nominal wage cost distributions.

The simulation began on the 1982 initial database (---). The outcome of the simulation (...) can be compared with the real 1985 state from the database (—).

Source: MOSES Database.

Figure 9 Wage cost and value productivity distributions 1992 in reference case and in fast market experiment

