CHAPTER II

A Description of the Initial 1982 and the Synthetic 1990 Databases

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CONTENTS

Introduction

This chapter describes the initial 1982 and the synthetic 1990 databases (R1982.91 and R1990.10, respectively). The synthetic database has been prepared for external use. The MOSES model uses and generates a large number of micro and macro variables. It is almost impossible to describe and analyze all these variables. Therefore, only a small part of the variables is exhibited in this presentation. (For standard output tables and the variables saved in those tables, see the manual for the PC version, *MOSES on PC*.[1])

The R1990.10 database was prepared by using the model version 2.0 with the MSTART900 modification function and the dataset R1982.91.[2] The calibration process is explained in detail in *MOSES on PC*. The model is simulated 8 years and the output workspace is saved by using the function SAVE OUTPUT. Although the micro data of about 130 firms in this dataset is a simulated extension of the real firms' data, it is not possible to get specific information about real firms from this dataset which is based completely on simulation results.

Comparing actual and simulated macro data

Figures 1a-e compare real and simulated macro variables used in the calibration process for 1983-1988. (Solid lines are simulated data, broken lines real data.) As shown in these figures, the model mimics pretty well the *trends* in the real data. The performance of variables on the manufacturing sectors (Figures 1a-c) which are defined explicitly on the basis of micro data in the model is particularly good. In the case of annual growth rates of GNP, simulated results are higher than real changes. However, as shown in Figure 5f, the explicitly defined sectors comprise only a (small) part of total GNP. Thus, the discrepancy between the simulated and real variables is mainly due to the specification of the implicitly defined sectors (services, agriculture,

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1. Taymaz, E. (1991), *MOSES on PC: Manual, Initialization, Calibration*. IUI Research Report No. 39, Stockholm.

2. The MSTART900 function uses calibrated parameters. The simulation results after 1990 are exactly the same for R1982.91 (used with the MSTART900 function) and R1990.10 (no modification function) datasets when the version 2.0 is used.

etc.).

Comparing actual and simulated micro data

Figures 2a-d compare actual and simulated micro data. There are more than 70 firms/divisions used in the MOSES model whose actual data are available for 1988. Sales, employment, labor productivity, and the share of exports in total sales of these firms in 1988 are plotted against the simulated results in Figures 2a-d. The sales and labor productivity figures are based on current prices. The solid line in these figures is the 45° line, i.e., those firms whose simulated and actual figures are same are shown *on* this line. Apparently, there are strong correlations between simulated and actual figures even for the micro data.[3] Recall that calibration so far has not been made against micro data.

To test more rigorously the relation between the simulated and actual variables, we can use the distribution of the log of simulated/actual values. If, for example, the model did generate the same employment levels for real firms in 1988, then

$$LEMP_i = ln(EMP_i^{sim} / EMP_i^{act}),$$

would be equal to zero for all firms where EMP_i^{sim} and EMP_i^{act} are the simulated and actual employment level of the i^{th} real firm in 1988. It is, of course, impossible for the model to simulate exact values on micro variables. However, if the model mimics the micro variables *on average*, then we expect that the $LEMP_i$ is distributed as $d(\mu,\sigma)$ where d is any (likely a normal) distribution with mean $\mu=0$.

The histograms of the distributions of (log) sales (LSALE), exports ratios (LXRAT), labor productivity (LPROD), and employment (LEMP) variables for those firms with actual data available for 1988 are shown in Figures 2e-f. The dotted lines on these figures represent the normal distributions that have the same mean and standard deviation.

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3. We expect that the simulated value of a micro variable will be distributed around the actual value of that variable if the model generates good results. In other words, the *expected values* of micro variables should be equal to their actual values. Note that there is also another reason for the differences between simulated and actual values. The Planning Survey data cover divisions of firms. Data on these divisions can show differences from one survey to another due to changes in the boundaries of a division. We assume that the effects of these changes are also randomly distributed.

Table 1 **Kolmogorov-Smirnov tests for normality**

	Variables			
	LPROD	LEMP	LSALE	LXRAT
Mean	-.112	-.065	-.176	.095
Standard deviation	.370	.538	.502	.499
Mean/standard deviation	-.303	-.121	-.350	.190
K-S statistic	.595	.942	.798	1.880*
2-tailed probability	.870	.338	.548	.002

Note: * means statistically significant at the 1% level. There are 74 observations.

The results of K-S tests (see Table 1) show that we cannot reject the hypothesis that the LPROD, LSALE and LEMP variables are normally distributed. Moreover, their mean values are not statistically different from zero. Although the LXRAT variable is /not normally distributed (a large number of observations are concentrated around the mean value), its mean value is also not statistically different from zero. In other words, the simulated micro data are, on average, equal to the actual data.

Presenting the micro-structures: Salter curves

The main advantage of microsimulation models lies in the fact that they capture the effects of distributional characteristics by allowing micro-heterogeneity. The so-called Salter curve is a nice graphical representation of the distributional characteristics on which a specific firm's relative position can also be shown.

Figures 3a-e exhibit the Salter curves for actual and potential labor productivities, epsila (rates of return over the interest rate), capital/output ratios and wage rates superimposed on the actual labor productivity in 1983. The epsilon variable is equal to the difference between the rate of return and the interest rate.

The solid lines in these figures represent those firms nullified during the simulation period, 1983-1990. As may be expected, the nullified firms have generally lower initial actual and potential labor productivities in 1983. Moreover, all but two

of them have negative initial epsilon values. Figure 3e reveals that more productive firms are more likely to pay higher wages. The correlation between these two variables are statistically significant at the 1% level.

Figures 4a-e present the same Salter curves for 1990. The solid lines on these figures represent those firms that entered into the model during the period of 1982-1990. A comparison of Figures 3 and 4 reveals that not much structural change has occurred in this period. The most notable difference is a slight improvement in the rates of return in 1990. Moreover, it seems that new firms generally perform better than incumbent firms. Note, however, that this better performance in terms of rates of return does not generally mean a relatively better productivity performance. The rate of return is affected by financial ratios, stock behavior, etc.

Firms in the MOSES model have over a hundred attributes (employment level, desired level of input and output inventories, expectations, capital structure, etc.). All of these attributes can be presented in various ways, e.g., Salter curves, Lorenz curves, etc. Thus it is possible to analyze any type of structural change in an economy.

Evolution of the economy: Aggregate time series data

During an experiment, the model stores a large number of aggregated time-series data for all sectors including the financial accounts of each sector, banking and government. Variables are saved in standard output tables for each category so that the data in those tables can be easily accessed by the graphics functions in the MOSES.GRAPH workspace (for details, see *MOSES on PC*).[4]

Figures 5a-h show some time series data. The rates of return in four explicit sectors (RAW: raw materials, INTER: intermediate goods, CAPG: capital goods and consumer durables, and CONG: consumer nondurables) are shown in Figure 5a. (These variables are stored in the output table, YEARLY PRICES.) Figure 5b shows firms' expenditures by categories (INTPY: interest payments, TAXES: corporate taxes, DIVID: dividends, INVST: investment spending, and CURRT: change in current assets). Note

4. All figures except 2e and 2f in this chapter were created by the MOSES.GRAPH functions, usually from the standard output tables.

that this figure shows aggregate values for the manufacturing industry. The same variables are also stored for each explicit sector separately. The composition of firms' assets is shown in Figure 5c (FIXED: physical capital, CURRT: current assets, INPIN: input goods inventories, and OUTIN: output goods inventories). The model also simulates complete financial life histories of individual firms on the same format that can be obtained if requested.

Figures 5d and 5e compares the distribution of *state revenue and expenditures* in 1983 and 1990. (In Figure 5d, WAGE: wage payments to government employees, PURCH: purchase of goods, SUBS: subsidies, TRANS: transfer payments, INVST: government investment, and INTPY: interest payments. In Figure 5e, ITAX: income tax, WTAX: wage tax, VATAX: value-added tax, CTAX: corporate tax, and DEFIT: government deficit.) Recall that a significant portion of government expenditures (number of employees, level of government purchasing, etc.) are exogenously determined in the model.

Figure 5f shows the *components of GNP* over the simulation period. Note that only four sectors of the economy (raw materials, intermediate goods, capital goods, and consumer goods) are specified on the basis of micro-data. Finally, Figures 5g and 5h present two scatter-charts for those firms who remained in the model during the entire period of 1983-1990. Figure 5g shows that there is a close correlation between the rates of return in different years. Those firms who were highly profitable in 1983 tend to be more profitable in 1990, as well. However, as shown in Figure 5h, the correlation between rates of return and the growth rate, although statistically significant at the 5% level, is weaker.

Evolution of individual firms: Micro time series data

The MOSES model enables us to follow the changes in specific firms in the model. By using the transcription functions of the model, firm-specific time series data can be saved during a simulation. (The Y R FIRM and Y R FIRM FINANCE functions prepare YEARLY FIRM *xx* and YEARLY FIRM FINANCE *xx* tables where *xx* is the firm code.) The format of standard firm-specific data tables are almost the same as the sector tables, YEARLY MARKET *yy* and YEARLY FINANCE *yy*, where *yy* is the sector number.

Figures 6a-g present data on two randomly selected real firms in the raw materials industry. Figures 6a and 6b depict the simulated and actual employment levels of both firms. Incidentally, the model simulates the employment levels of these firms pretty well. (Of course, this may not be the case for some other firms.)

Figure 6c shows the rate of returns in the raw materials industry in 1983. The solid bar on this figure represents Firm A (MOSES firm code: 1.11), and the shadowed bar Firm B (MOSES firm code: 1.15). Recall that the thickness of these bars is equal to firm's share in total capital stock. Labor productivity in the raw materials industry in 1983 is presented in Figure 6d. As shown in Figures 6c and 6d, both firms had over average rates of return and labor productivities at the initial year. Firm A's performance was particularly good.

Figure 6e shows annual output growth rates of both firms and the raw materials industry average. Firm B had relatively lower and declining growth rates during the simulation period. Firm A had growth rates higher than the industry average in all but one year. As may be expected, Firm A's relative rate of return performance was improved in the final year (see Figure 6f). Although Firm B had increased its rate of return as almost all other existing firms, its relative position detoriated. Finally, Figure 6g shows the level of labor productivity in 1990. Firm A's relative position was improved slightly whereas Firm B's relative position declined somewhat.

Summary

A (very) small part of the data produced by the MOSES model is presented in this chapter. The model generates almost all (aggregate) national accounts as well as a large number of data on each firm in manufacturing industry. It seems that the model tracks pretty well the historical data for the period of 1983–1989 which is used for the calibration of the model. The synthetic database, R1990.10 was prepared for external use by using the calibrated parameter set. (See section 3.4 in *MOSES on PC*.)

Figure 1a **Growth rate of manufacturing employment**

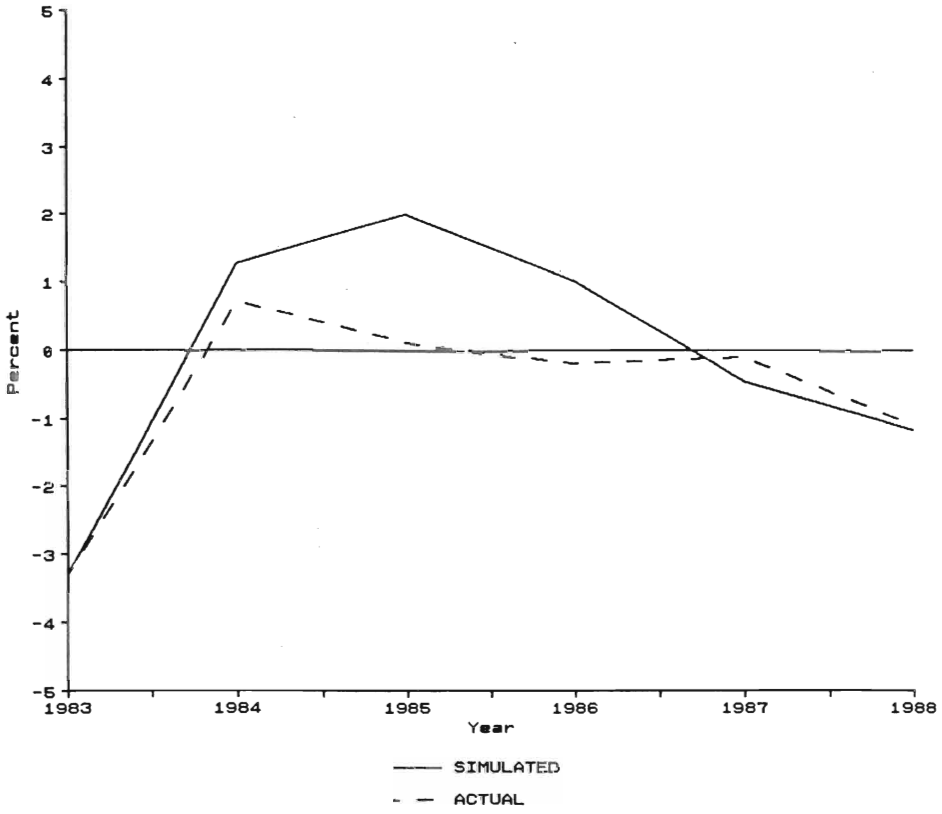


Figure 1b Growth rate of manufacturing output

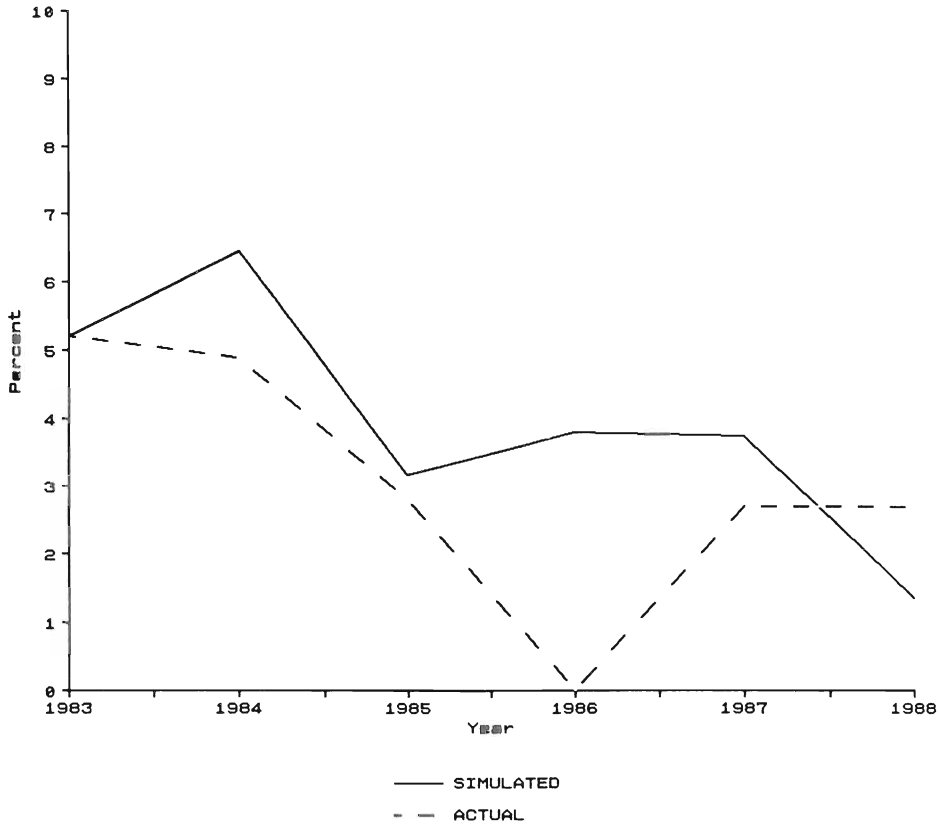


Figure 1c Growth rate of manufacturing prices

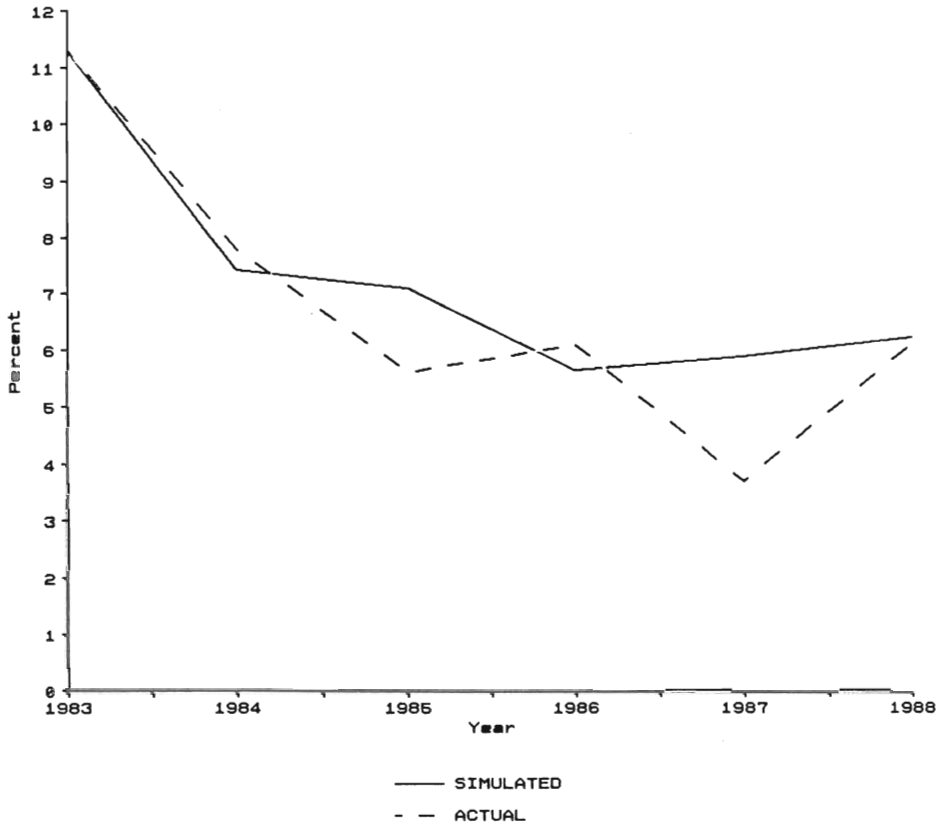


Figure 1d Growth rate of GNP

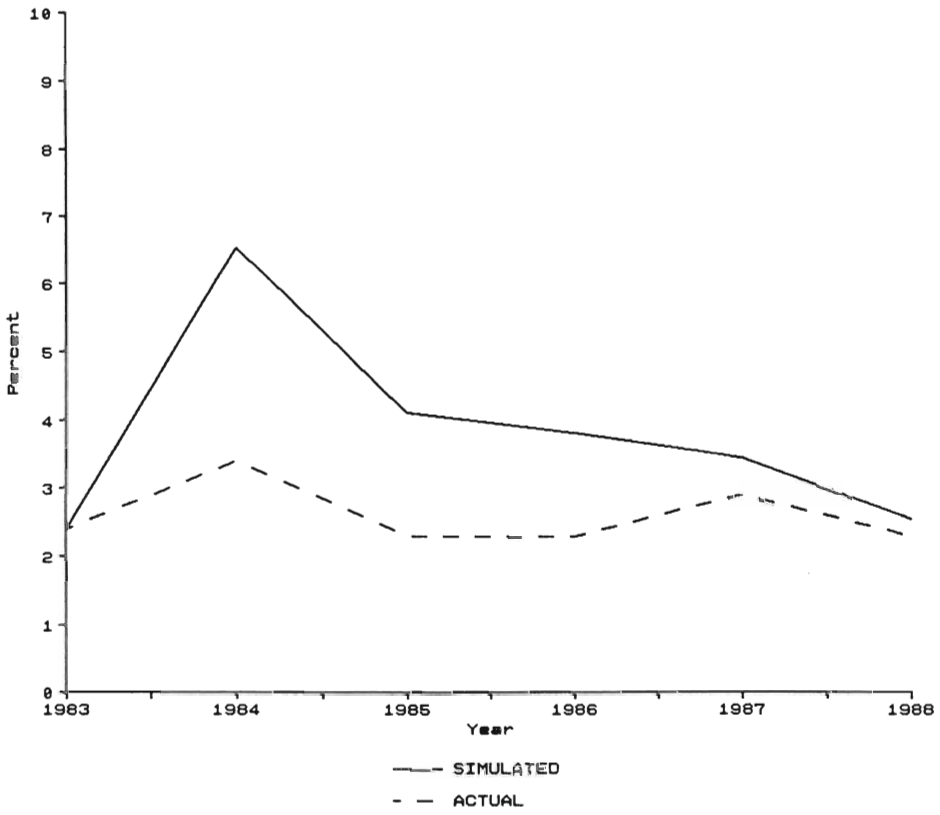


Figure 1e Interest rates

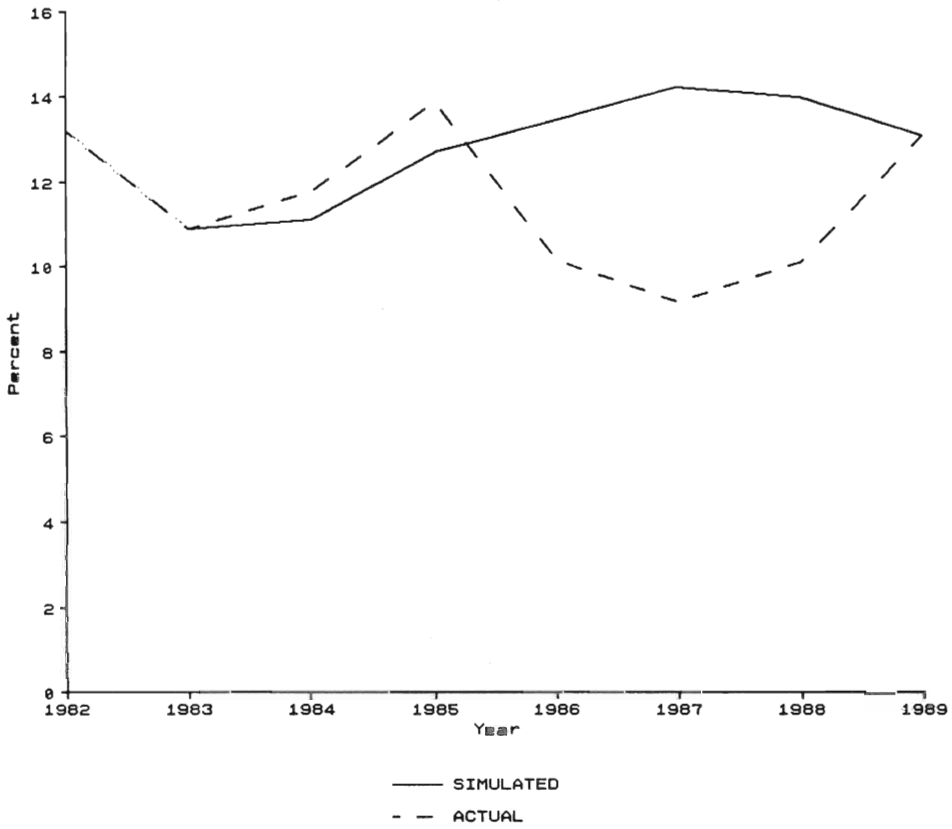


Figure 2a **Micro data comparisons**
Sales

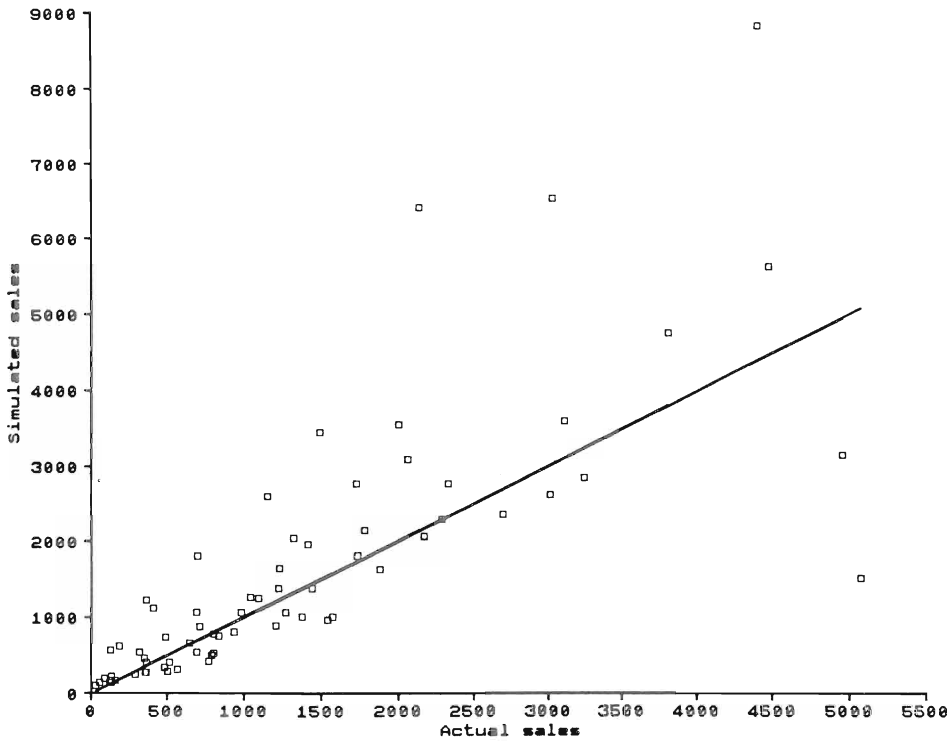


Figure 2b **Micro data comparisons**
Employent

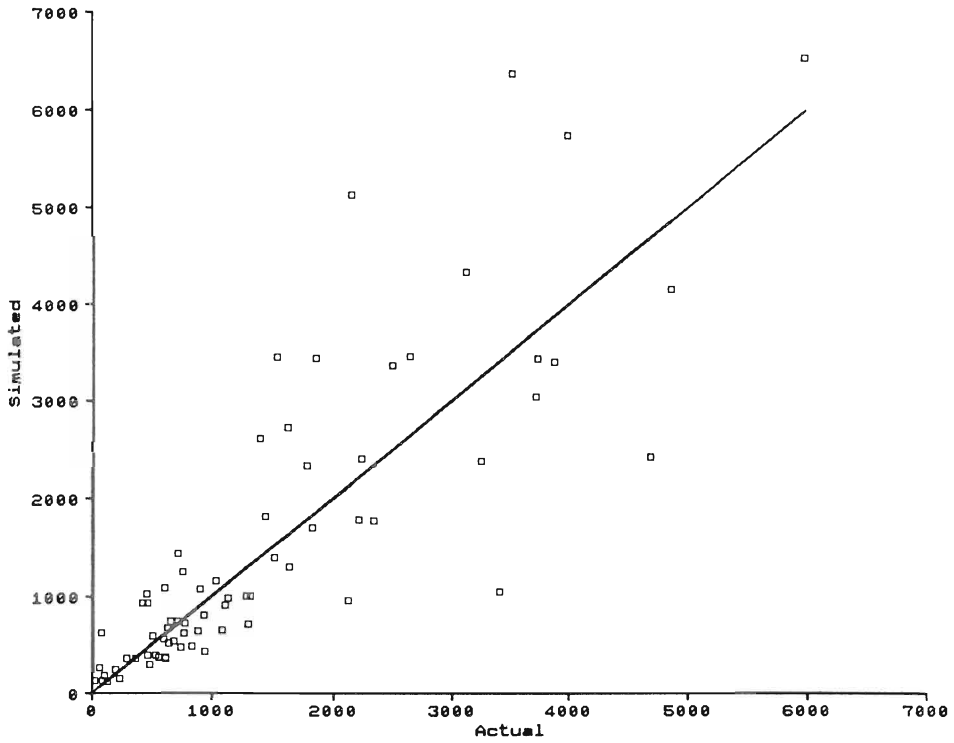


Figure 2c **Micro data comparisons**
Labor productivity

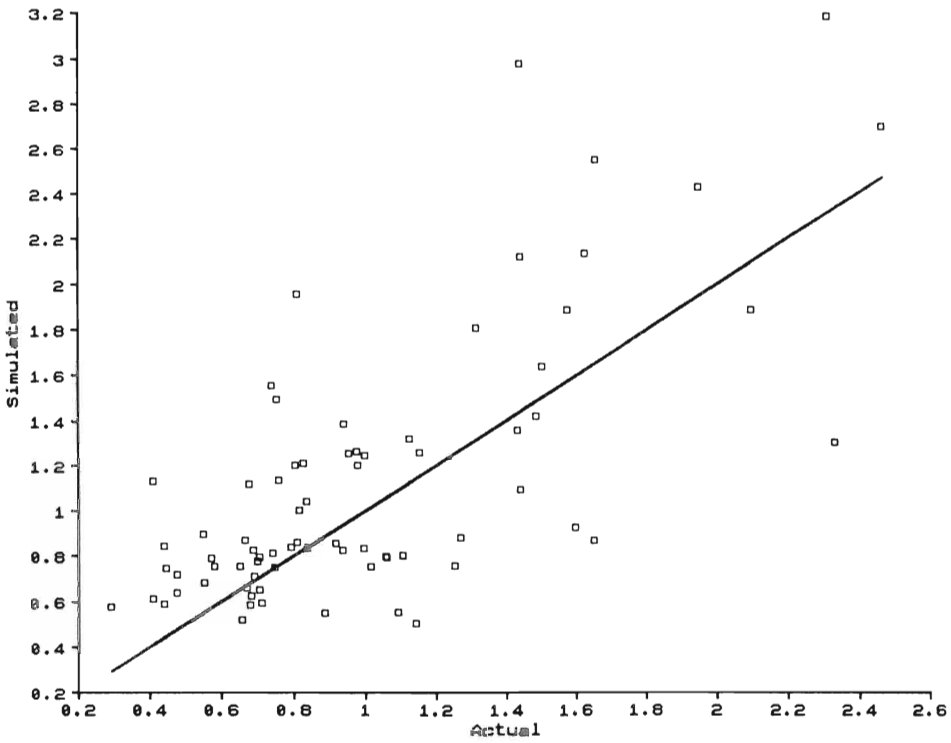


Figure 2d **Micro data comparisons**
Export shares

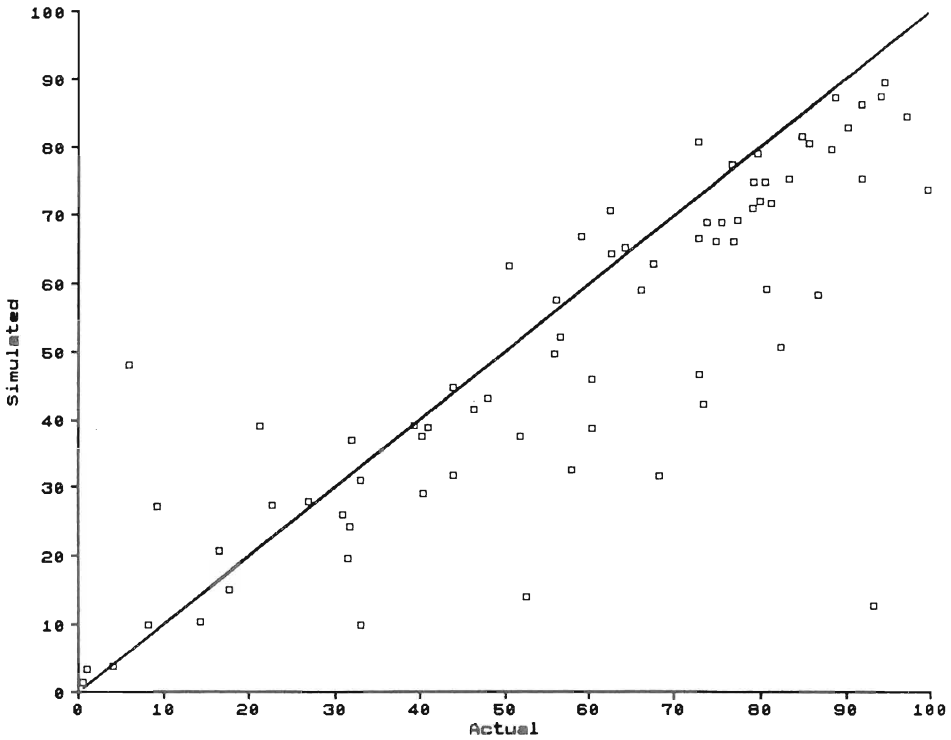


Figure 2e Frequency distributions of LSALE and LEMP

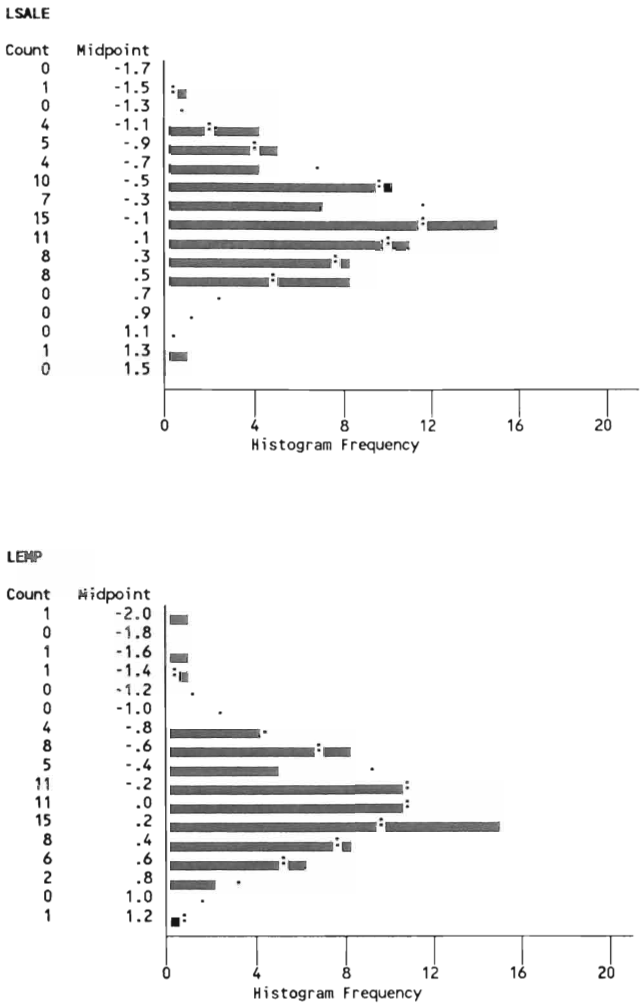
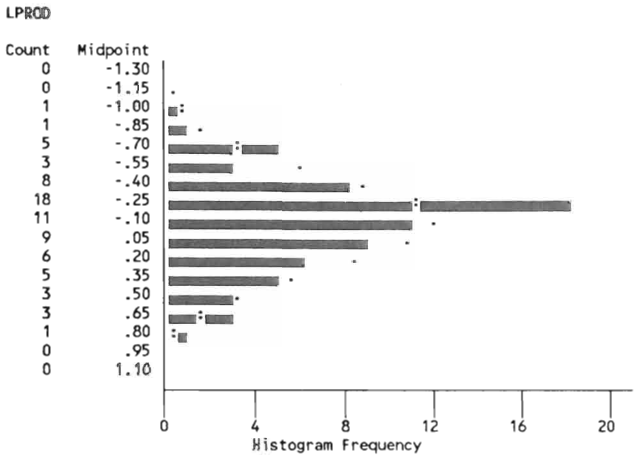


Figure 2f Frequency distributions of LPROD and LXRAT



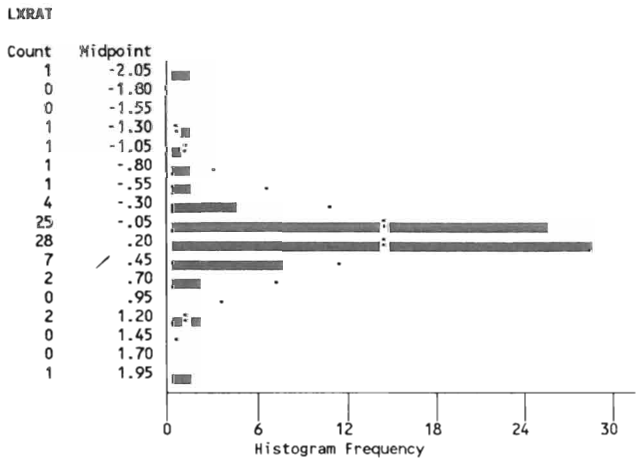


Figure 3a Actual labor productivity, 1983

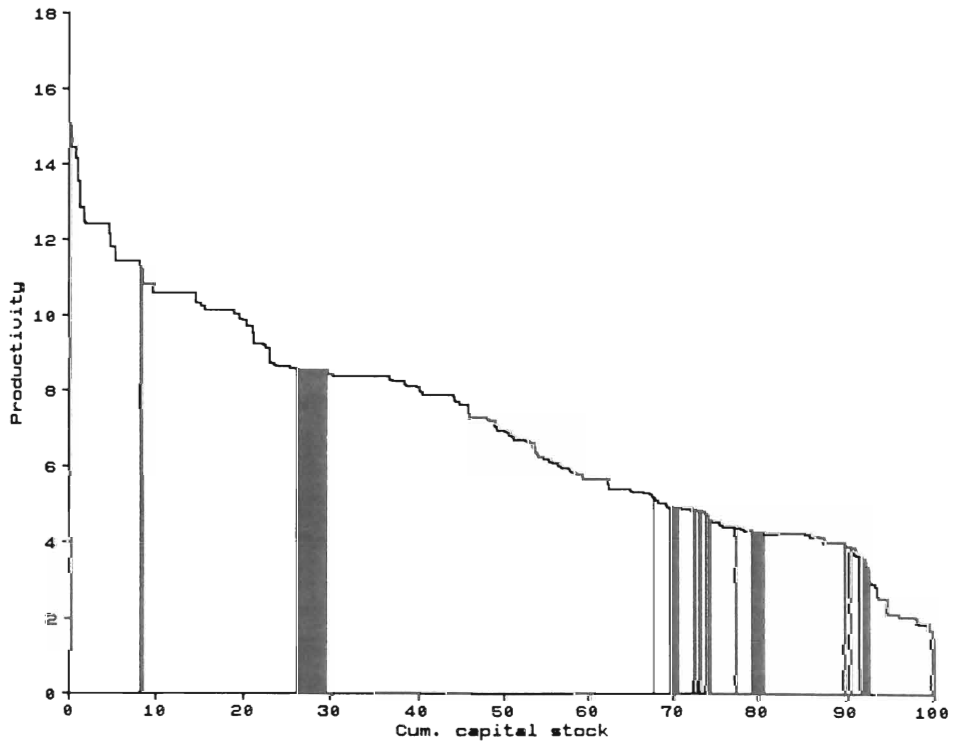


Figure 3b Potential labor productivity, 1983

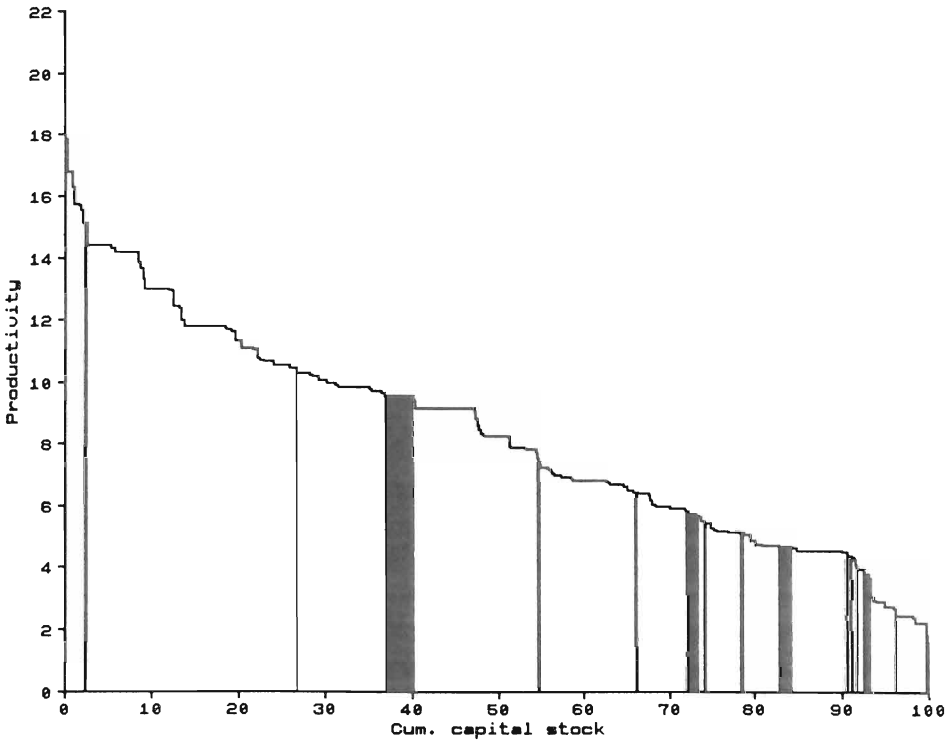


Figure 3c Epsila, 1983

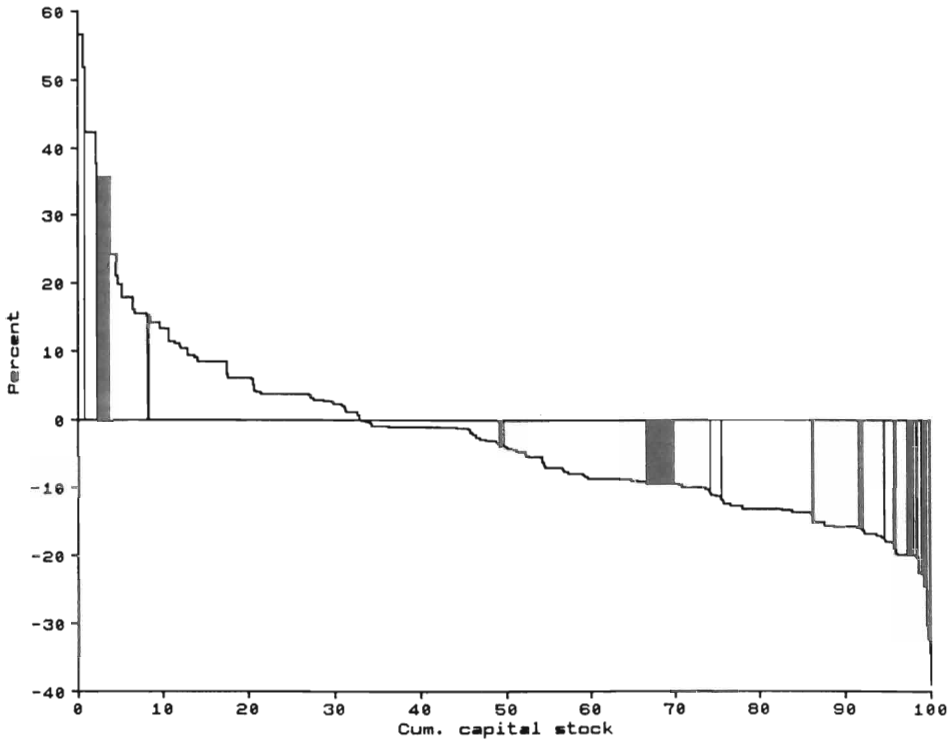


Figure 3d Capital output ratio

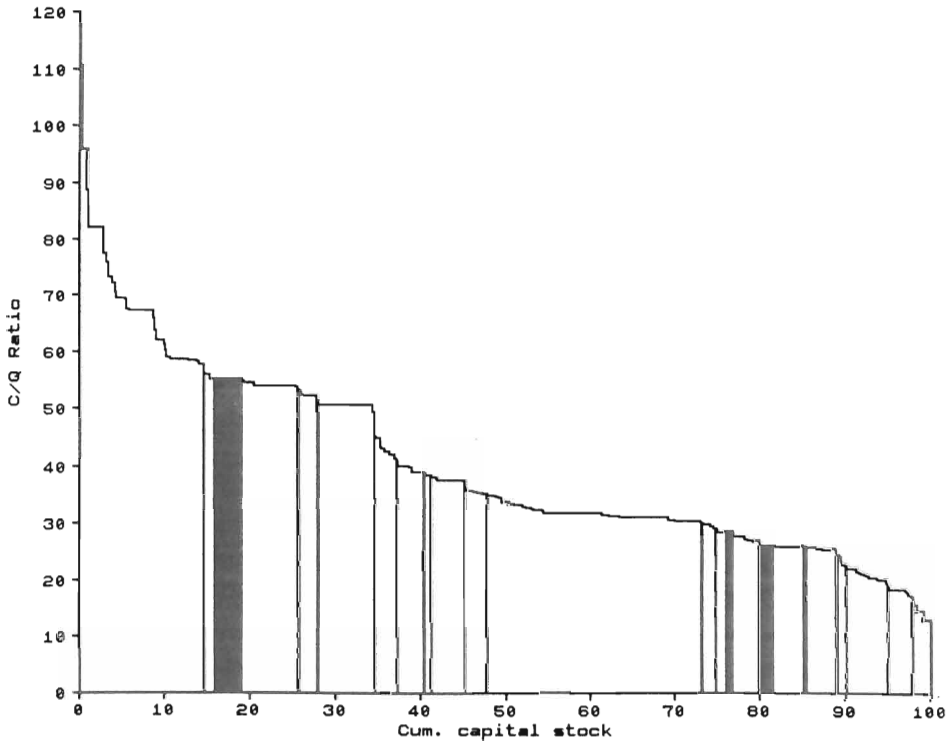
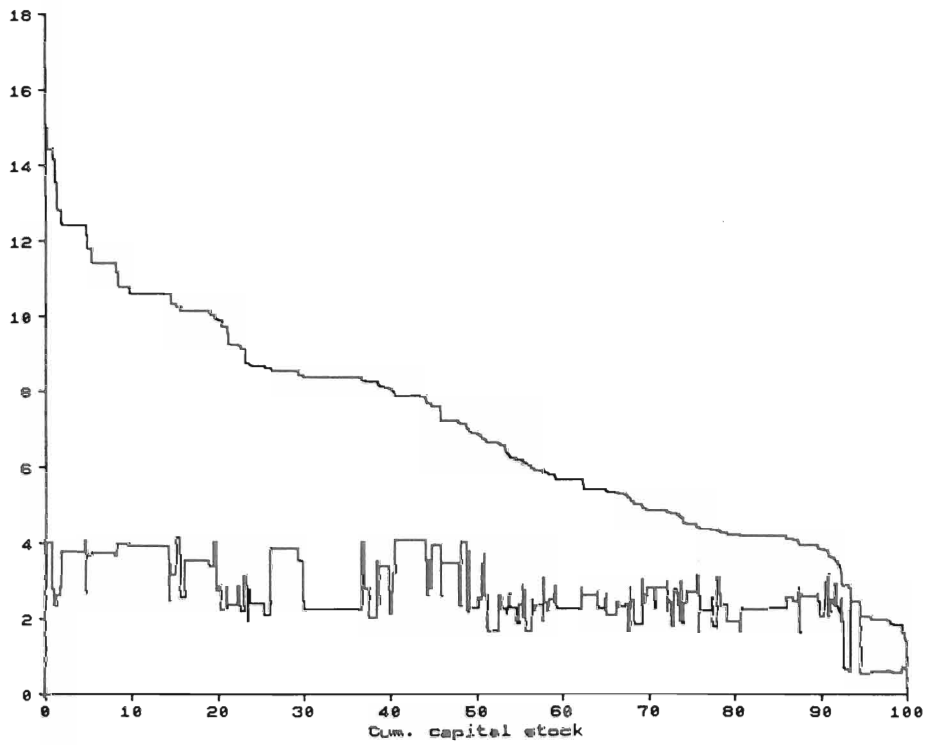


Figure 3e Actual labor productivity and wages, 1983

Hundred thousand SEK
current price/employee



Actual lab prod = 59,140 + 04.38 wages
(1.018) (9.81)

R^2 = 30.9
n = 217

Figure 4a Actual labor productivity, 1990

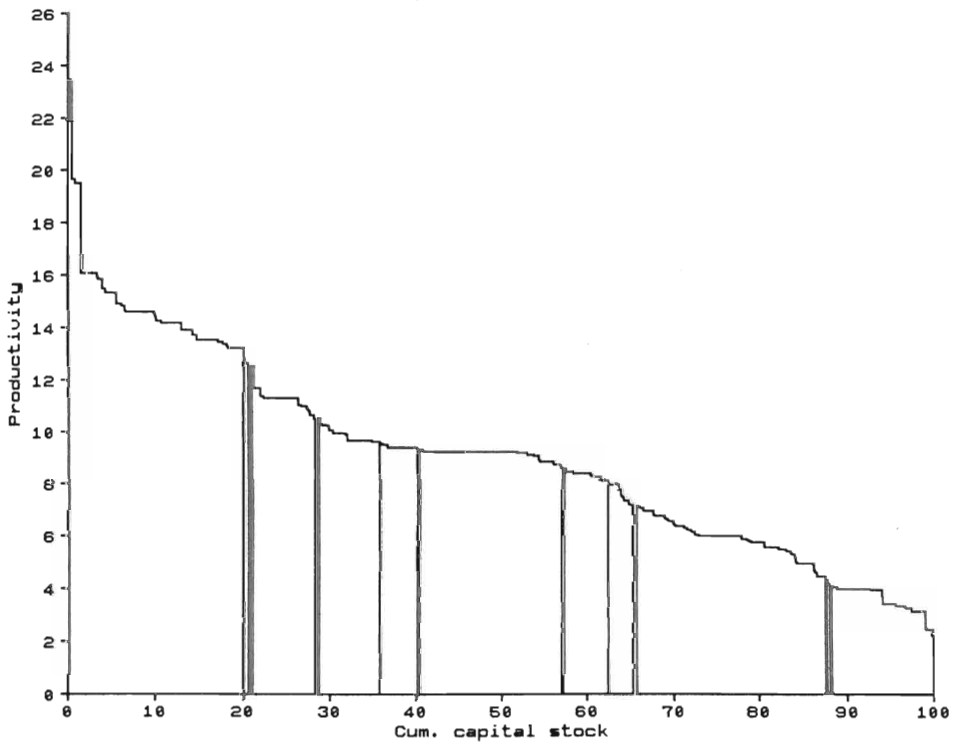


Figure 4b Potential labor productivity, 1990

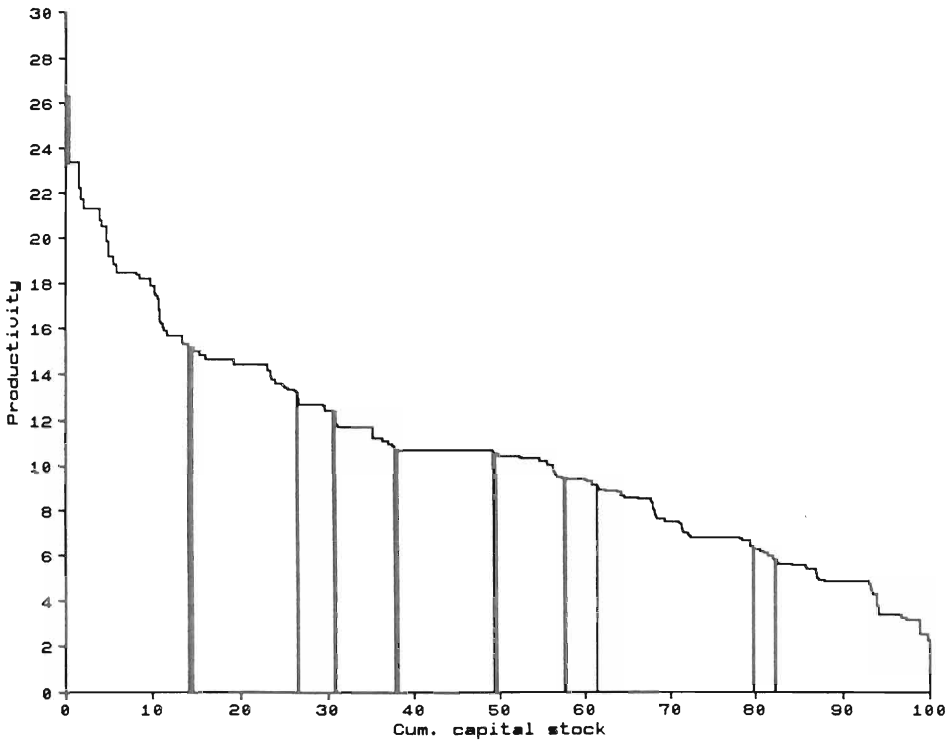


Figure 4c Epsila, 1990

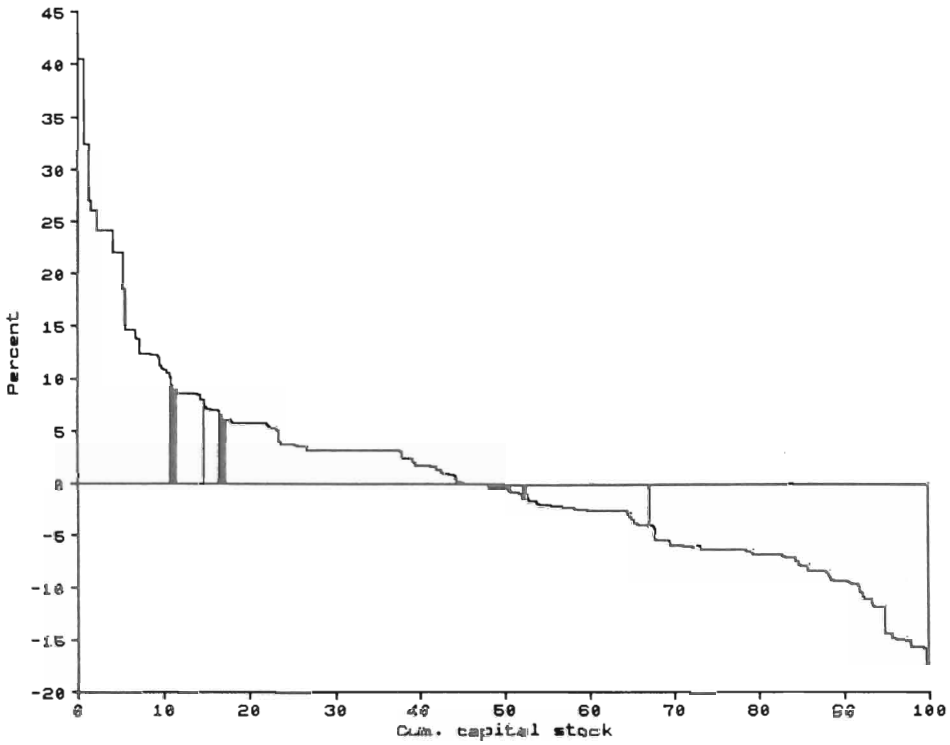


Figure 4d Capital output ratio, 1990

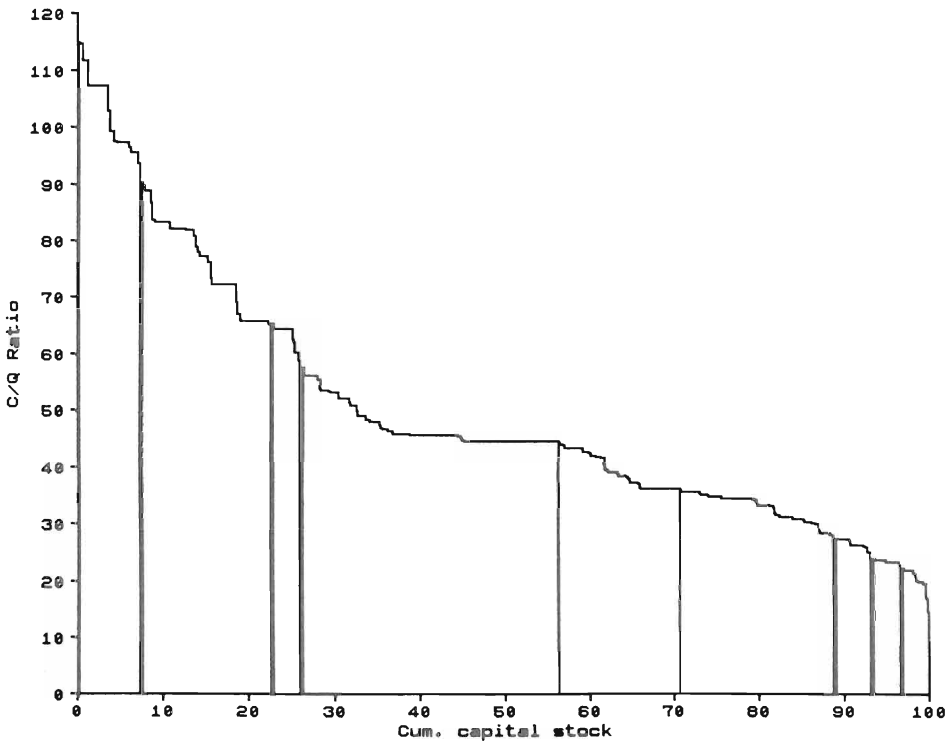
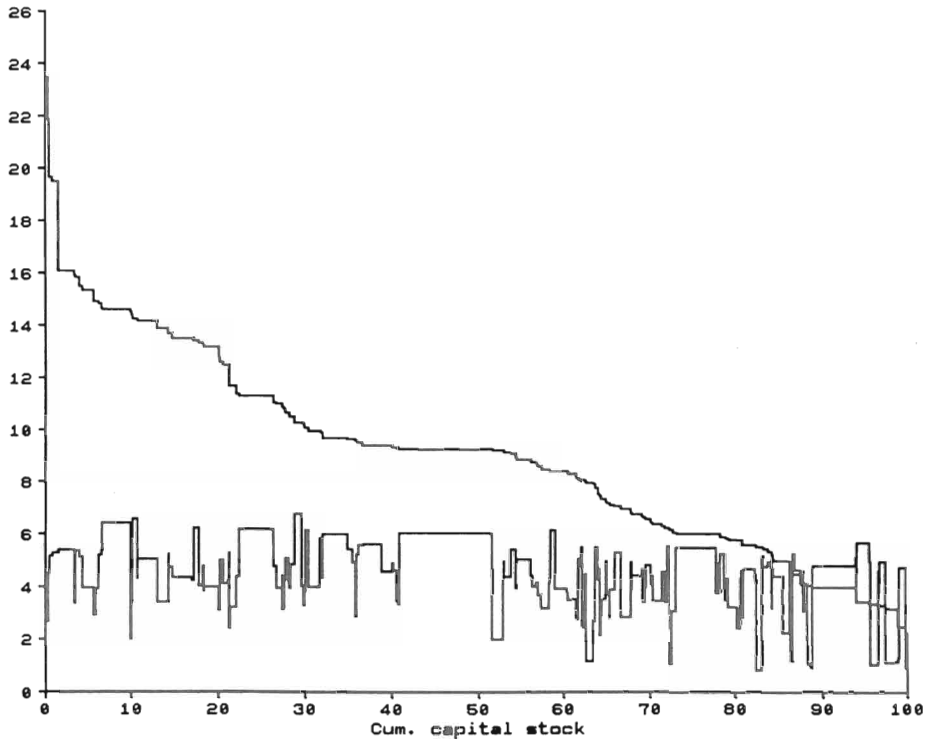


Figure 4e **Actual labor productivity (1000 units of output; or output in 1982 prices) and wages (50000 SEK/employee), 1990**



Actual labor productivity = 5,107.16 + .0166 wages
(5.00) (3.45)

R^2 = 5.6
n = 201

Figure 5a Rates of return

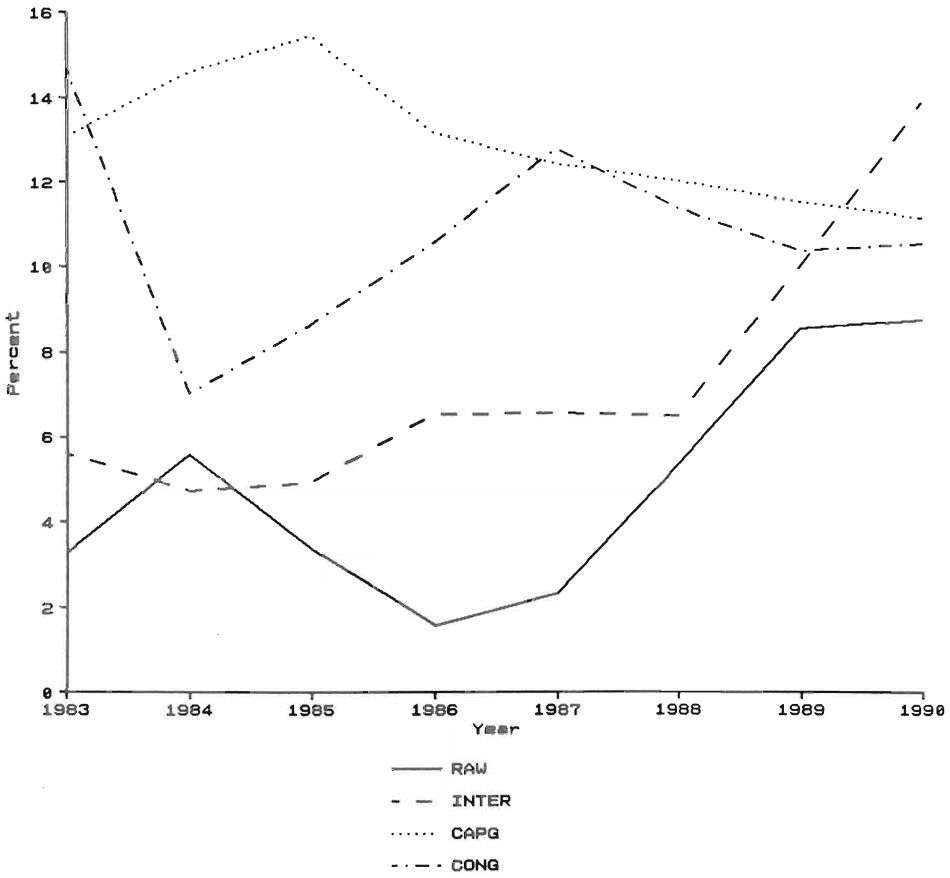


Figure 5b **Firms' expenses**
(10^9 SEK, current prices)

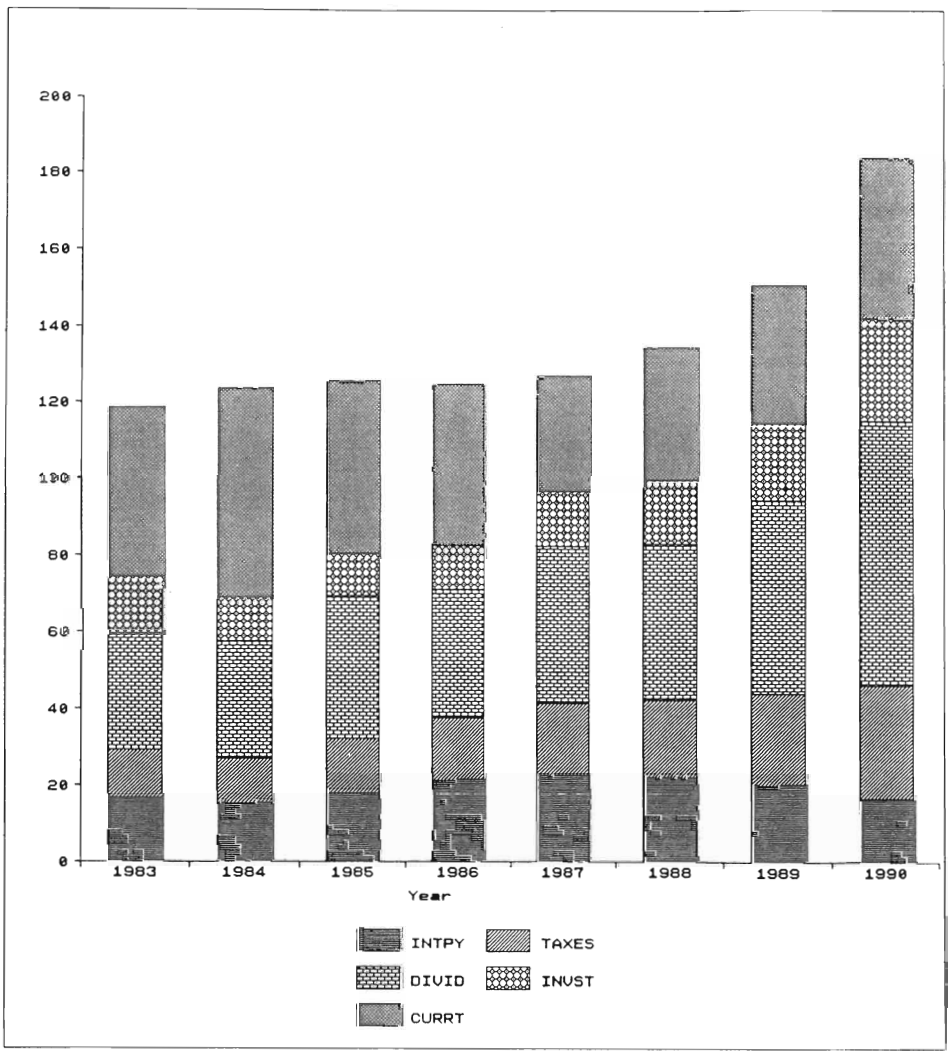


Figure 5c **Firms' assets**
(10^9 SEK, current prices)

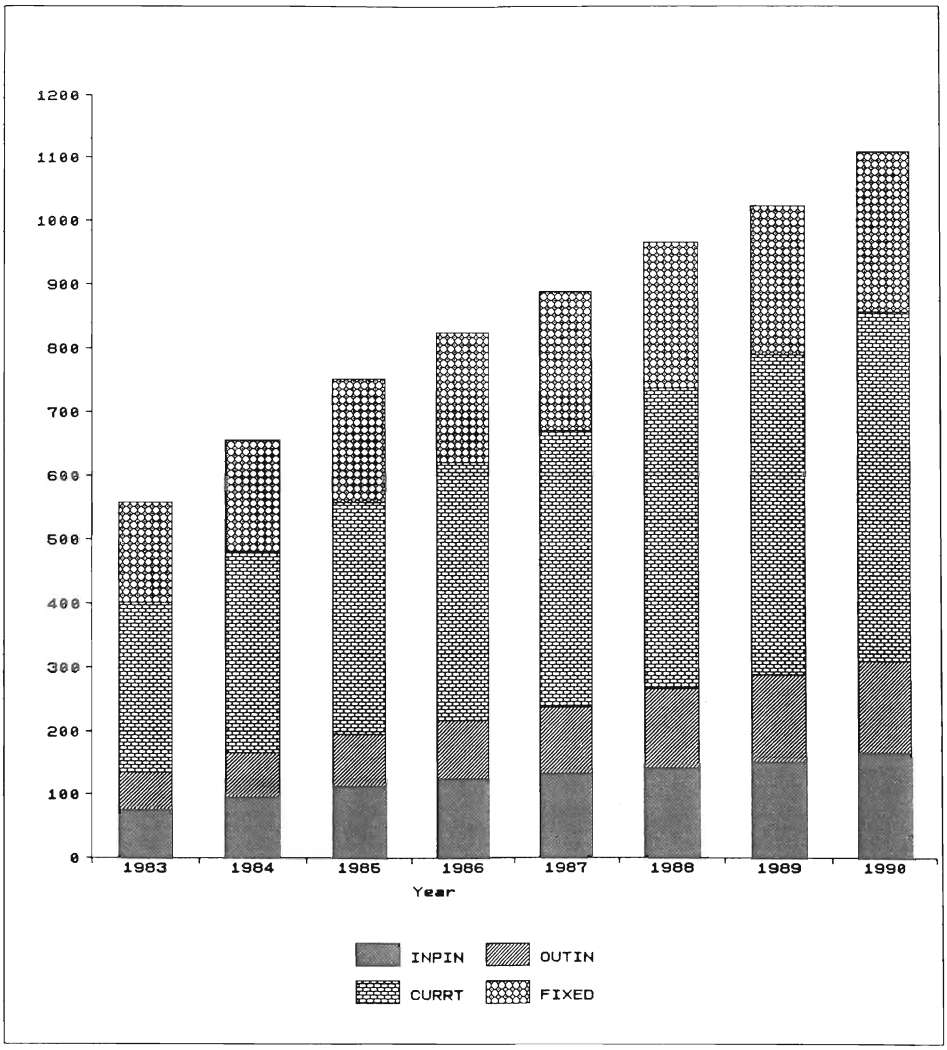


Figure 5d State expenditures

Figure 5e State revenue

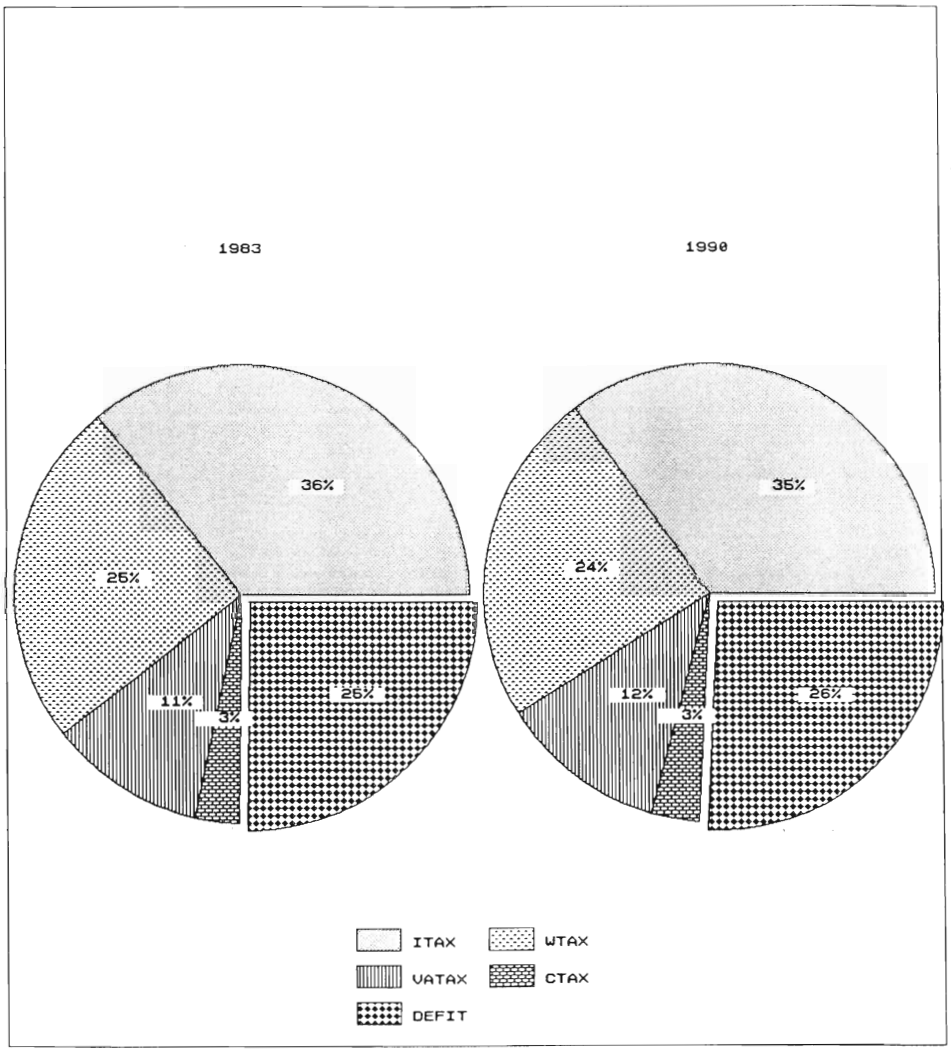


Figure 5f GNP components (10^9 SEK, current prices)

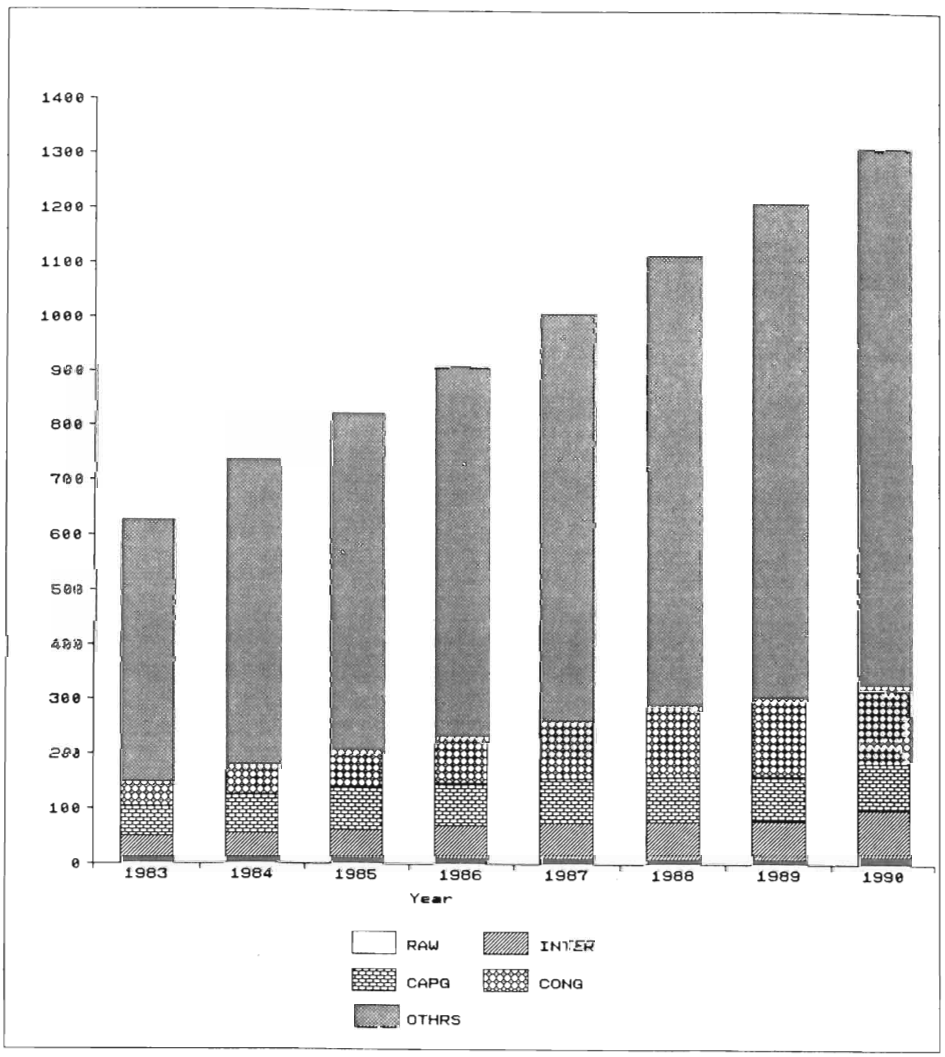
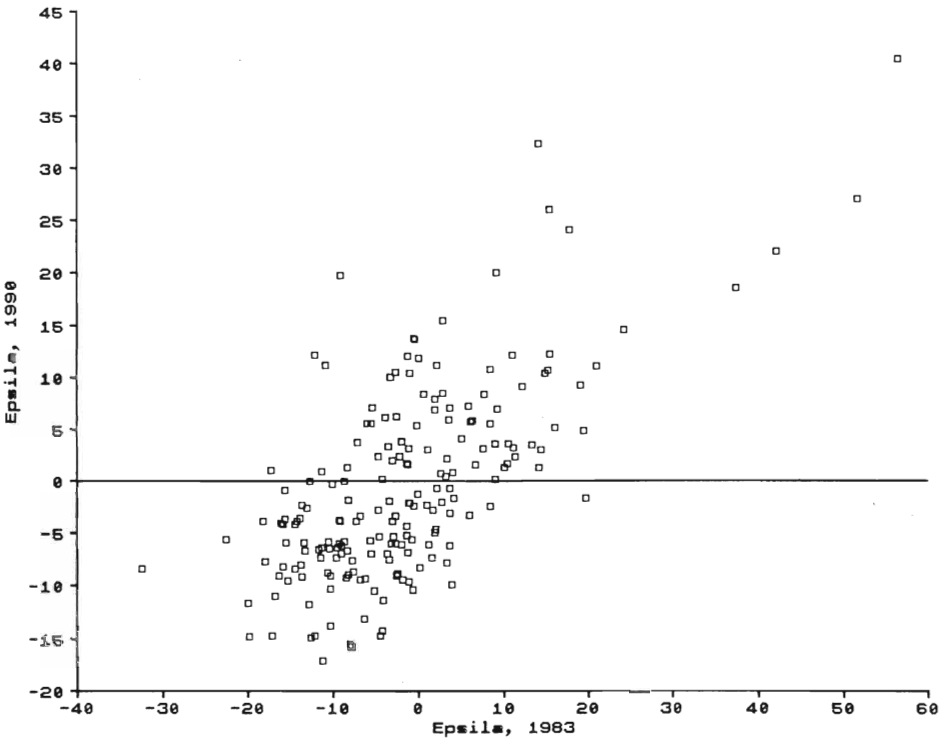


Figure 5g Correlation between profitability in 1983 and 1990

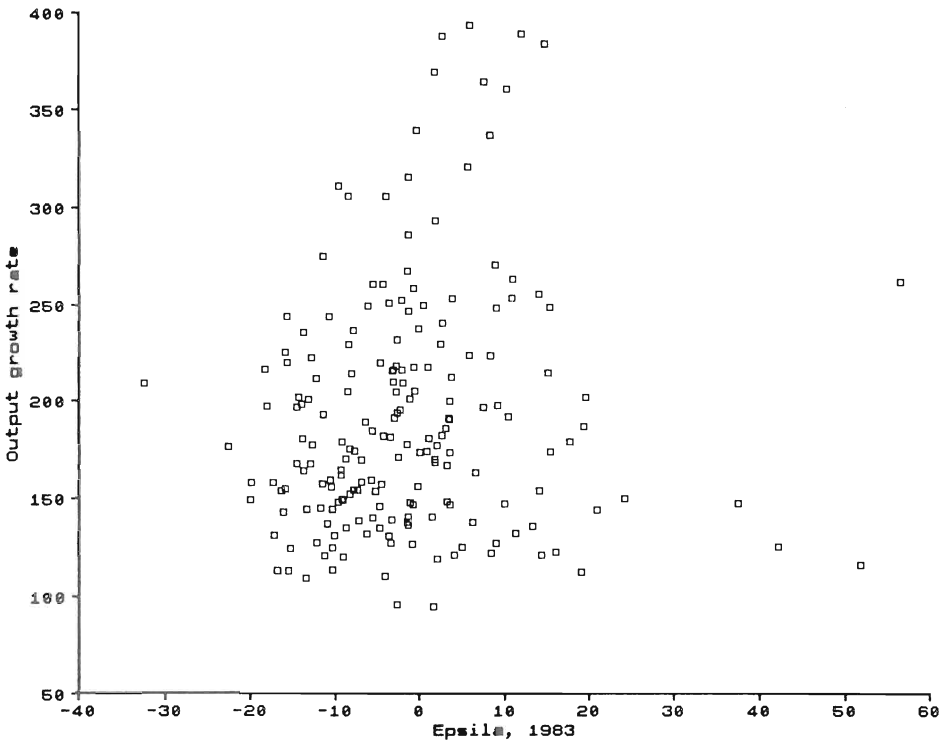


Epsila 1990 = .38 + .53 Epsila 83
(.75) (12.88)

R^2 = 46.8

n = 191

Figure 5h Correlation between epsila and growth rate



Output growth rate = 1.93 + .65 Epsila 83
(42.55) (1.72)

R^2 = 3.4
n = 191

Figure 6a **Employment level of firm 1.11**
(equivalent of full-time employees)

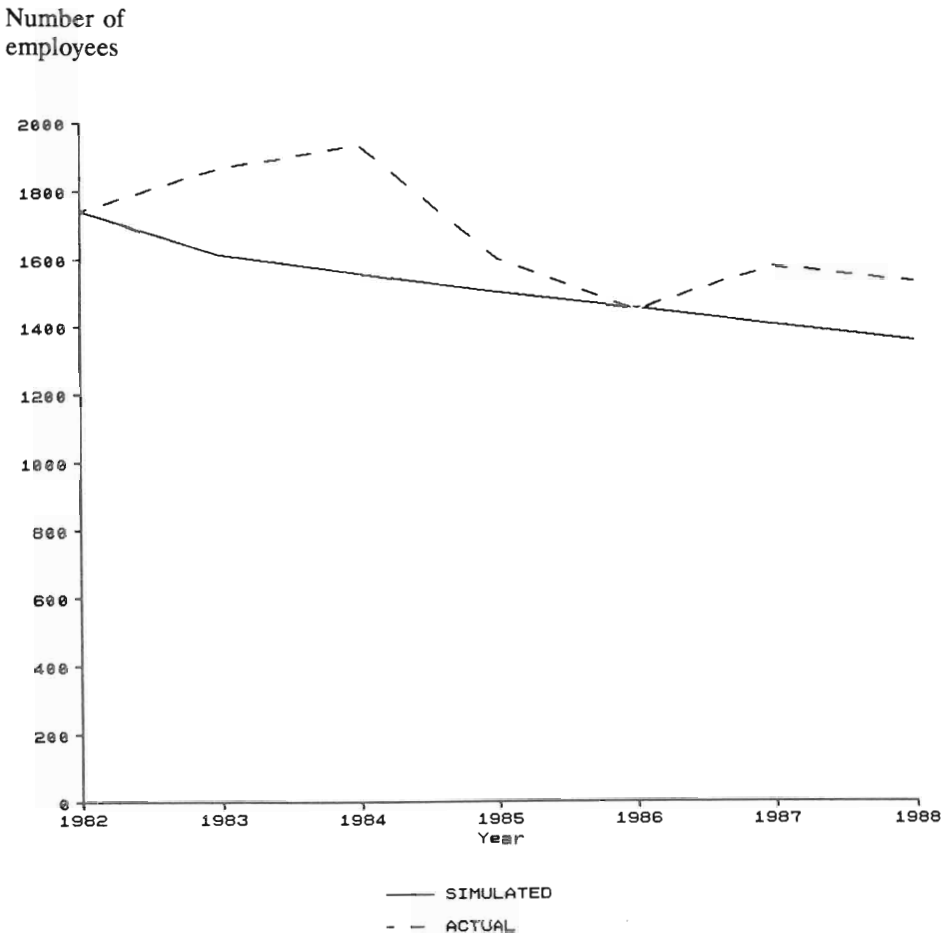


Figure 6b **Employment level of firm 1.15 (equivalent of full-time employees)**

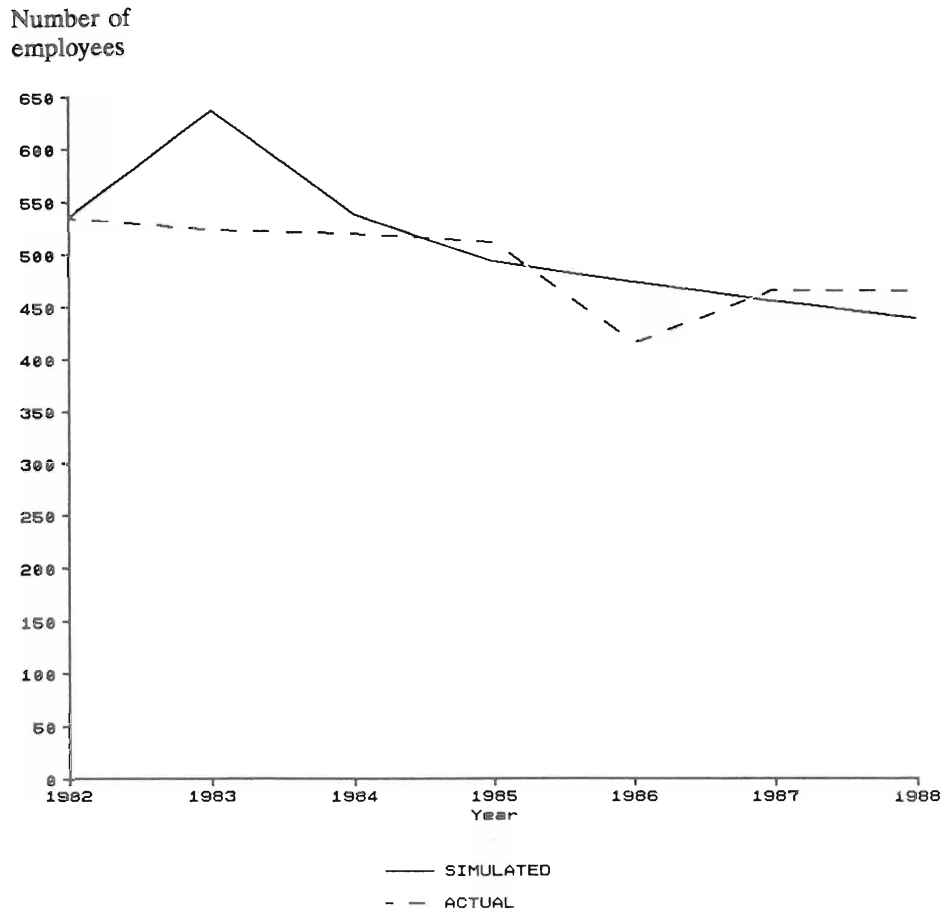


Figure 6c Rates of return in raw materials industry, 1983

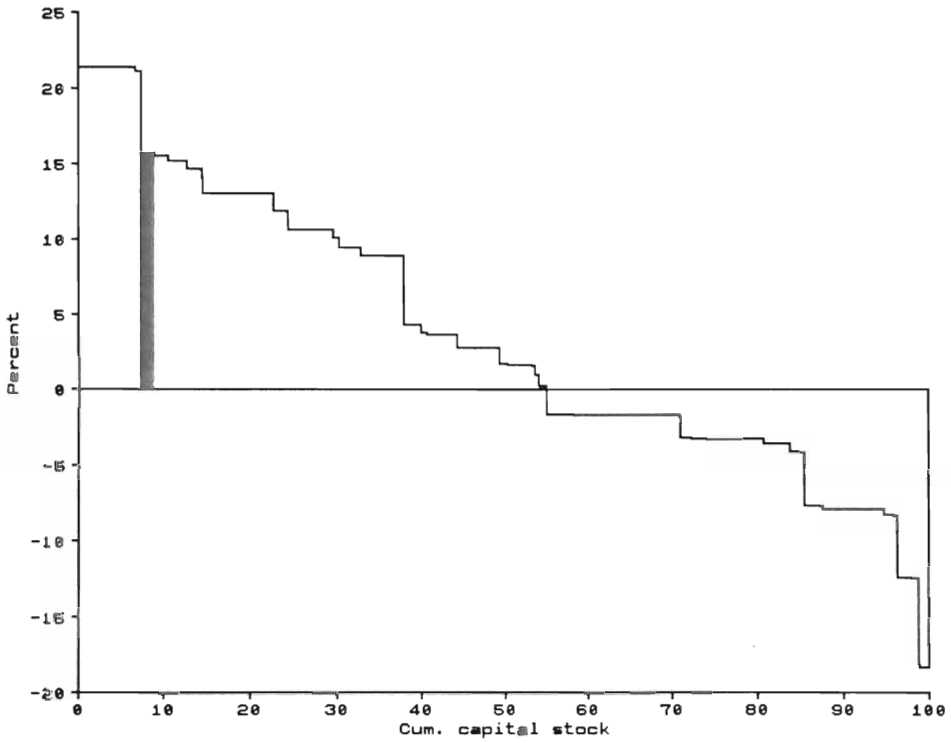


Figure 6d **Labor productivity in raw materials industry, 1983 (1000 units of output)**

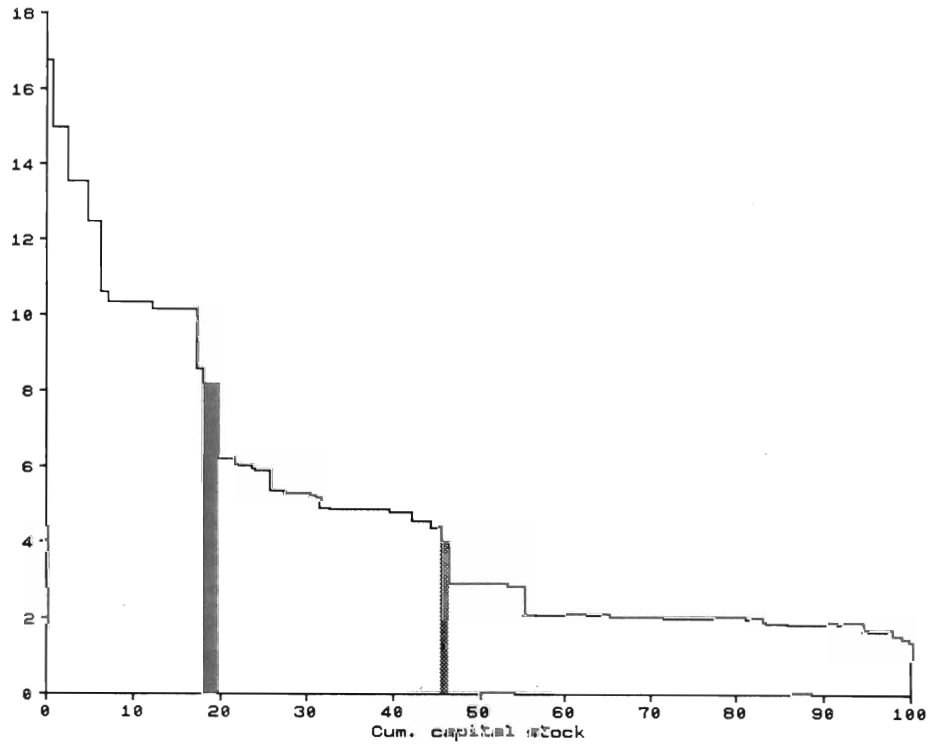


Figure 6e Annual growth rates of output

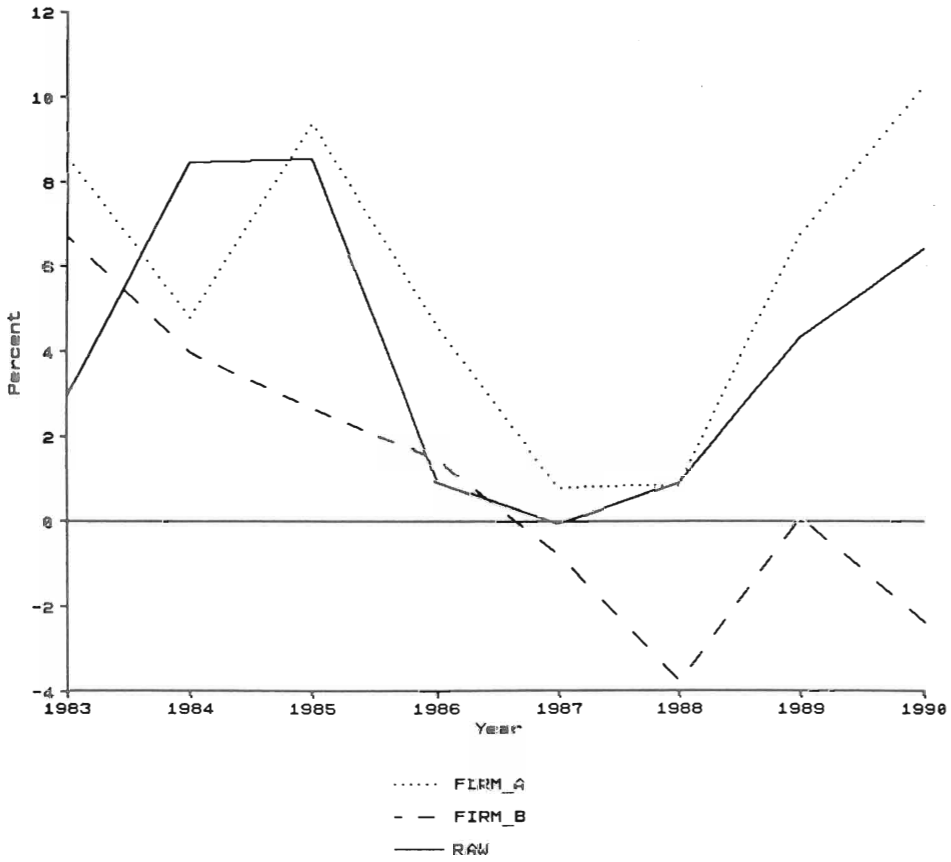


Figure 6f Rates of returns in raw materials industry, 1990

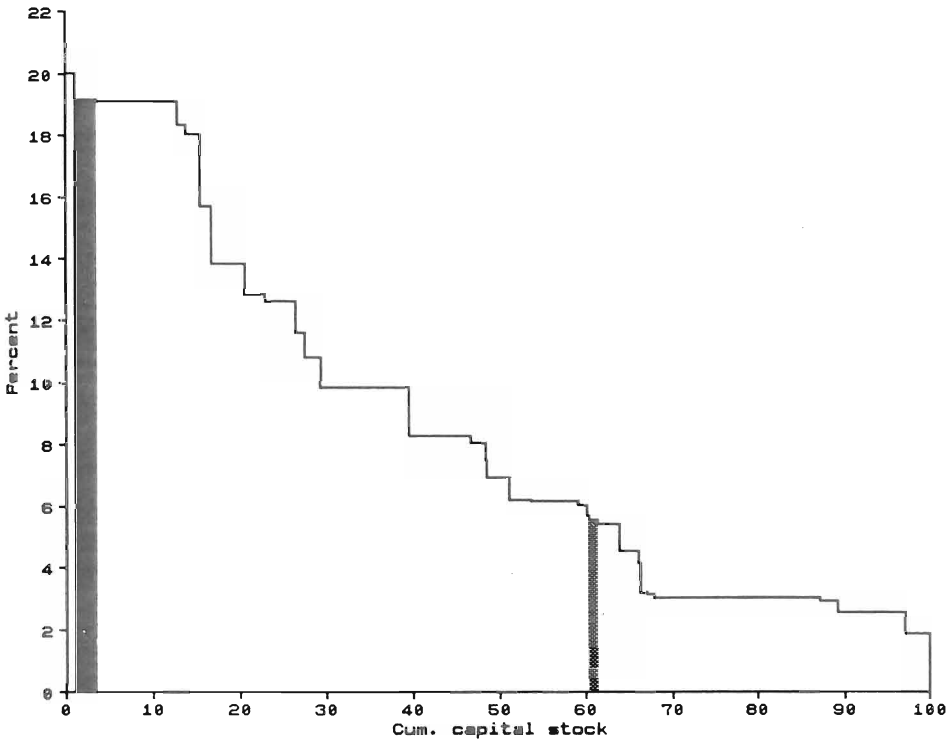


Figure 6g **Labor productivity in raw materials industry, 1990 (1000 units of output)**