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1. INTRODUCTION

The rate of productivity growth in the service sector is an increasingly important issue in many countries since the productivity of labour in services is a key to economic growth as the economy becomes more service intensive. Many argue that the productivity growth of the service sector is markedly lower than in manufacturing and that this is the major cause of the slow-down in economic growth during the last decades. There are, however, great difficulties in arriving at any clear conclusion in this debate over the productivity of the service sector, primarily owing to problems of data availibility in general and measuring service outputs in particular. This holds for private as well as public services. In their national accounts many countries, Sweden among those, adopt the totally arbitrary assumption of zero change in public sector productivity over time (a recommendation by the UN to the countries which apply the UN System of National Accounts, SNA) and a guesstimate for private service sector productivity change. Thus, there is an urgent need for more realistic estimates.

The gradually increasing political concern in service sector productivity has also spurred the interest among economists of applied studies of service production. The literature seems to be dominated by two types of studies, one concerning economies of scale and scope in multiproduct service production (banking has been particulary popular), the other estimation of cross section differences in productive efficiency between individual production units (municipalities, universities, post offices, health services, transport activities etc).

Since service production usually is multiproduct the development of methods handling multiple inputs - multiple outputs should get a high priority. Studies of economies of scale and scope are usually based on a Translog cost function while the estimation of technical efficiency of individual production units usually are based on a parametric frontier production function or on the non-parametric

Farrell-DEA (data envelopment analysis) method or sometimes on some form of combination of these two approaches.; see e.g. Bessent et al (1982), Charnes et al (1981) and Banker et al (1986). (For further references see Journal of Econometrics, special issue, forthcoming.)

Most empirical studies are, however, limited to cross-section analysis of productivity or efficiency differences between production units. Studies of long term rates of productivity growth over a number of years in service sectors are rare.

The purpose of this study is to analyse productivity growth in the production of public social insurance services in Sweden on the basis of data for all local offices of the Swedish social insurance system during a time span of 11 years, 1974 to 1984.

The analysis is based on estimation of a deterministic frontier production function. Since the offices produce several types of services with one dominant input, labour, we have applied an "inverted" production function with one input and multiple output.

Representation of technology in multiproduct service production is not a trivial issue and we have little a priori information what should be a suitable specification of the transformation properties between different outputs. From a technical point of view there are very few tractable production function specifications. Since we are adopting a frontier production function approach the Translog function and several other flexible forms are less attractive so the choice set is fairly restricted.

In a recent paper, Bjurek et al (1989), a comparison of different specifications was undertaken. In particular the Cobb-Douglas (CD) function with a non-convex transformation surface was compared with a quadratic (QD) production function with a convex transformation surface. The main result was a high correlation of efficiency rankings between the different specifications. Since we in this

study are not interested in individual office efficiency the exact nature of the transformation properties is even less important. Therefore we have utilised a Cobb-Douglas (CD) production function with trends in all parameters. This makes it possible to study the character of productivity change as regards output bias and Hicks neutral change. The elasticity of scale is constant in the production function but may vary between years. Implicitly we assume some degree of specialisation economies in the production of different outputs. The same manpower is allocated to the production of all types of output. A similar study but limited to relative efficiency is Deprins et al (1984) measuring labour efficiency in a cross-section of Belgian post-offices using a one-input six-output CD deterministic frontier production function.

Since we are studying productivity change on the basis of the frontier production function it may also be interesting to investigate how the average of the sector keeps up with the performance of the best units represented by the frontier production function. To illuminate the development of the distance between best-practice and average performance we have estimated the average production function as well as calculated measures of structural efficiency.

In Sweden The Expert Group on Public Finance (an independent body attached to the Ministry of Finance) has commissioned a large number of studies concerning productivity change and productive efficiency in local as well as central government activities.

In one of these studies, performed by the Swedish Agency for Administrative Development (Statskontoret, rapport 1985:26), the productivity development of the total social insurance sector is investigated for the time period 1960 to 1980. We will return to this study below.

2. THE SWEDISH SOCIAL INSURANCE ADMINISTRATION AND THE DATA

The System

The general Swedish Social Insurance consists of vast system of rules for economic compensation in different situations and phases during the life-cycle. The main activities are

- health insurance (including birth grants and dental insurance)
- retirement pensions
- disability pensions
- employement disability insurance
- child grants

The annual turnover was about SEK 100 billion in 1980 representing 19.2 percent of GNP. The number of administrators has increased substantially at the regional and local levels from about 6000 in 1963 to about 17 000 in 1980 and xxxx in 1984. The staff employed at the National Social Insurance Board has been about 1000 all the time since the beginning of the 1960s.

The present system got its basic structure in the beginning of the 1960s. The central authority is the National Insurance Administration Board. Below this level there is a regional level with 26 general insurance bodies, one for each regional health area. This regional body has its own board. The body consists of one central office and several local offices and sometimes even local branches to the local offices. Of the total staff about 30% is at the central office and about 70 % at the local level. The number of local offices is about 460 during the first part of 1980s. Our data base consists of these local offices.

The division of labour between the regional and local level is such that appeals and more complicated cases are treated by the central offices while the regular cases are handled by the local offices.

The Data Set

From 1972 onwards, all local offices use a system of achievement measurement. All tasks are measured by frequency studies and all tasks are aggregated into cases, for which standardised time use is estimated and all cases handled are registrated. In our study we use the number of cases as output. The data covers the services of all local social insurance offices in Sweden during the period 1974 - 1984 with the exception of 1983. During that year statistics were changed and it proved too costly to link the data into a coherent set for that year. Data is collected directly from The National Social Insurance Board.

The main input categories are labour, capital and materials. Labour is the totally dominating cost component in social insurance service production, amounting to about 80 percent of total costs. Office space amounts to about 12 percent, user cost of inventories to less than 1 percent, mail and telephone about 3 percent and other expenses about 4 percent; see Jonsson (1982a). It is only possible to get data on labour, however.

Capital in the form of office space and computer terminals are almost proportional to labour input and varies very little across offices due to common standards. Moreover, the office space-terminal-labour ratio has been fairly constant during this period. Strict complementarity on the input side is therefore a very reasonable assumption. Productivity differences are then due to the efficiency of labour. Even if data on capital were available they would not influence our results. Thus, we have applied an "inverse" production function or factor requirements function with one input, labour, and multiple outputs.

Output is aggregated into four main types of final output services on the basis of similarities in the handling of the cases within each group. Before aggregation the number of services varies between eight and nineteen. The higher figure holds for the last years of

the period and represents a further disaggregation of the first years' output classification. (To some degree the high number also reflects a statistical artifact since during some years some services were registered in two overlapping categories.) Therefore, if the same output vector is used for the entire period, eight is the maximum number of output services. However, some of these services are of minor importance or just a part of a "full" service so therefore it seems appropriate to aggregate further, and we end up with four services. These four services are regarded as distinctive different outputs by the administrators. There are no zero entries at this aggreation level. The composition of the aggregated output has remained constant during the entire period except for a few new types of services which have been added.

Output No 1 consists of income evaluation assessments. The average time used in that type of services is about 30 minutes per case.

Output No 2 is sickness reports and control. The average time per case is about 30 minutes.

Output No 3 consists of minor reimbursements of personal outlays for travel expenses, medicine etc. The average time per case is about 5-10 minutes.

Output No 4 consists of more time-consuming cases mainly evaluation of pension and social insurance payments. Usually the time per case is in the interval of 2-4 hours.

In the analyses we will use the annual cross sections for all years. The annual number of observations is in the range 392 to 462.

In Table 1 the data set is presented.

INSERT TABLE 1

Labour input coefficient distributions

The observed labour input coefficients in 1974 and 1984 and the development of labour productivity between 1974 and 1984 are plotted in Figure 1 to 4 below for each output.

INSERT FIGURE 1

For output No 1, income evaluation assessments, the distribution is fairly flat in both 1974 and 1984 but rising steeper and with a somewhat thicker tail of low productivity units in 1984. There seems to be no relationship between size and labour productivity. Large and small units are spread all over the distribution. Between 1974 and 1979 there was a strong and fairly uniform decrease in labour productivity but after that the distribution of labour productivity has not changed.

INSERT FIGURE 2

Output No 2, sickness reports and control, shows a relatively uneven distribution of labour productivity in 1974. Due to the non-uniform shift in the distribution between 1974 and 1979 and the almost parallell shift between 1979 and 1984, the distribution is relatively even in 1984. Although there is a concentration of small units among worst-practice the largest units are fairly evenly spread. Labour productivity increased markedly between 1974 and 1979 and somewhat further between 1979 and 1984.

INSERT FIGURE 3

Output No 3, minor reimbursements of personal expenses, shows a very uneven distribution, particularly in 1974 but also in 1984. While the large units are spread all over the distribution there is, paricularly in 1984 a strong concentration of small units in the best-practice part of the distribution. The development between 1974 and 1984 is characterised by a strong and uniform decrease in

productivity between 1974 and 1979 followed by a further, but less uniform, decrease between 1979 and 1984.

INSERT FIGURE 4

Output No 4, more time consuming and complicated cases, shows an extremely uneven distribution of labour productivity in 1974. Due to a non-uniform productivity change the distribution is more even in 1984. In 1984 the largest units are mainly found in the best 60 percent of the distribution while they are spread more evenly in 1984. Between 1974 and 1979 there is a strong productivity increase over a large range of the distribution except for the 30 percent of best-practice production and between 1979 and 1984 a somewhat further productivity increase in the least productive half of the distribution. The best practice part of the distribution is characterised by a slight productivity increase between 1974 and 1979 but a productivity decrease between 1979 and 1984 resulting in a small overall productivity decrease in this range between 1974 and 1984.

The main conclusion from this description of the development of labour productivity is that the diverging development of the different outputs calls for a production function analysis which simultaneously takes into account all outputs.

3. ESTIMATION OF FRONTIER PRODUCTION FUNCTIONS

The problem of obtaining functional forms for multiple output production functions has received relatively little attention in the literature in contrast to the voluminous literature on single output, multiple input production functions.

We will here apply an inverse Cobb-Douglas production function. The Cobb-Douglas time series-cross section frontier is pre-specified to be a function of the following form:

$$(1) \qquad x = A\, e^{-\alpha t} \prod_j y_j^{a_j - \beta_j t}$$

where x is input and y a vector of outputs. With this specification the estimation problem is reduced to the most simple problem of solving a standard linear programming problem.

$$(2) \qquad \max \sum_{i=1}^{N} \left[\ln A - \alpha t + \sum_j (a_j - \beta_j t) \ln y_{ji} \right]$$

s.t.

$$(3) \qquad \ln A - \alpha t + \sum_j (a_j - \beta_j t) \ln y_{ji} \leq \ln x_i \qquad i = 1, \ldots, N$$

securing the observed input points to be on or below the frontier.

All kernel elasticities are restricted to nonnegative values, which seems reasonable from an empirical point of view:

$$(4) \qquad a_j - \beta_j T \geq 0$$

where T is equal to max(t)+1.

The deterministic cross-section frontiers are estimated by solving the linear programming problem (2) - (4) with t and T set to zero. The corresponding average functions are simply estimated by OLS.

The elasticity of scale $\epsilon(x)$ i.e. the elasticity of output with regard to input, outputs being expanded along rays, μ, (see Starrett (1977) is then

$$(5) \qquad \epsilon(x) = \frac{1}{\epsilon(\mu)} = \frac{\delta\mu}{\delta x} \frac{x}{\mu} = \frac{1}{\sum_j a_j - \beta_j t}$$

The input saving measure of efficiency for an individual office is expressed as

$$(6) \qquad E = \frac{A\, e^{-\alpha t} \prod_j y_{ji}^{a_j - \beta_j t}}{x_i^o} = \frac{x_i^*}{x_i^o}$$

where x_i^o is observed amount of input and x_i^* is the amount of input required at the frontier; see Forsund and Hjalmarsson (1974), (1979) and (1987).

On the basis of the individual input saving efficiency measures the saving potential for the whole sector may be calculated. This measure may be termed structural efficiency, S.

$$(7) \qquad S = \frac{\sum_{i=1}^{N} E_i x_i^o}{\sum_{i=1}^{N} x_i^o}$$

where x_i^o denotes observed amount of input and E_i denotes the input saving efficiency measure for micro unit i.

Productivity changes in the combined time series-cross section specification is accounted for by changes in the trend parameters α and β_j, (8), and in the cross-section specification, changes in the intercept A and the parameters a_j, (9):

$$(8) \qquad T_{tc} = e^{-\alpha} \prod_j y_j^{-\beta_j}$$

$$(9) \quad T_c = \frac{A_{t+1}}{A_t} \prod_j y_{jt+1}^{a_{jt}} - a_{jt}$$

4. EMPIRICAL RESULTS

Combined time-series-cross-section results

The estimates of the parameters of the frontier and average production functions are shown in Table 2.

INSERT TABLE 2

The trends in the output elasticities of the frontier function are fairly strong and there is a strong increase for output No.1 and a strong decrease for outputs No 2 and 3 while the trend for output No 4 is small. An increasing output elasticity means a lower productivity at the margin in the production of this output. Thus, productivity change may be considered as output 1-and 4-decreasing and output 2- and 3-increasing.

As expected, the average function results differ a lot from the frontier results both for the parameter levels and trends. Compared to the average function the output elasticity of No 1 is considerably lower first year at the frontier but rapidly increasing while the opposite holds for output No 3.

Starting at about the same elasticity level both functions indicate a decreasing marginal productivity for the more complicated and time consuming output No 4. All standard deviations are small for the base year elasticities and for the large trends (output No 1 and 4) too, but large for the small trends (output No 2 and 3).

In the frontier case the Hicks neutral term contributes to a strong negative productivity growth while the average function gets a small

positive Hicks neutral term, with a large standard deviation. The elasticity of scale level is slightly falling and below 1 all years at the frontier but somewhat above 1 but falling in the average function.

The development of the production surfaces of the frontier and average functions is shown in Figure 5.

INSERT FIGURE 5

The development of both production functions along the average output ratio gives the impression of a marked productivity regress and an increasing distance between the average and frontier production functions during this period i e the productivity regress at the frontier is considerably stronger than at the average. This is also confirmed by the numerical calculations below.

Cross-section results

Since the constant trends in the combined time series - cross section analysis are smoothing out year to year variations in the development it may also be of interest to estimate the production functions for each separate year. The results are reported in Table 3 and 4.

INSERT TABLE 3

As one might expect there is a lot of variation in parameter estimates. On the avarage relatively high values are obtained for output 1 and 3 and relatively low for 2 and 4 and with a scale elasticity somewhat below 1. There is no obvious trends in the estimates.

INSERT TABLE 4

Compared with the frontier the average results show less variation

between years but still there are fairly large shifts between consecutive years. In all years elasticity of scale is slightly above one. The last row in Table 3 and 4 is the result obtained when the entire data set is treated as one combined time series cross section sample. The frontier result of this case will be used for calculations of structural efficiency.

5. PRODUCTIVITY CHANGE MEASURES

One of the most important aspects of productivity change is its impact on unit costs of production. Here the rate of productivity change will be measured by the relative change in total unit costs, for constant input levels, along an output ray; see Salter (1960) and Forsund and Hjalmarsson (1979b) and (1987). Different input levels and output ratios may give different cost changes. We have chosen the average input level and the average output ratio and to check the sensitivity with respect to the chosen ray we also calculate cost changes for the average ray plus and minus 0.5 standard deviations. Due to the scale properties of the production function we have only calculated productivity changes for one "output" level corresponding to the average input level.

This measure may be called proportional productivity change. Since the output composition is exogenously given, bias change is not considered here. The empirical results are presented in Table 5 for the combined time-series-cross-section cases together with the cross-section results based on the difference between the functions in 1974 and 1984.

INSERT TABLE 5

At the frontier productivity growth has been negative, increasing unit costs by 3.0 to 3.4 per cent annually according to the combined time-series-cross-section results and between 4.6 and 3.1 per cent according to the cross-section results. The average function shows a slower productivity regress than the frontier particularly in the

trend case. The values are moderately sensitive to the chosen output ray.

The annual changes are presented in Table 6 and 7 for the frontier and average respectively. Particularly in the frontier cases the values vary substantially with the output ratio. Values with negative signs indicate productivity growth i.e. reduction in unit costs. Only one period shows a cost reduction for all three output ratios. In the average case this happens in four periods.

INSERT TABLE 6

INSERT TABLE 7

The main conclusion from this analysis is a considerable decrease in productivity in this sector during a fairly long time period. An interesting question is, of course, the reasons for this development. Are there any explanations?

In a government investigation of the budgeting process, (DsS 1980:7) it turned out that the cost control was very lax and that the local offices just ordered necessary means from the National Social Insurance Board to perform their tasks. This report suggested a new mechanism for allocation of resources to the local offices and this new regime was implemented the fiscal year 1982/83; see Statskontoret, rapport 1985:26 p. 16-17, and Jonsson 1982b, p 16).

There is, however, a sort of indicative pressure on the productivity of the insurance offices. The National Social Insurance Board regularly performs inspections at the different offices and organises conferences discussing productivity development. In Section 7 we will also compare our results with a few other related studies.

6. EFFICIENCY

Measures of structural efficiency show how the average structure keeps up with the performance of the best-practice at the frontier. The input saving potential for the sector is 1 - S i.e. the structural measure of 0.70 in 1974 means that the saving potential is 30 percent. The structural efficiency measures reveal how close the entire set of micro units is to the frontier.

The level of structural efficiency depends on a lot of factors e.g. rate of productivity growth at the frontier, input and output price changes, scale economies or diseconomies and dispersion in managerial skill and little can be said a priori what should be a normal level. Instead comparisons may be made with efficiency levels obtained in other empirical studies. However, there are very few studies of service production to make a comparison with an exception being Deprins et.al. (1984) The empirical results are presented in Table 8.

INSERT TABLE 8

In all years the level of structural efficiency is fairly low, however, the values are markedly higher than the corresponding value obtained by Deprins et.al. (1984). The figures vary somewhat but there seems to be no clear trend in the development over time. From 1979 to 1980 structural efficiency increased but from 1980 to 1981 there was a still greater decrease in efficiency. One reason for these shifts in efficiency levels may be an increased degree of "capacity" utilisation during the first period followed by an, on the average, larger staff during the last period resulting in a lower degree of capacity utilisation.

7. A COMPARISON WITH EARLIER STUDIES

The productivity in the Swedish social insurance service sector has got some attention in earlier studies. Here two studies will be

mentioned.

In a study by the Swedish Agency for Administrative Development (Statskontoret, rapport 1985:15) an attempt is made to measure the productivity change for the entire social service sector, including all levels. Quantitative indices for different types of output are weighed together by cost shares as weights. According to this study productivity decreased by 2.4 percent annualy as an average during the entire period. The subperiod 1970 to 1975 it decreased by 4.8 percent annually, but during the period 1975 to 1980 it decreased only by 0.2 percent annually. An attempt was also made to calculate the development of labour productivity defined as labour use per standardised output. Between 1963 and 1980, labour productivity fell by 1.6 per cent annually and for the subperiods 1970 to 1975 and 1975 to 1980 by 1.2 and 0.5 per cent respectively. This and several other studies are summarised in a report from the Swedish Ministry of Finance (1987). According to this summary a negative productivity growth seems to have characterised most branches of the Swedish public sector during the 1960's and 1970's (with a relative improvement during the latter part of the 1970's) except public roads and a few administrative agencies. A general observation is that "productivity falls when the resources increase strongly and rises when the resources decrease. This indicates that it is easier to maintain a certain level of output despite dwindling resources than to raise the level at a rate corresponding to an increase of resources." (p. 16).

A study of the productivity change between 1973 and 1980 is performed by Jonsson (1982b). He applied three different productivity measures

- the number of employed per 1000 standardised case days
- the number of employed adjusted for the load factor per 1000 standardised case days
- the total cost per standardised case day

The main result in this study is a positive productivity growth. The costs per standardised case day decreased by 2.5 percent between 1973 and 1980.

In another study by Jonsson (1982a) the focus is on explanations for differences in costs bewtween the 26 different regional insurance offices in 1980. A regression model is applied where the variation in total number employed at the local offices inside each region per 1000 standardised case days are explained by

- population density
- degree of absentee (due to vacations, sickness, education etc)
- employment turnover
- unemployment rate
- number of subsidiares to the local offices
- education level of the employees
- number of cash reimbursements
- number of requirements of medical certificates (läkarintygsföreläggande)

The main result is that more than 90 percent of the variation is explained by this multiple regression equation, the most important variable being population density explaining about 50 per cent of the variation. The absentee, subsidiary and certificate variables were also significant but of less importance numerically. The impact of education level was not significant at all.

Quality aspects

One key question in productivity estimations is related to changes in quality of the services during the measurement period. Are there any evidence that quality changes will have any significant effect on our results? The main quality components in social insurance service administration are

- the speed of the service e.g. the time elapsed from when the case arrives at the office until it is finished
- the number of errors in the handling of cases e.g. leading to wrong compensation
- the accuracy and "volume" of information about compensation possibilities and social rights

Other qualitative aspects which may influence productivity is changes in the degree of complexity in the rules or laws which determine social rights in this area.
The practical handling of the cases has changed substantially since the 1960s. The manual handling of cases dominated during the 1960s and a substantial amount of cash payments directly to the receivers took place. In the beginning of 1970s the system was computerised. Gradually the amount of cash payments has decreased and almost disappeared during the 1980s. Thus, there has been a radical change in the system from manual routines and a lot of direct contact with the recipients to computerised work and few customer appointments.

Concerning quality changes the study on productivity trends for some central government authorities including social insurance service concluded that "A general observation is that if the services are broken down to a sufficiently detailed level, the quality changes of the individual services often prove to be minor" (The Swedish Ministry of Finance 1987, p. 70).

The study by Jonsson (1982a) also concluded that the low cost insurance offices were not characterised by a lower service level or quality of service. On the contrary, a few quality indicators pointed in the opposite direction.

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Statlig tjänsteproduktion. Produktivitetsutvecklingen 1960-1980. Huvudrapport. Statskontoret, PRISA- projektet 1985:15.

Table 1. The data set. Average values of input in working days and outputs in number of cases handled.

Year	Number of offices	Working days	Output No 1	2	3	4
		x	y_1	y_2	y_3	y_4
1974	392	2889	10062	15098	50264	1110
1975	400	3115	9996	16098	47146	1184
1976	404	3496	9960	21598	50909	1501
1977	416	3704	10609	21530	50869	1425
1978	436	4194	9894	25292	53723	1692
1979	452	4562	10075	30246	55450	2069
1980	458	4647	12680	30307	53662	2366
1981	460	4707	10590	30175	48986	2225
1982	462	4572	9895	29313	43346	2100
1984	456	4180	9324	29738	43734	1814

Table 2: Estimates of the frontier and average production functions. Combined time series - cross section analysis.

Output elasticities

		Trend 1		Trend 2		Trend 3		Trend 4
Case	a1	β_1*10	a2	β_2*10	a3	β_3*10	a4	β_4*10
Frontier	0	-0.49	0.31	0.26	0.67	0.28	0.07	-0.07
Average	0.27	0.16	0.36	-0.02	0.21	-0.05	0.10	-0.12
Stand dev	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.01)	(0.02)

Constant term and scale parameters

	Constant	Trend	Scale Elasticity Year	
Case	term A	α	1	11
Frontier	-3.08	-0.10	0.96	0.94
Average	-1.02	0.01	1.05	1.02
	(0.07)	(0.01)		

Table 3. Frontier estimates for annual cross sections 1974 to 1984.

	Constant term	Output elasticities				Scale elasticity
Year	ln A	a1	a2	a3	a4	
1974	-3.01	0	0.11	0.85	0.05	0.99
1975	-2.66	0.41	0	0.55	0.10	0.95
1976	-2.21	0.57	0	0.38	0.11	0.95
1977	-1.65	0.29	0.30	0.35	0.02	1.04
1978	-1.34	0.03	0.45	0.25	0.24	1.02
1979	-2.19	0.34	0.28	0.33	0.15	0.94
1980	-2.05	0.63	0	0.33	0.09	0.95
1981	-2.63	0.54	0.10	0.39	0.08	0.90
1982	-2.74	0.31	0	0.56	0.27	0.88
1984	-0.96	0.69	0	0.09	0.24	0.98
1974-84	-2.60	0.01	0.41	0.47	0.16	0.96

Table 4. Average production function estimates for annual cross sections 1974 to 1984. Standard errors within brackets.

	Constant term	Output elasticities				Scale elasticity
Year	ln A	a1	a2	a3	a4	
1974	-1.25	0.38	0.15	0.33	0.10	1.04
1975	-1.12	0.46	0.12	0.27	0.13	1.02
1976	-0.86	0.33	0.33	0.15	0.15	1.04
1977	-0.98	0.29	0.32	0.23	0.13	1.04
1978	-1.34	0.23	0.31	0.32	0.13	1.01
1979	-1.22	0.21	0.34	0.28	0.14	1.02
1980	-1.05	0.12	0.48	0.17	0.20	1.03
1981	-1.11	0.18	0.32	0.27	0.21	1.01
1982	-0.88	0.08	0.48	0.17	0.24	1.03
1984	-0.94	0.06	0.34	0.28	0.29	1.02
1974-84	-0.98	0.16	0.43	0.21	0.17	1.03

Table 5: The Development of Unit Costs along the Average Output Ratio and the Average Input Level. Annual Percentage Changes.

		Proportional technical advance 1974/84		
		$\bar{y}$	$\bar{y}$ + 0.5s	$\bar{y}$ - 0.5s
Frontier	ts - cs	3.3	3.4	3.0
Average	ts - cs	0.8	0.9	0.5
Frontier	cs	4.2	4.6	3.1
Average	cs	1.9	2.1	1.5

Table 6: The Development of Unit Costs along the Average Output Ratio and the Average Input Level respective years, 1974-1984. Annual Percentage Changes. Frontier cross section results.

Year	$\bar{y}$	$\bar{y}$ + 0,5s	$\bar{y}$ - 0,5s
1974/75	15.3	18.8	8.2
1975/76	11.2	11.8	9.4
1976/77	7.0	3.2	13.4
1977/78	10.7	13.2	4.2
1978/79	3.1	5.9	-0.02
1979/80	-7.8	-8.9	-4.5
1980/81	12.9	15.7	7.7
1981/82	3.0	4.1	1.4
1982/84	-1.1	-4.8	3.9

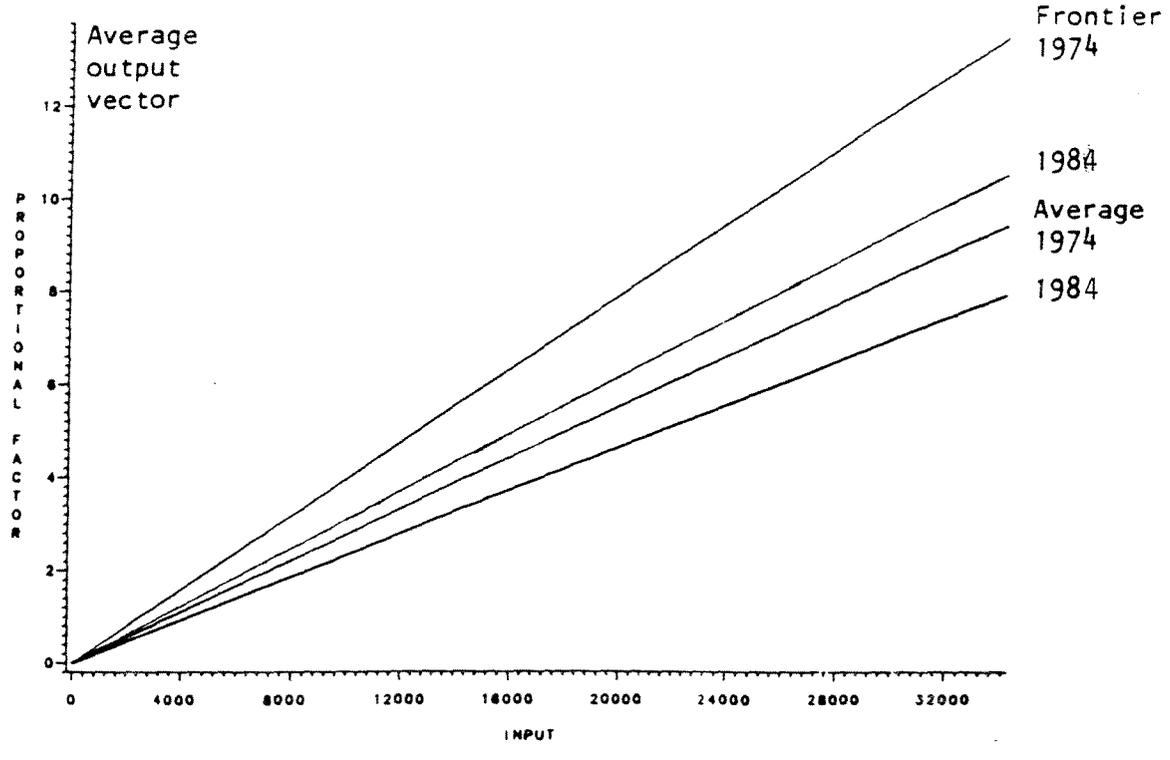
Table 7: The Development of Unit Costs along the Average Output Ratio and the Average Input Level, 1974-1984. Annual Percentage Changes. Average cross section results.

Year	$\bar{y}$	$\bar{y}$ + 0.5s	$\bar{y}$ - 0.5s
1974/75	7.6	8.6	5.6
1975/76	7.8	8.0	5.9
1976/77	3.7	3.4	4.8
1977/78	3.8	4.8	2.4
1978/79	-1.2	-1.3	-1.1
1979/80	-5.3	-4.8	-7.5
1980/81	9.0	9.0	10.2
1981/82	-0.03	-0.03	-1.4
1982/84	-2.7	-2.9	-1.7

Table 8. Estimates of Structural Efficiency 1974-84.

	Frontier combined ts-cs	Frontier one cross section	Frontier cross sections
1974	0.70	0.71	0.69
1975	0.67	0.66	0.74
1976	0.72	0.72	0.77
1977	0.71	0.67	0.75
1978	0.69	0.67	0.77
1979	0.70	0.70	0.83
1980	0.76	0.69	0.81
1981	0.70	0.64	0.79
1982	0.68	0.61	0.79
1984	0.76	0.66	0.79

Figure 5. The development of the frontier and average productions functions between 1974 and 1984. The production function cut with a plane along the average 1974/84 output ray.



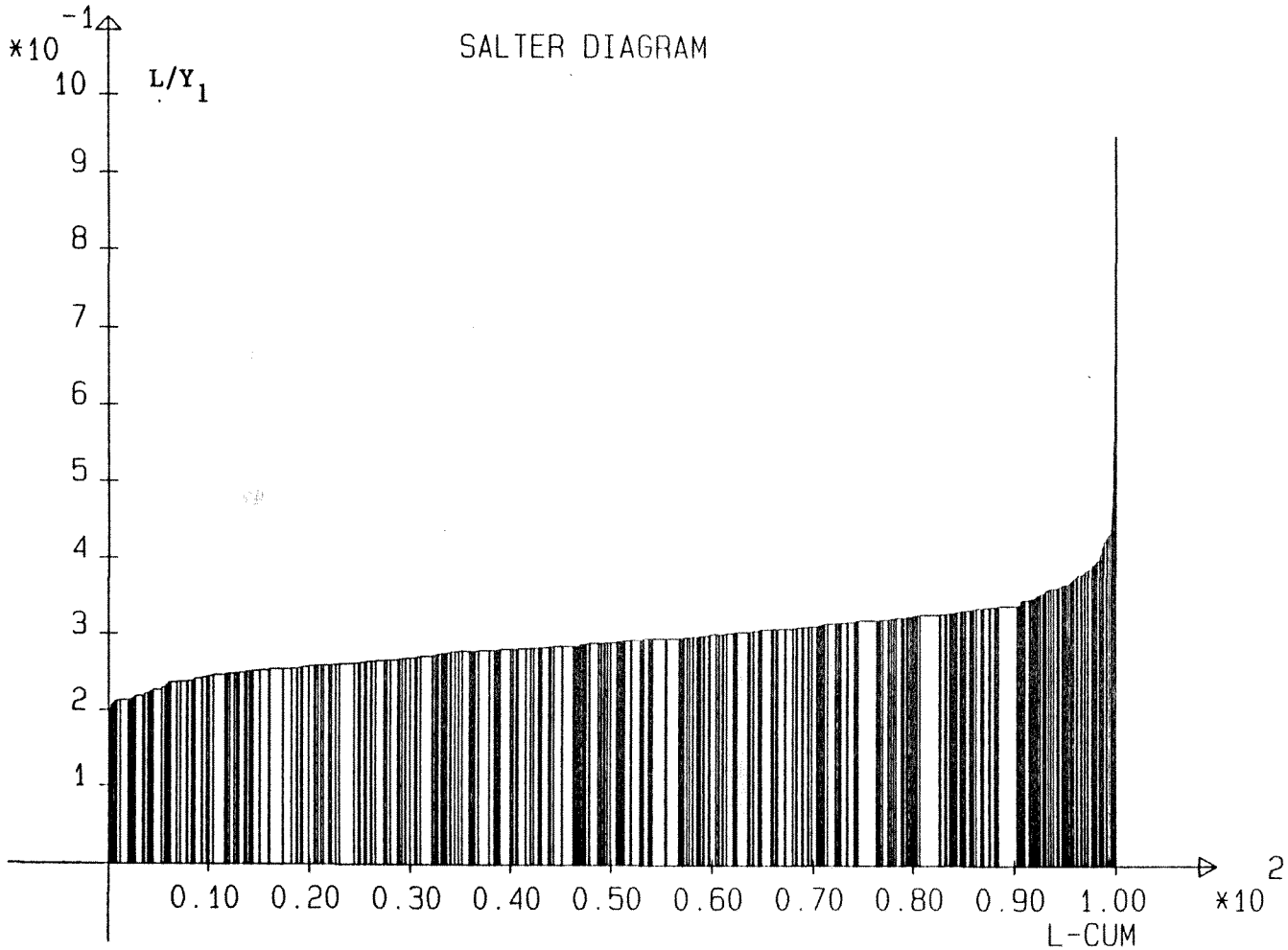
ABSTRACT

PRODUCTIVITY CHANGE AND PRODUCTIVE EFFICIENCY IN SWEDISH SOCIAL WELFARE OFFICES

The purpose of this study is to analyse productivity change and productive efficiency in local welfare offices of the Swedish social insurance system on the basis of the frontier production function.

The process of productivity change is studied by means of a frontier production function, estimated on data for all local welfare offices of the Swedish social insurance system during the period 1974-1984. Since these offices produce several types of services, pensions, public health benefits, child grants etc with one dominant input, labour, we have applied an "inverted" production function with one input and multiple output. The estimated frontier production function also serves as the basis for measurements of efficiency.

The main result is that productivity growth has been negative during the period.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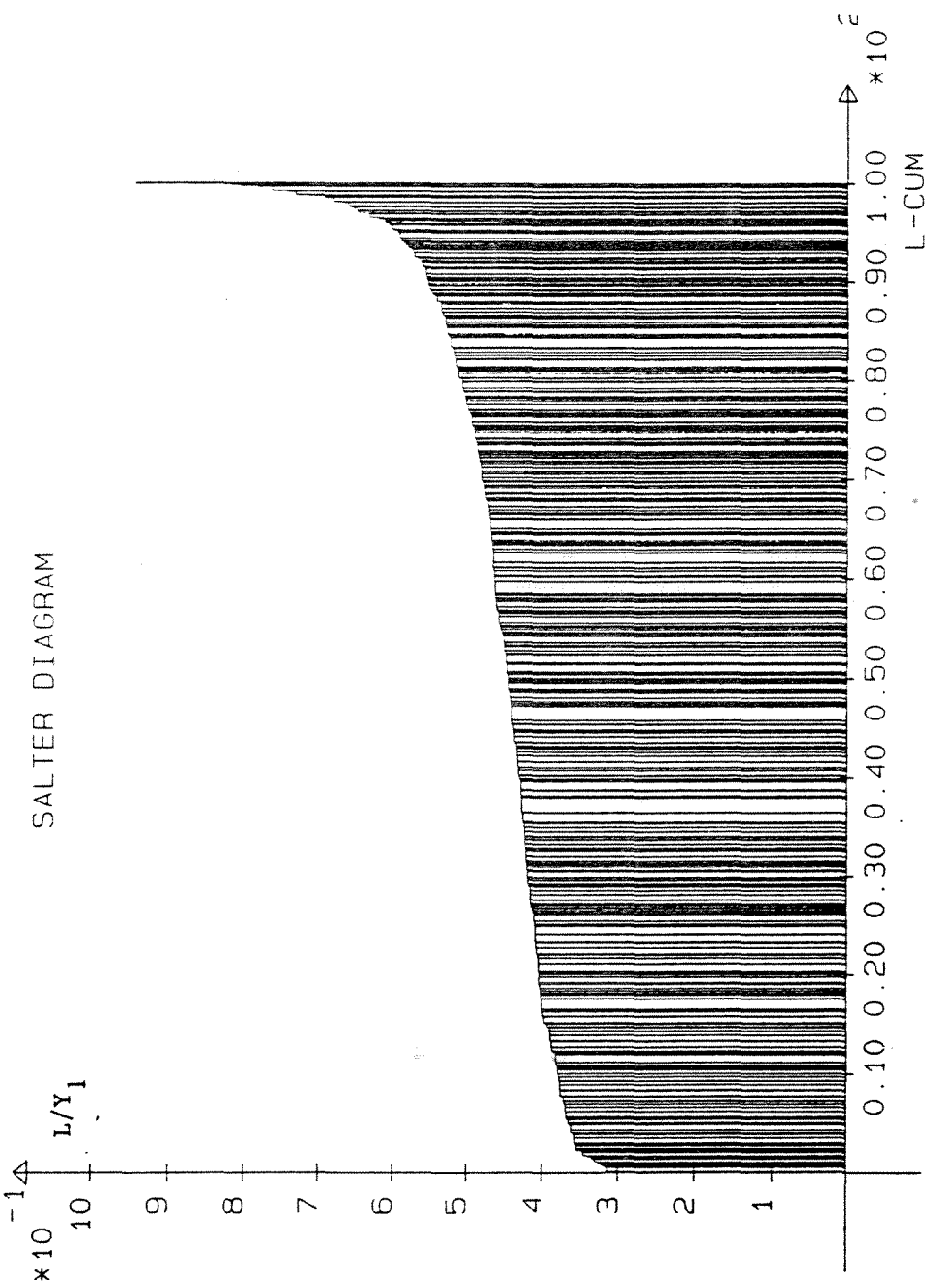
L/Y1
10
9
8
7
6
5
4
3
2
1
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
*10 2
L-CUM

FIGURE 1 A

FIGURE 1 B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$*10^{-1}$
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9
8
7
6
5
4
3
2
1
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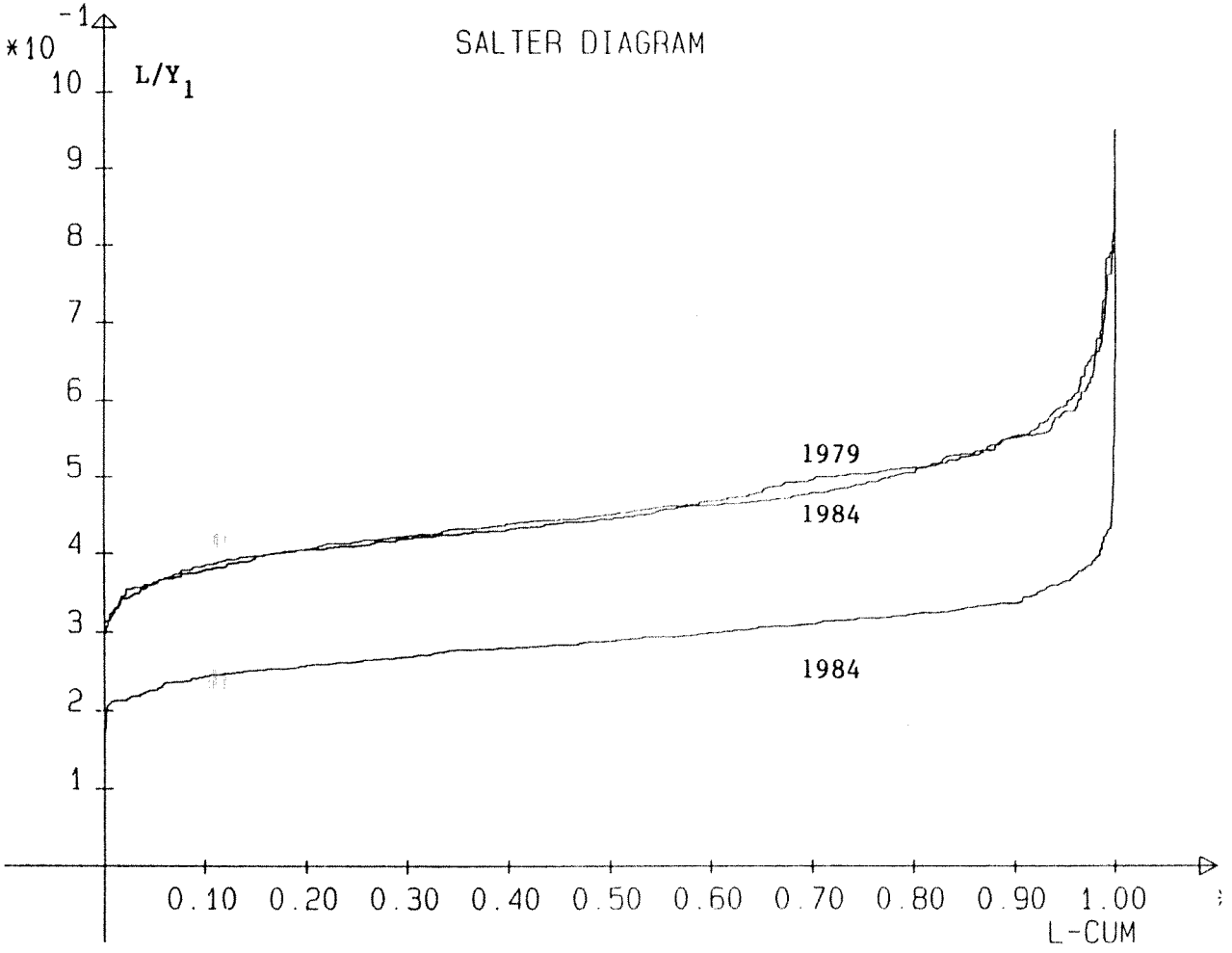
L-CUM
$*10^{2}$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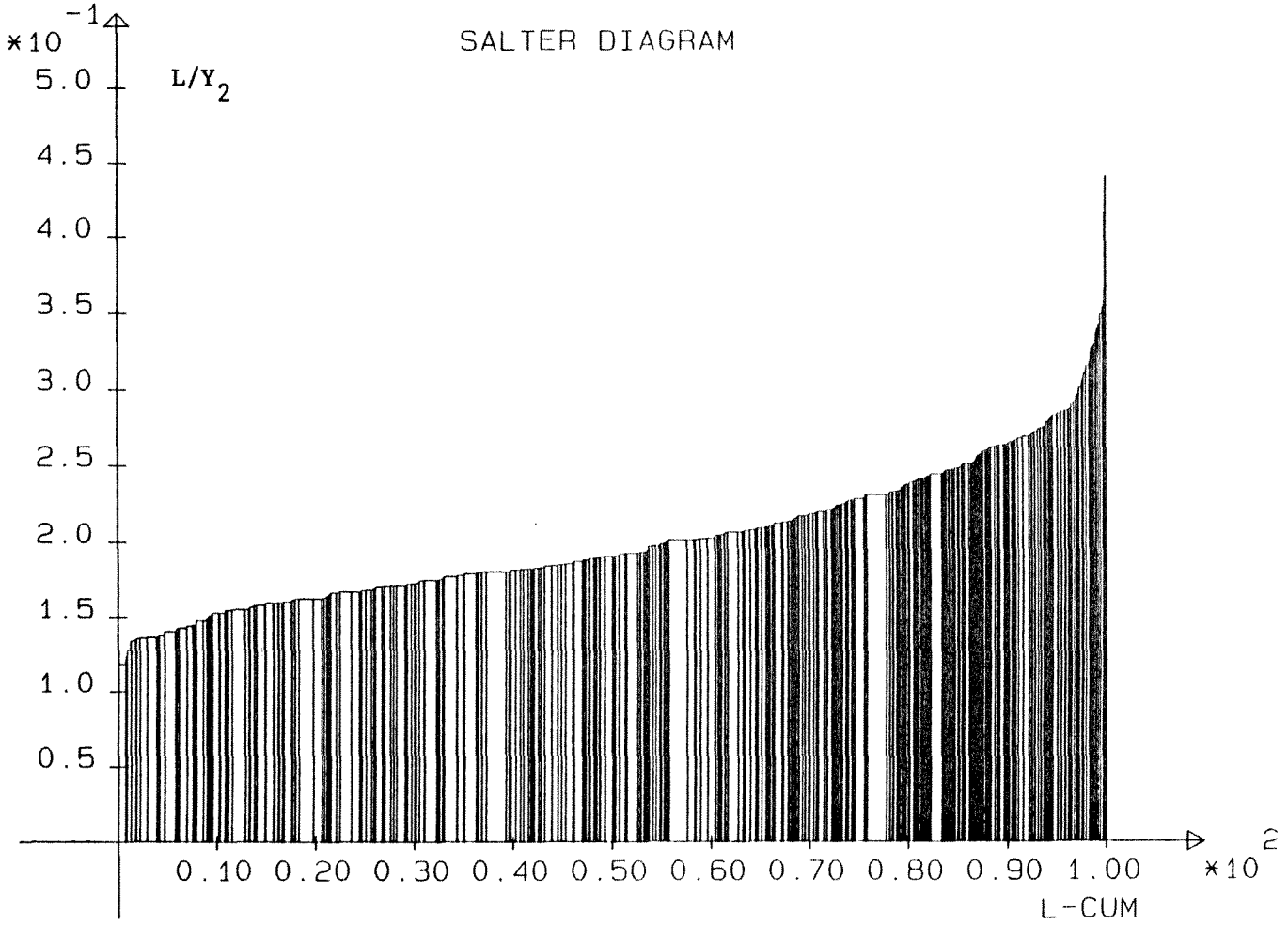
L/Y1
10
9
8
7
6
5
4
3
2
1
1979
1984
1984
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
L-CUM

FIGURE 1 C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4.0
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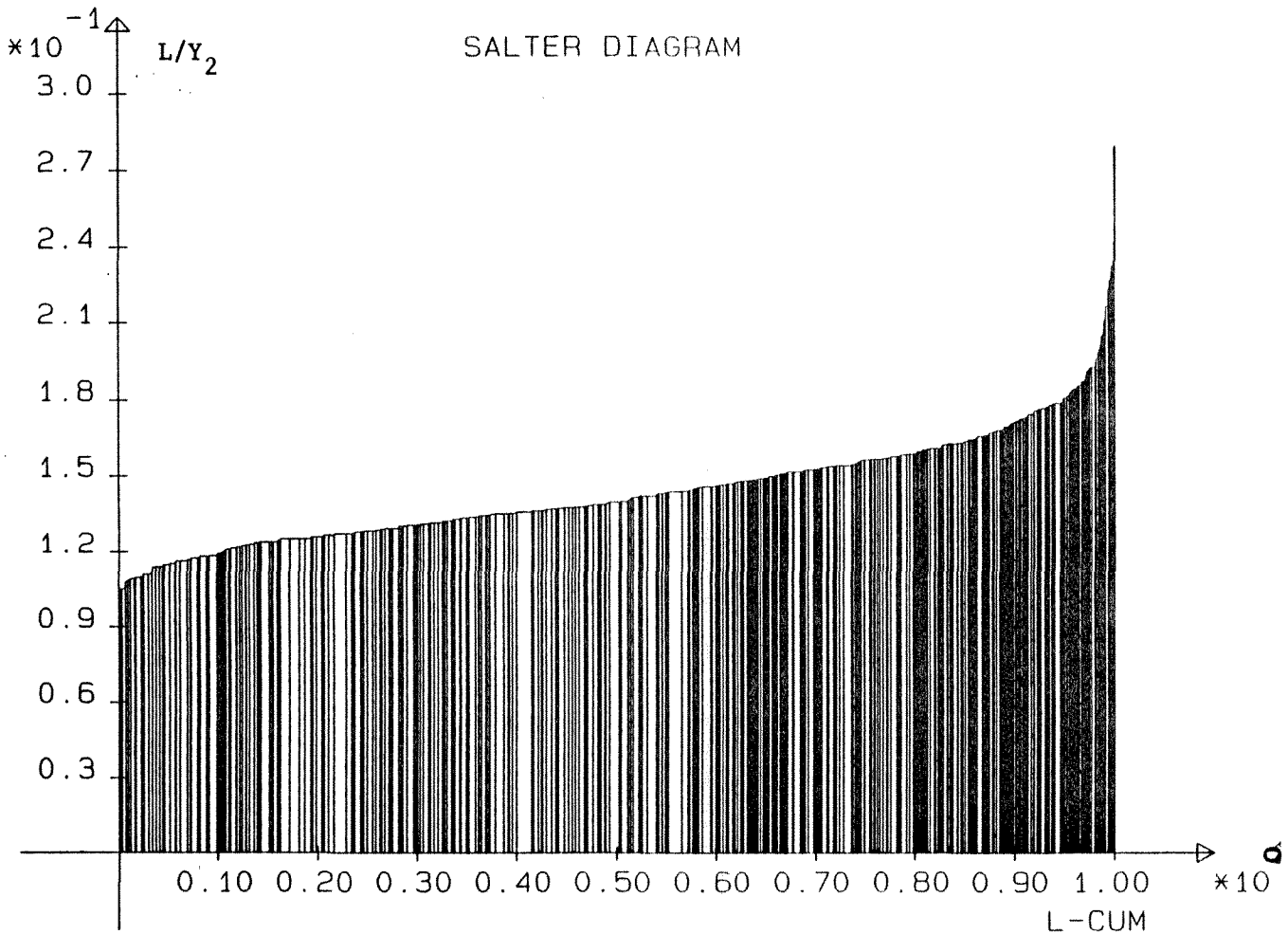
2.5
2.0
1.5
1.0
0.5
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
*10 2
L-CUM

FIGURE 2 A


SALTER DIAGRAM
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L/Y2
3.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
*10
L-CUM

FIGURE 2 B

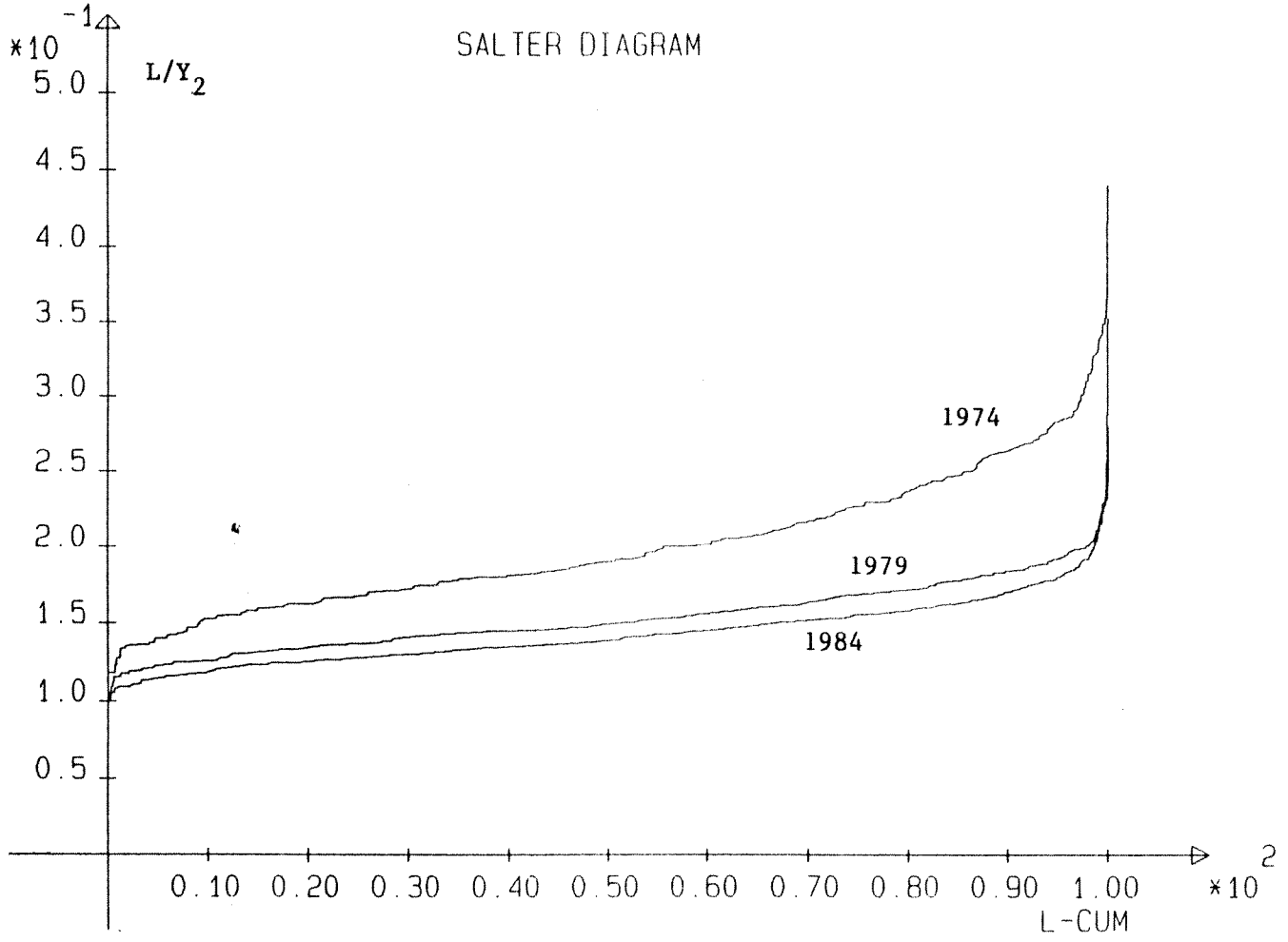
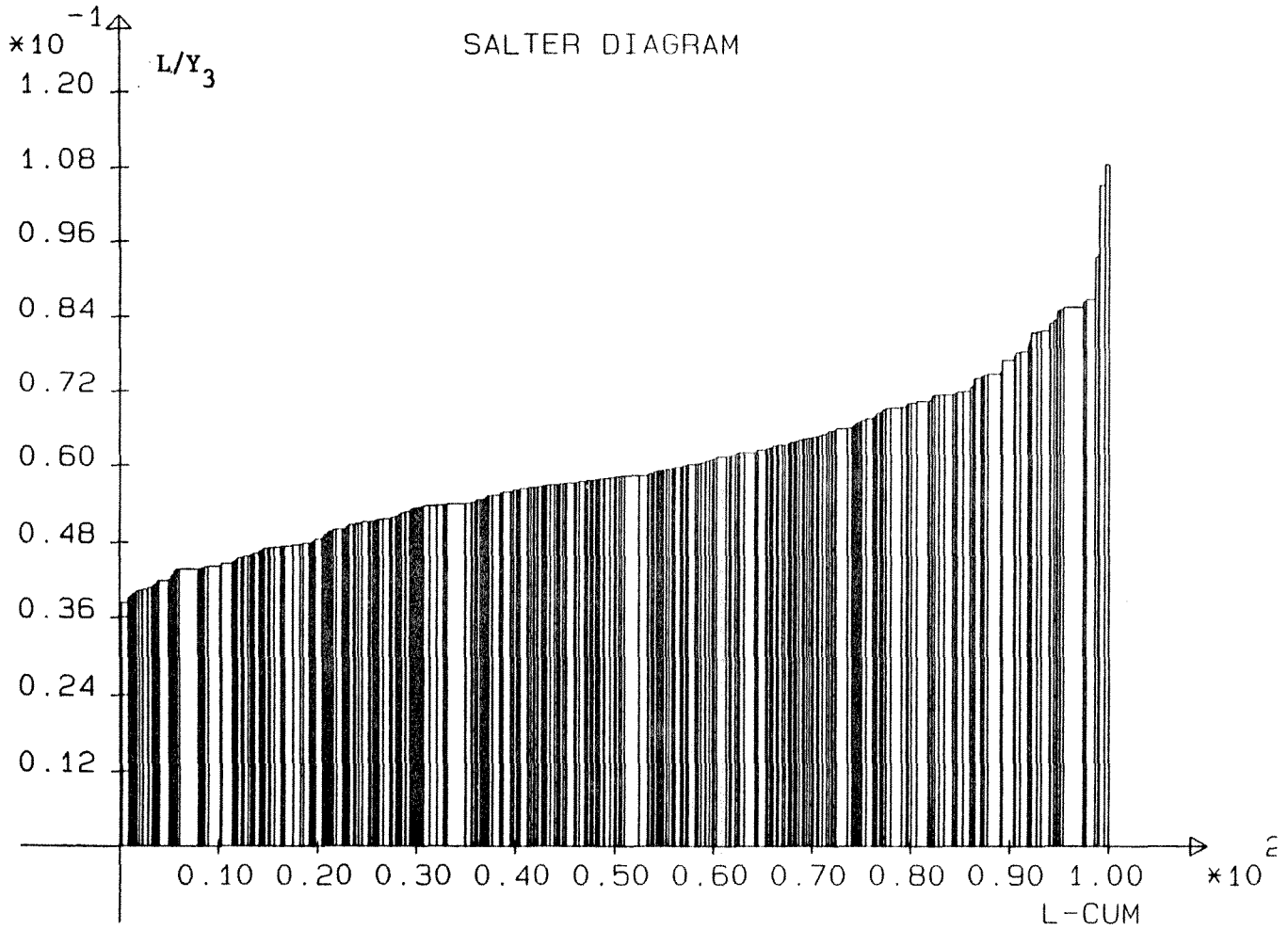

SALTER DIAGRAM
*10 -1
L/Y2
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1974
1979
1984
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
*10 2
L-CUM

FIGURE 2 C


SALTER DIAGRAM
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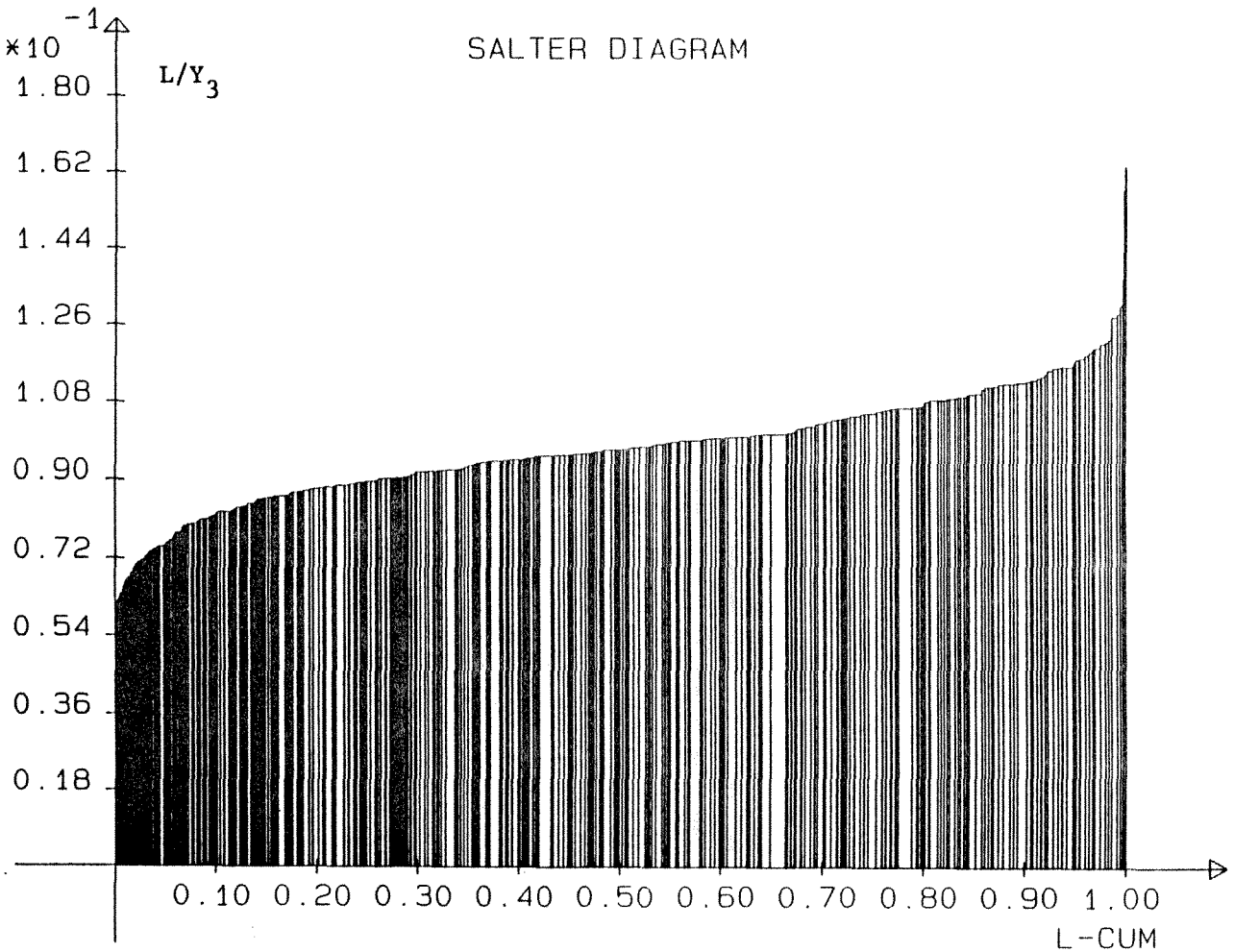
L/Y3
1.20
1.08
0.96
0.84
0.72
0.60
0.48
0.36
0.24
0.12
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
*10 2
L-CUM

FIGURE 3 A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0.90
0.72
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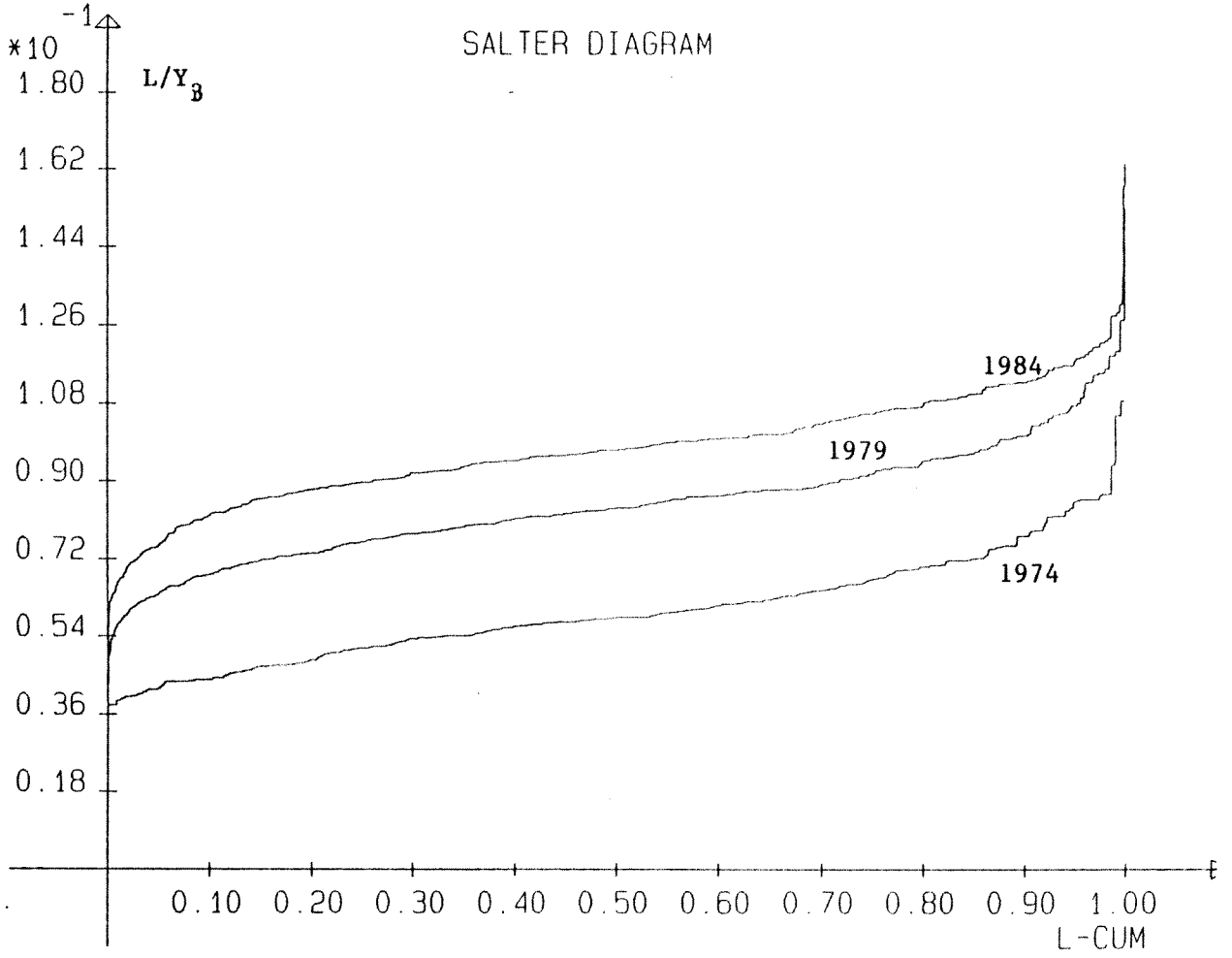
0.18
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
L-CUM

FIGURE 3 B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L/Y3
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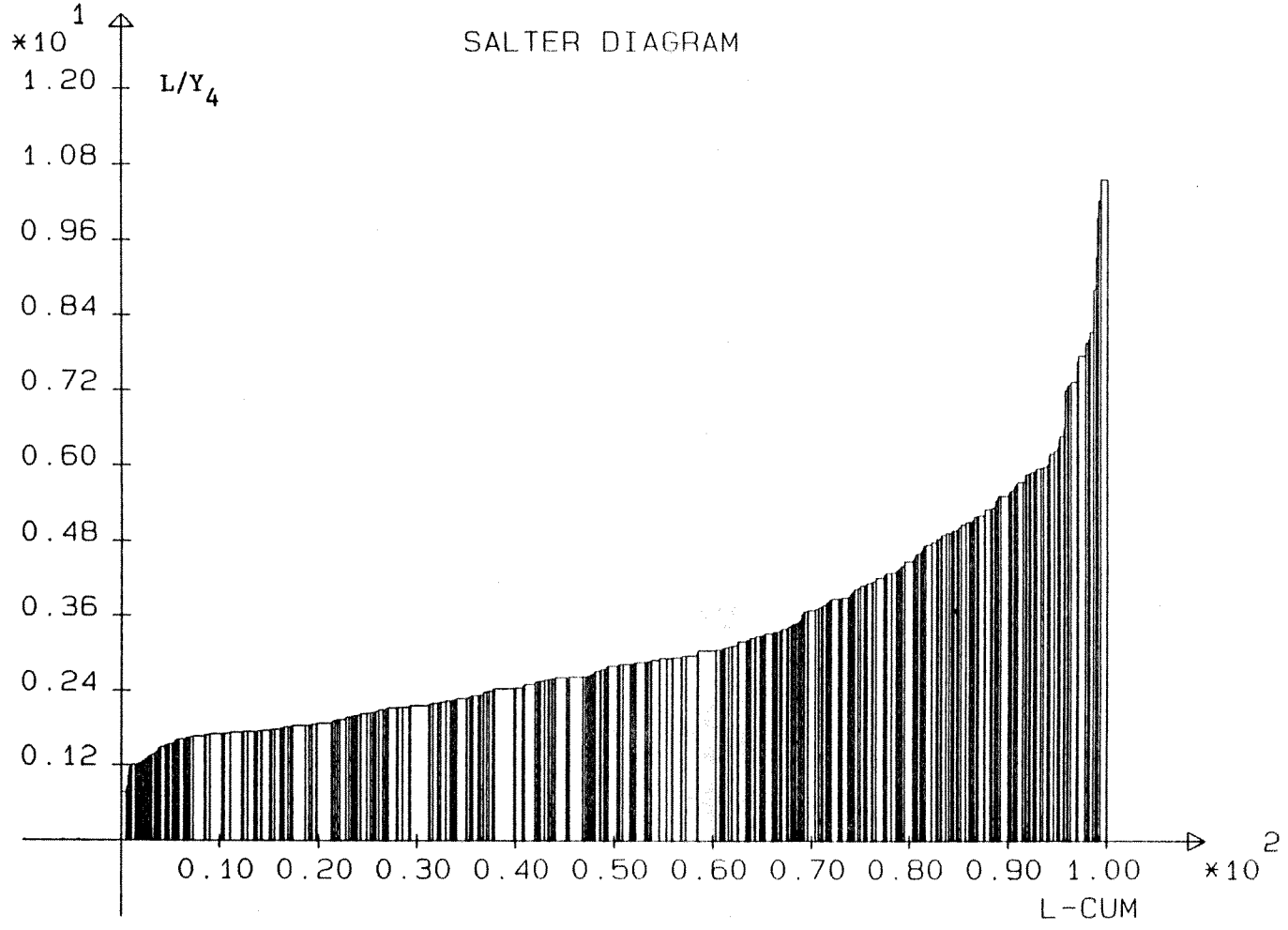
1.62
1.44
1.26
1.08
0.90
0.72
0.54
0.36
0.18
1984
1979
1974
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
L-CUM

FIGURE 3 C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1.08
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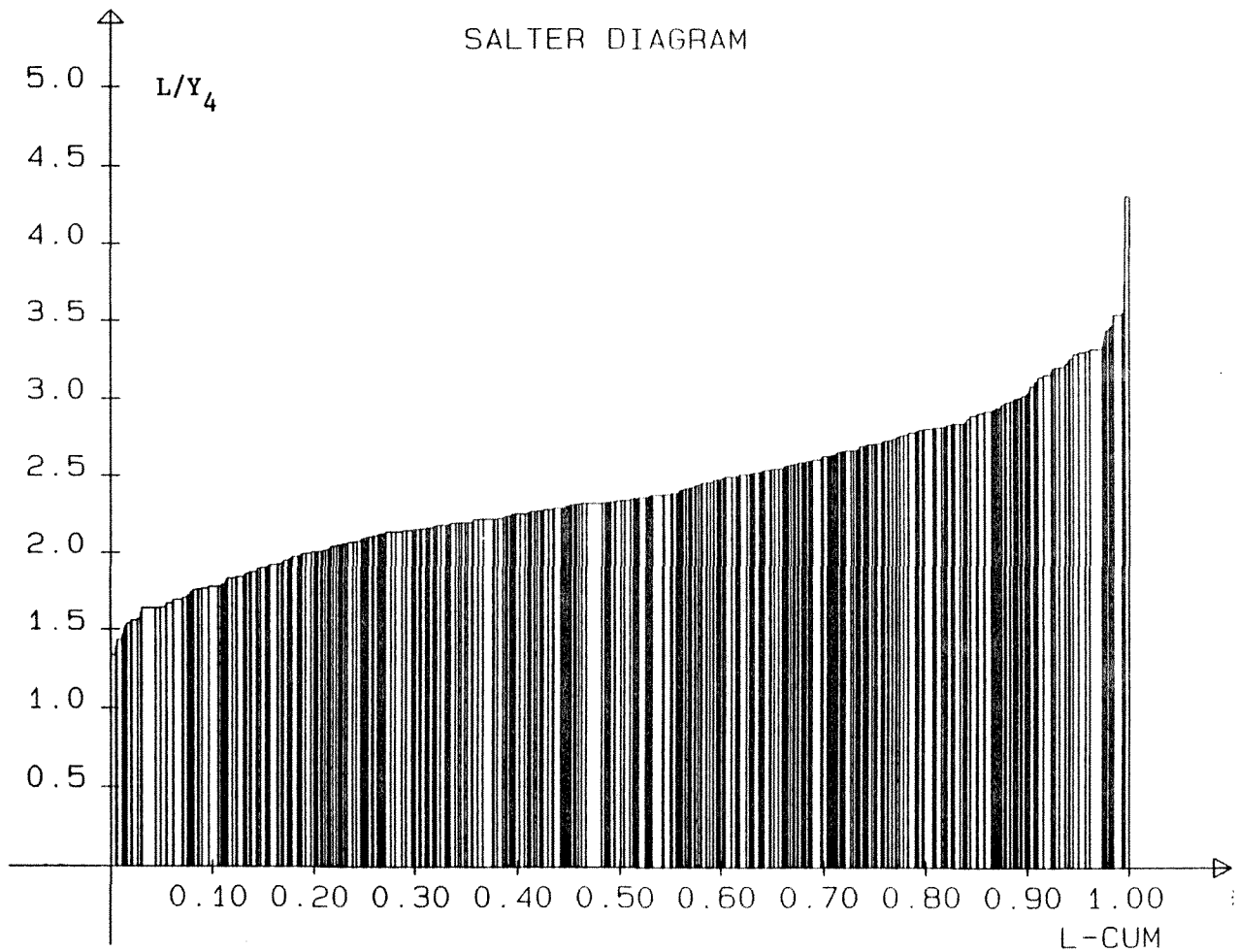
0.84
0.72
0.60
0.48
0.36
0.24
0.12
L/Y4
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
*10 2
L-CUM

FIGURE 4 A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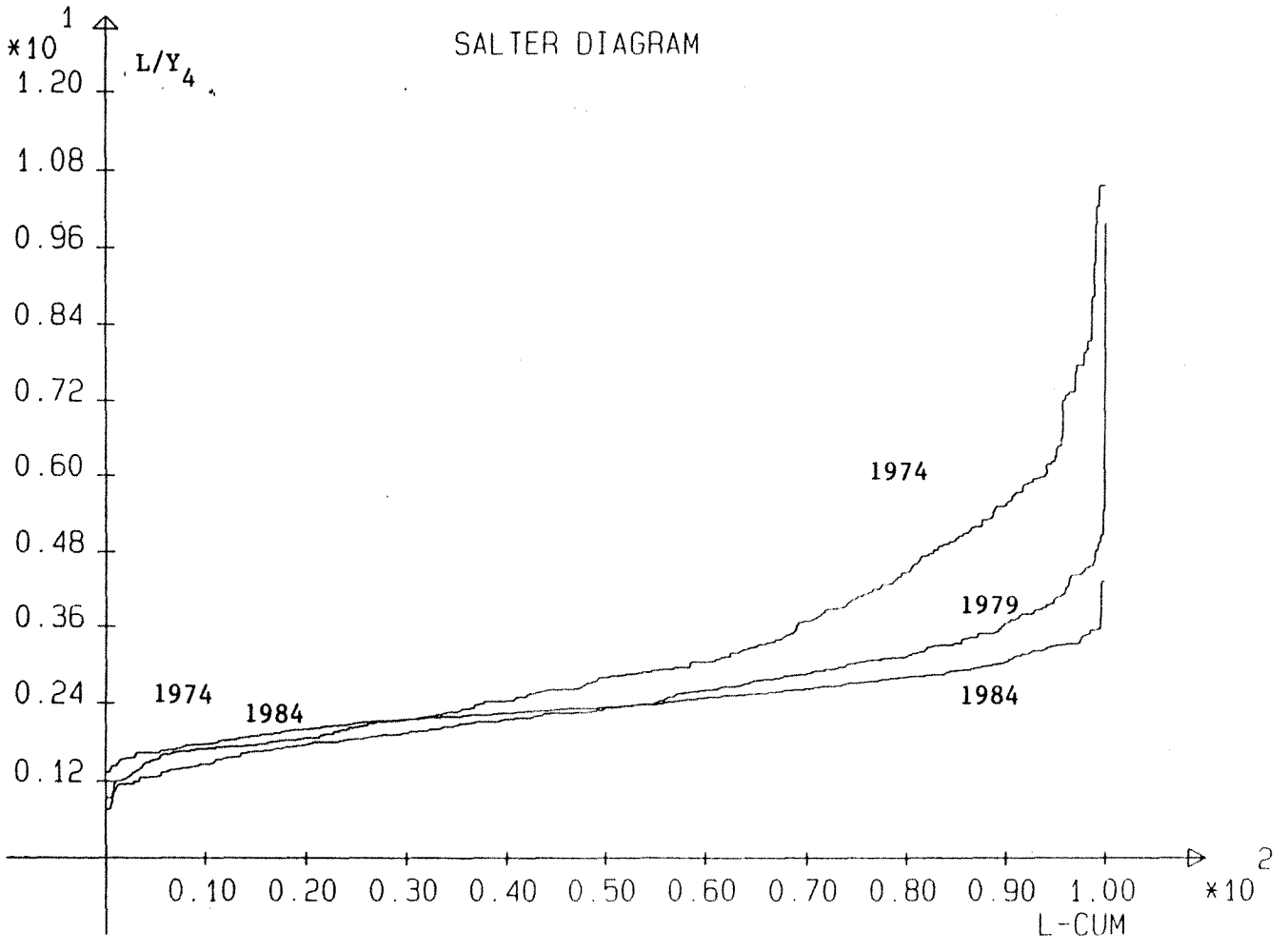
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
L-CUM

FIGURE 4 B


SALTER DIAGRAM
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L/Y4
1.20
1.08
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0.84
0.72
0.60
0.48
0.36
0.24
0.12
1974
1979
1984
1974
1984
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
*10 2
L-CUM

FIGURE 4 C