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Decentralisation of bargaining and manufacturing employment: Sweden 1970–96

Anders Forslund
Thomas Lindh

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Postal address: P.O. Box 513, 751 20 Uppsala
Visiting address: Kyrkogårdsgatan 6, Uppsala
Phone: +46 18 471 70 70
Fax: +46 18 471 70 71
ifau@ifau.uu.se
www.ifau.se

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Decentralisation of Bargaining and Manufacturing Employment: Sweden 1970–96*

Anders Forslund† and Thomas Lindh‡

Abstract

Swedish unemployment was very low up to the early 1990s when it rose rapidly. At the same time manufacturing employment fell by more than 20 %. The decentralisation of wage bargaining that started in 1983 may have contributed to this by making employment more shock sensitive or by increasing wage mark-ups. In Swedish plant-level data for manufacturing 1970–96 relatively *less* employment is in low-productivity plants after decentralisation than before, but the correlation between *industry* wage costs and productivity becomes stronger. Our conclusion is that decentralisation of bargaining in Sweden has not allowed more low-productivity plants in manufacturing to survive. On the contrary, the evidence indicates that a higher wage mark-up may have resulted from the decentralisation. This would weed out low-productivity plants and decrease manufacturing employment.

JEL codes: E24, J31, L60
Keywords: Manufacturing employment, bargaining institutions, industry structure

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†Institute for Labour Market Policy Evaluation and Department of Economics, Uppsala University, e-mail `anders.forslund@ifau.uu.se`

‡Institute for Futures Studies and Department of Economics, Uppsala University, e-mail `thomas.lindh@nek.uu.se`.

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1 Introduction

Swedish unemployment rates averaged at around 2 per cent up to the early 1990s, when they rose rapidly to slightly below 10 per cent in the recession. One background fact, that distinguishes the Swedish experience, was a centralised bargaining system—resulting in very compressed wage distributions—that disintegrated in the beginning of the 1980s and was replaced by a more decentralised system, with bargaining mainly at the industry level.

Decentralisation of bargaining could play a role in the determination of employment by two distinct mechanisms. *First*, if decentralisation results in a positive correlation between wages and productivity at the plant level, it may concentrate employment in low-productivity plants. *Second*, since externalities like increased unemployment are more likely to be internalised in a centralised bargaining system, decentralisation may also raise the wage mark-up. Both mechanisms potentially make employment more sensitive to macro shocks: the first by increasing the number of plants that cannot cover costs when a negative shock hits, the second by decreasing profit margins for all firms.

When a real interest hike occurred in the Swedish economy in 1990, the accompanying investment slump thus may have hit a more shock-sensitive employment distribution. To analyse the event we study plant-level data on the distribution of employment, productivity and wages in Swedish manufacturing 1970–96 from Statistics Sweden.

The tentative conclusion is that our evidence supports the wage mark-up mechanism rather than the low-productivity mechanism. In the plant-level data there is only a weak correlation between plant wage levels and plant labour productivity or gross profits. Nor do we find any strong correlation within any of the manufacturing industries, and there are no signs that low-productivity industries were favoured by decentralisation in spite of a stronger correlation at the industry level between (median) wage costs and (median) productivity. Moreover, the data also show that the decentralisation of wage bargaining is accompanied by productivity distributions that contain relatively *less* employment in marginal plants.[1] The industry wage-productivity correlation could, therefore, be interpreted as an increase in wage mark-ups that weeded out low-productivity plants and decreased average productivity dispersion between industries at the

[1]Plants that barely cover wage costs.

lower end of the distributions.[2]

Our results bear evidence on two different questions that have been raised in the Swedish discussion of decentralisation of wage bargaining.

First, we have the question whether decentralisation of bargaining provides shelter for low-productivity firms to survive longer. Hibbs Jr. & Locking (2000)—using Swedish data—provide evidence that increased within-plant wage dispersion has had positive effects on aggregate labour productivity and output, but they also find that increased wage dispersion between industries and between plants has had negative productivity effects. This result supports the Swedish Rehn-Meidner model,[3] that in the 1950s motivated a centralised solidaristic wage bargaining institution to achieve faster industrial restructuring and productivity growth by pruning low-productivity firms and allowing high-productivity firms more profits to reinvest.

The mainly verbal notions of the Rehn-Meidner model were formalised by Agell & Lommerud (1993). Theoretical studies have identified a number of possible mechanisms, through which decentralised wage setting may concentrate low-quality labour in firms earning only marginal quasi-rents, e.g., Davis (1995) using a decentralised job-search model, and Moene & Wallerstein (1995) in a vintage model including decentralised wage bargaining.[4] In the aggregate, the consequence would be that low-productivity firms paying lower wages will survive relatively longer and that the competitive pressure to use best-practice technology is relaxed. A given negative macroeconomic shock would then make a larger share of firms unprofitable, translating into more job destruction, as illustrated in *Figure 1.* We find little or no support for these implications in our manufacturing data.

Second, decentralisation of wage bargaining to an intermediate industry level (as was the case in Sweden) may give rise to higher wage mark-ups by making unions more insensitive to the employment consequences of high wage demands. As analysed by Calmfors & Driffill (1988), decentralisa-

[2]The evidence on productivity growth presented in Andersson (1999) indicates that relatively less of productivity growth can be attributed to productivity growth in existing plants in the period 1988–96 than in earlier periods. Evidence in Andersson & Vejsiu (2001) suggests that plant exit played an important role for productivity growth over the 1985–96 period.

[3]The main reference on the Rehn-Meidner model is LO (1951).

[4]Uneven technical progress (Cohen & Saint-Paul 1995) and creative destruction effects that decrease the duration of job matches (Aghion & Howitt 1994) provide other mechanisms with similar effects.

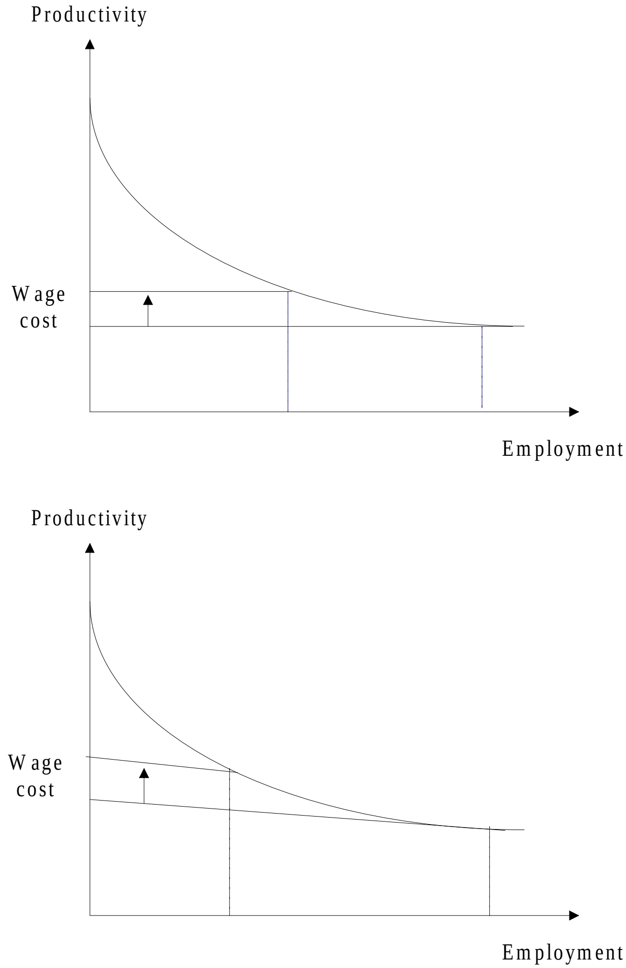

Figure 1: A positive relation between wages and productivity makes the employment distribution relatively more shock sensitive

tion to the industry level may not substantially decrease union bargaining strength but is likely to make individual unions ignore externalities like unemployment to a higher degree than in a centralised bargaining regime. Layard et al. (1991), Chapter 2, provide an extensive survey of research along these lines. In a recent paper, Bénassy (1997) formalises a capital shortage argument[5] by combining real business cycles with imperfect competition in the labour market. The upshot of this analysis is persistent unemployment in response to shocks. We do find indications in our manufacturing data that wage mark-ups may have increased with decentralisation of bargaining, thus creating more severe employment responses to negative shocks.

The next section describes and interprets the empirical facts we have found in Swedish manufacturing data. *Section* 3 outlines a simple bargaining model which is used to interpret the transition from centralised to decentralised bargaining. *Section* 4, finally draws some tentative conclusions.

2 Empirical observations

In this section we report and analyse patterns and statistics from our data material. First, we examine to what extent the decentralisation of bargaining gave rise to productivity-dependent wages. Second, we derive different measures of how the shock-sensitivity of employment evolves over time to see whether decentralised bargaining was associated with an increase in "marginal" employment.[6] We also look at employment growth in low-productivity plants and industries to see whether decentralised bargaining was accompanied by increased employment shares in low-wage, low-productivity plants or sectors. Finally, we look at patterns in aggregate industry employment, wages and investment and relate them to the

[5]The capital shortage hypothesis is proposed in for example Sneessens & Drèze (1986) and Bean (1989) as an explanation for persistent European unemployment. In short the hypothesis implies that capital adjustment is too slow to provide sufficient job creation to replace jobs destroyed by macroeconomic shocks. It was dismissed in the debate "... because it again seems inconsistent with the outward shift of the UV curve." (Bean, 1994, p. 614). A higher number of jobs created, i.e. vacancies, for a given unemployment rate is indeed not directly consistent with capital shortage. However, if it is difficult to reabsorb laid-off low-productivity workers in high-productivity jobs, as some researchers have suggested, an outward shift of the Beveridge curve could still be compatible with capital shortage.

[6]By marginal employment we mean employment in plants where revenues will not cover wage costs if the latter increase marginally.

findings in our micro data.

The plant-level data consist of value-added, wage sums and employment for all plants in Swedish mining and manufacturing 1970–96 with more than 5 employees (more than 10 employees from 1988) subdivided into 27 production industries.[7] We complement this core material with National Accounts data from Statistics Sweden on manufacturing production, investment and relevant price indices.

2.1 Swedish mining and manufacturing 1970–96: Plant-level productivity, wages and employment

In *Figure 2* the Salter[8] curves for selected years in the period 1970–96 show labour productivity—value added per employee—ordered from lower to higher and the corresponding average wage cost for plants in Swedish manufacturing. We have excluded some productivity outliers in both tails of the distributions to enhance comparability over time.[9] On the horizontal axis accumulated employment is measured. There are no signs of any strong relationship between wages and productivity. Formal regressions, presented in *Appendix* A, confirm that impression.

In *Figure 2* there is no discernible tendency that the tails of the productivity distribution become flatter over time. On the contrary, marginal employment rather seems to have decreased. To check that impression we calculated the share of employment where value added covered wage costs and the corresponding share if wage costs were 10 percent higher. The difference yields a rough measure of how sensitive the distribution would be to a wage cost shock. The results, reported in *Table 1*, confirm the impression that shock-sensitivity measured in this way has decreased over time, and, more to the point, that there was no marked increase in the late 1980s and early 1990s.[10]

It also seems that the decentralisation of bargaining to the industry level, that started after 1982, has had no major impact on the plant-level relation between wages and productivity. Wage costs are essentially

[7] This data set derives from the *Manufacturing Statistics* from Statistics Sweden.

[8] Named after Salter's (1960) pioneering study of industrial structure.

[9] More specifically, the graphs include establishments with recorded productivity between the 10^{th} and the 90^{th} percentiles. In *Figures B1–B3* in *Appendix B* all Salter curves for the period 1970–96 are displayed.

[10] In addition to the trend wise decrease in shock sensitivity, there is also a co-variation with the business cycle.

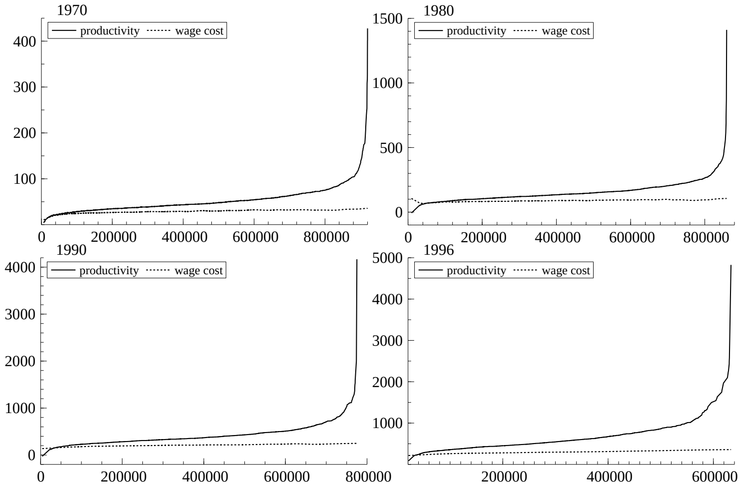

Figure 2: Salter curves for Swedish Manufacturing 1970, 1980, 1990, and 1996

Table 1: Percentages of employment in Swedish manufacturing plants that covered their own wage costs and the decrease in that percentage if wage costs were to be increased by ten percent

percent employment	1970	1971	1972	1973	1974	1975	1976	1977	1978
wages covered	87.9	88.4	89.4	89.6	88.1	86.7	83.7	81.8	82.8
1.1*wages covered	81.8	81.9	82.9	85.6	84.6	80.5	76.5	75.2	75.2
diff row 2–row 1	6.1	6.5	6.5	4.0	3.5	6.2	7.2	6.6	7.6
	1979	1980	1981	1982	1983	1984	1985	1986	1987
wages covered	86.8	85.1	86.6	88.3	91.5	89.6	91.1	91.0	90.8
1.1*wages covered	82.6	81.0	82.2	84.8	87.3	86.8	87.8	88.1	88.7
diff row 2–row 1	4.2	4.1	4.4	3.5	4.2	2.8	3.3	2.9	2.1
	1988	1989	1990	1991	1992	1993	1994	1995	1996
wages covered	90.8	91.3	91.6	89.5	88.1	92.6	93.1	93.1	92.5
1.1*wages covered	88.0	89.5	88.7	86.8	84.7	91.2	91.2	91.8	90.5
diff row 2–row 1	2.8	1.8	2.9	2.7	3.4	1.4	1.9	1.3	2.0

unrelated to the plant's productivity level, see *Table A1*.[11]

[11] Plant wages depend significantly on plant level productivity, but the point estimates are very small. Furthermore, there is no tendency for the point estimates to increase

2.2 Employment distribution over productivity

To look closer at the data, a formal characterisation of the productivity distributions is helpful. The main problem is to find a reasonable measure of the minimal and maximal productivity. In both ends of the empirical distribution we are likely to find accumulations of measurement errors due either to downright faulty data or time aggregation problems associated with plant closures and new plants.[12]

Our solution was to take average wage costs as the measure of minimal sustainable productivity and 95^{th} percentile productivity as a fairly reliable indicator of maximal sustainable productivity. The empirical employment distribution between these two productivity values turned out to be well described by a simple parametric distribution; a truncated Cauchy distribution of employment over the logarithm of productivity:

$$\tilde{N}(p) = \frac{A}{N\pi} \int_X^p \frac{\mathrm{d} \ln p}{\lambda \left[1 + \left(\frac{\ln p - \mu}{\lambda} \right)^2 \right]} \\ = \frac{A}{N\pi} \left[\tan^{-1} \left(\frac{\ln p - \mu}{\lambda} \right) - \tan^{-1} \left(\frac{\ln X - \mu}{\lambda} \right) \right] \quad (1)$$

where $\tilde{N}$ is the accumulated employment *share* with productivity p or less, down to X. The constant A compensates for the truncation. Hence, it will vary with the minimum and maximum levels of productivity. The localisation parameter μ denotes the mode of the non-truncated distribution, while λ is a spread parameter ($\mu \pm \lambda$ is the first and third quartile of the non-truncated distribution).[13]

Using the accumulated employment share within our defined "normal range", the parameters were estimated for manufacturing in each year by non-linear least squares. The fit is very good, in no case was $\bar{R}^2$ less

after 1982.

[12]This makes it hard to study entry of new plants and, especially, exits of low-productivity plants directly.

[13]The non-truncated Cauchy distribution has very fat tails as compared to a normal distribution for example. Not only is the second but also the first moment of the distribution undefined. For a detailed summary of its properties, see Johnson & Kotz (1970). This distribution is perhaps better known as Student's t-distribution with 1 degree of freedom.

than 0.99, so there is a great deal of stability over time in the form of the distribution. In *Figure B4* in the appendix a visual impression is presented for a selection of years. There is some variation in the parameters over time, although not very much, λ is around 0.4 and μ drifts upward as expected both because low-productivity plants are replaced with plants with higher productivity and because productivity increases within plants with time.

Letting $n(p)$ be employment per productivity unit, it is clear from the employment distribution that this can be written

$$n(p) = \frac{A}{\pi\lambda\left[1 + \left(\frac{\ln p - \mu}{\lambda}\right)^2\right]p} \tag{2}$$

We can compute estimates of the tail elasticity of the employment density over productivity as

$$e(X) \equiv \frac{n'(X)\,X}{n(X)} = -\frac{2\frac{\ln X - \mu}{\lambda^2}}{\left[1 + \left(\frac{\ln X - \mu}{\lambda}\right)^2\right]} - 1 \tag{3}$$

i.e. the proportional change in marginal employment that follows from a change in minimum sustainable productivity, or, as we use it, in the wage level. This provides another measure of the sensitivity of employment to changes in the wage level. The results are reported in *Table 2* and *Figure 3*. The difference to the rough measure in *Table 1* is that this elasticity indicates the employment lost continuously as the cut-off level rises.

The results, reported in *Table 2*, are broadly consistent with those in *Table 1*, in that they indicate that cost shocks will hit employment relatively harder in the years immediately prior to the transition to decentralised bargaining than afterwards. Most importantly, however, *Table 2* tells us that the employment distribution may be sensitive to large wage cost shocks. To see this, consider *Figure 4*, which plots $n(p)$ for the estimated 1983 distribution. The positive values of the elasticity means that the cut-off wage level (X) is to the left of the mode of the distribution, so the affected employment mass is increasing as wages go up.

There is no significant increase in between-industry wage dispersion. The productivity dispersion, however, increases, see *Table C1*. Looking

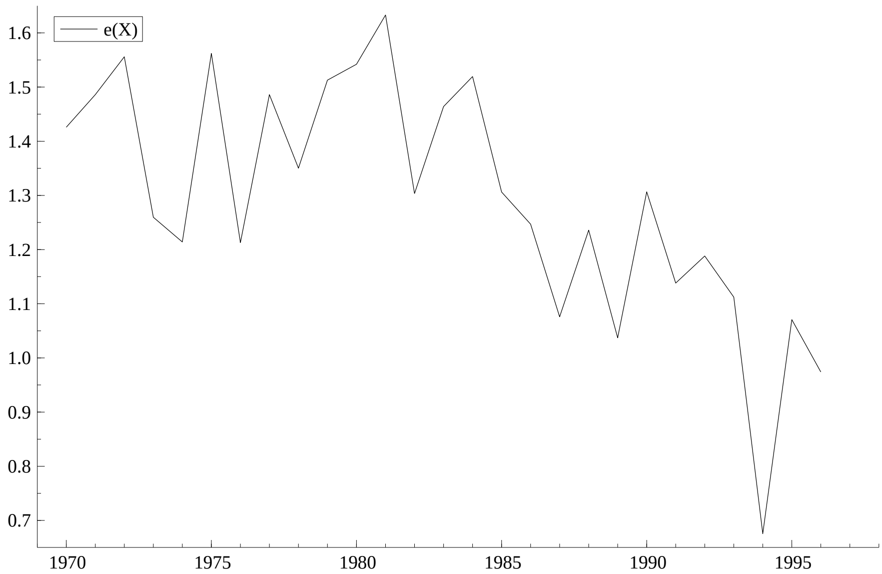

Figure 3: Employment density elasticity with respect to minimum productivity

Table 2: Estimated tail elasticities in the "normal range" distribution

year	1970	1971	1972	1973	1974	1975	1976	1977	1978
$e(X)$	1.43	1.49	1.56	1.26	1.21	1.56	1.21	1.49	1.35
year	1979	1980	1981	1982	1983	1984	1985	1986	1987
$e(X)$	1.51	1.54	1.63	1.30	1.46	1.52	1.31	1.25	1.08
year	1988	1989	1990	1991	1992	1993	1994	1995	1996
$e(X)$	1.24	1.04	1.31	1.14	1.19	1.11	0.68	1.07	0.97

closer at this, we find that the employment share in sub-median productivity plants increases (*Table D1*), whereas there is no tendency towards an increased employment share for low-productivity industries. Indeed, there is a weak tendency for industries with a low productivity level or low wage costs in 1970 or a low average productivity over the whole period 1970–96 to have a slower employment growth between 1970 and 1996 than high-

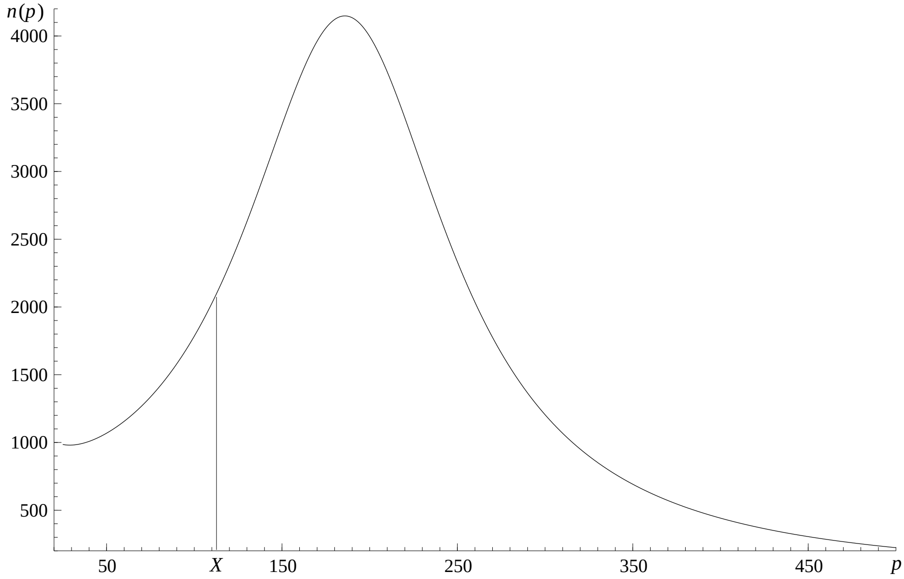

Figure 4: Plot of $n(p)$ for the estimated 1983 distribution

wage, high-productivity industries. Is this pattern more pronounced in the period of centralised bargaining than after 1983? To find this out, we have checked whether low-wage, low-productivity industries experienced a particularly rapid decline in employment in the period of centralised bargaining with a reversal taking place after the breakdown of centralised bargaining in 1983.[14] We find no support for this in our data—the low-wage, low-productivity industries seem to experience a small but steady decline over the whole sample period.[15] Hence, if there were any mechanisms that would concentrate employment in low-productivity industries under decentralised bargaining, these seem to have been counteracted by

[14] This analysis is a substitute for a direct analysis of plant turnover at the bottom tail of the productivity distribution. Although we would have preferred such an analysis, measurement errors are to serious at this tail of the distribution to warrant such an analysis.

[15] Edin & Topel (1997) also find that employment in low-income sectors grows slower both between 1960 and 1970 and between 1970 and 1990, whereas Davis & Henrekson (2000) find a reversal after the breakdown of centralised bargaining.

other mechanisms.[16] Looking instead at the within-industry dispersion of productivity and wages, the pattern is not so clear cut, although the productivity dispersion increases in a majority of the 27 industries.

The standard deviations of log wage costs and of log labour productivity in aggregate manufacturing are displayed in *Figure 5.* The increased between-industry productivity dispersion in the late 1980s has a counterpart in an increased productivity dispersion between plants in aggregate mining and manufacturing. This increased productivity dispersion is also accompanied by a slight increase in wage dispersion.

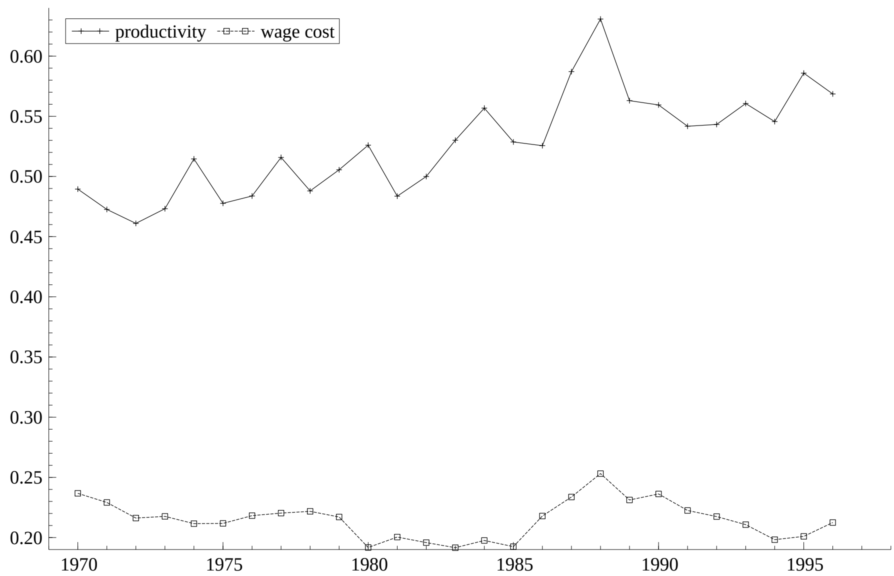

Figure 5: Wage and productivity dispersion (standard deviation of logs) in Swedish mining and manufacturing 1970–96

The pattern of aggregate industry labour productivity growth and wage growth in *Figure 6* shows a desynchronisation between these two variables before the decentralisation of bargaining and after 1991. In the years 1985–90 wages and productivity are nearly synchronised. Hence, it seems that we observe a coupling of aggregate wage and productivity movements that

[16] For example the increase in the inferred wage mark-up in *Figure 9* in *Section 3.2.*

is much less obvious looking at cross sections at the industry level or at the plant level. To see whether there is any relationship in the time series dimension at the plant level or industry level we have estimated panel data models. There is a small significant effect of productivity on wages at both levels over the whole period 1970–96 (the point estimates are in both cases just below 0.05). If anything, the estimated parameters are smaller for the 1985–90 sub-period.[17] These patterns would be consistent with the pattern in employment growth across sectors, where low-wage, low-productivity sectors tended to grow slower: the relation between wages and productivity at the aggregate level could be the result of such a sectoral reallocation of production and employment, in turn caused by wage-setting institutions.[18]

In *Figures 7* and *8*, investments and aggregate employment in manufacturing are depicted. While employment remained practically constant 1983–89, investment increased considerably.[19] The inflow of new capacity employment, thus, just managed to balance the outflow. This pattern together with the decreased shock sensitivity of the Salter curves indicate that decentralisation of bargaining to the industry level did not lead to a dominance of low-productivity firms, thus casting a shadow of doubt on the central tenet of the Rehn-Meidner model, that centralised bargaining promotes dynamic efficiency. In the next section a bargaining model is developed to formalise a set-up where this can be explained.

3 Wage bargaining

In the decentralised case each firm bargains with a local union about how to share the production surplus above an outside option for labour: w_X. The outside option captures outside opportunities as given by social and institutional arrangements as well as macroeconomic developments. The

[17]We added an interaction between a time dummy and productivity for the period 1985–90. The point estimates were negative, small and not significantly different from zero. In addition to productivity and the interaction term, the estimated models also included time dummies to capture the effects of all common time variation. Common trends in productivity and wages across sectors and plants would be captured by these time dummies.

[18]Similar mechanisms were discussed in relation to the "Scandinavian model of inflation", see for example Lindbeck (1979).

[19]The rise in employment between 1989 and 1990 in *Figure 8* is a statistical artifact reflecting new data collection procedures.

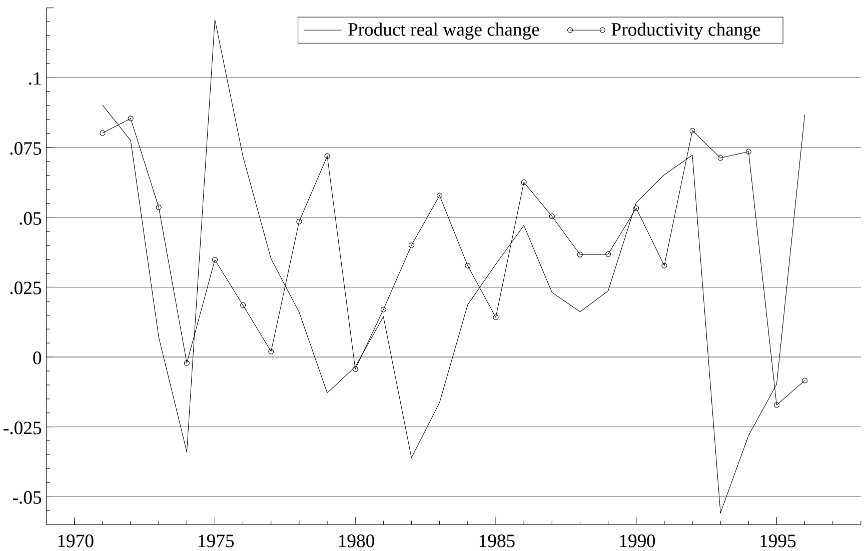

Figure 6: Annual changes in log labour productivity and log product real wage rate. Swedish mining and manufacturing 1970–96

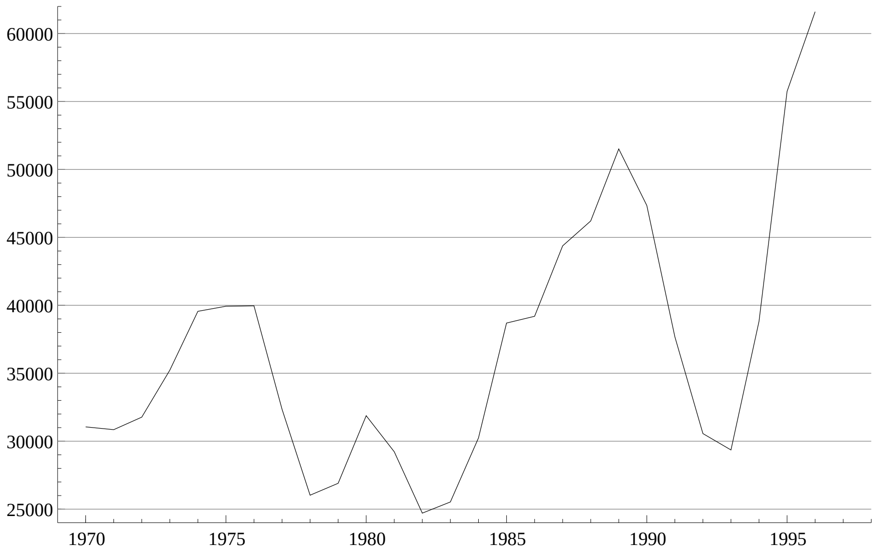

Figure 7: Investment in Swedish manufacturing 1970–96, 1991 prices

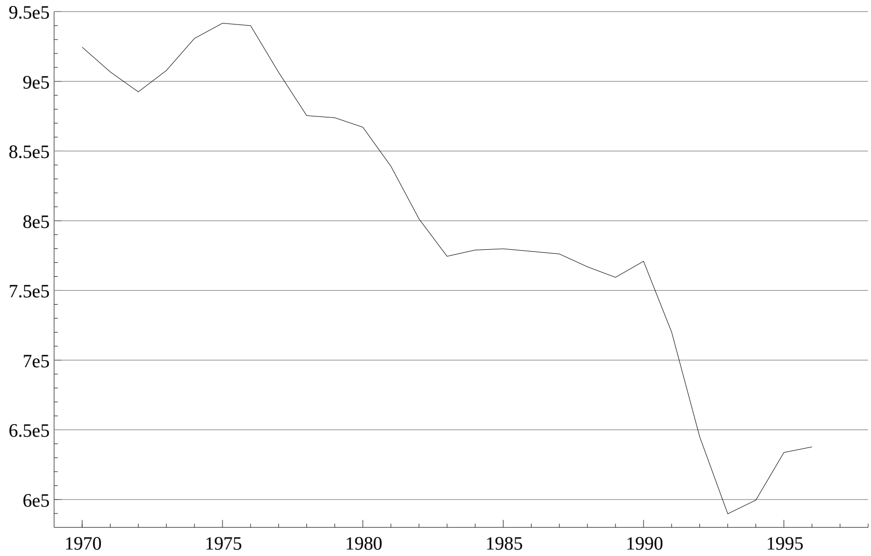

Figure 8: Employment in Swedish manufacturing 1970–96

local union is assumed to be concerned only with wages w_i for a homogeneous labour unit.[20] Existing plants have a given labour productivity p_i with the outside option of a zero profit. We abstract from capital adjustment here, the reason being that we lack data on plant level capital stocks.

The decentralised bargaining outcome is taken to be the asymmetric Nash bargaining solution to the problem

$$\max_{w_i} \ (w_i - w_X)^{\beta} (p_i - w_i)^{1-\beta} \tag{4}$$

with a common β for all firms. We assume that β, the union's relative bargaining strength, satisfies $0 < \beta < 1$. The assumption that β is equal across all firms, leads to the wage-setting equation

$$w_i = \beta p_i + (1 - \beta) w_X \tag{5}$$

defining the mapping from wages to productivity and the corresponding quasi-rent per labour unit, $q_i = p_i - w_i$, for firm i. Thus,

$$q_i = (1 - \beta)(p_i - w_X) \geq 0 \tag{6}$$

with a cut-off of quasi-rents when productivity equals the outside option. To avoid discussing special cases, the outside option is taken to be greater than or equal to some hypothetical market-clearing wage.[21] The firm will discontinue operations when the quasi-rent becomes negative so the minimal productivity, $X = w_X$, is determined by zero quasi-rents. The plant wage distribution over productivity would then be positively sloped for $\beta > 0$.

In the centralised case unemployment should, however, be of concern to the union if it seeks to maximise welfare for all members. Introducing unemployment into the objective function of the union would moderate

[20] An assumption of heterogeneous labour would complicate the model. As long as different categories of labour have fixed shares in the labour force the conclusions would still hold both for each category of labour and for the aggregate. If the shares are allowed to change the conclusions for the aggregate may not hold. For example, education levels have continuously increased at least from 1985 and forward. If returns to education are correlated with "typical" productivity, this could be an alternative explanation for an increasing wage markup.

[21] If it is less, some industries may land on market-clearing wages $> w_X$.

the level of wages in response to macroeconomic disturbances. To simplify, we will assume this to be roughly reflected in a lower β than in the decentralised case.

In the centralised case an employers' organisation bargains directly with a central union about a common wage rate w_a for all labour. If the employers seek to maximise the quasi-rent for a "typical" plant with productivity $\bar{p} > w_X$ we obtain the solution

$$w_a = \beta\bar{p} + (1 - \beta)w_X \tag{7}$$

Thus, the plant-level wage is no longer related to plant-level productivity.

Quasi-rents become zero at higher productivity levels than in the decentralised case if the "typical" productivity strictly exceeds the outside option, i.e., $\bar{p} > w_X$, even if β is lower in this case. As long as $\beta > 0$ the cut-off level will still be higher. Consequently, average productivity as well as wages will be higher in this case, *ceteris paribus*, but employment will be lower since more plants are closed down. On the other hand, quasi-rents for high-productivity firms will be higher, so investment incentives in those firms are higher. Dynamically, an economy with centralised bargaining would therefore have a higher turnover of plants, but not necessarily lower employment, since that depends on the balance between job destruction and job creation. This is the basic idea of the Rehn-Meidner mechanism.[22]

3.1 Transition from centralised bargaining to decentralised

Let us assume that bargaining moves from a centralised system to a more decentralised. To fit the Swedish case and our data, assume that bargaining as a first step moves down from the manufacturing-wide level to the industry level. Then it is reasonable to assume that we get a centralised solution in each industry, only substituting industry-typical plants for typical plants.

Since the employer organisation's choice of typical plants will depend on institutional specifics, that we do not model, the effects are *a priori*

[22]We have looked at this prediction by computing standard (Davis et al. 1996) job reallocation rates and job reallocation rates due to entry and exit of plants. Neither of these measures support the prediction: there is no clear trend before the crisis of the early 1990s, when all measures rise dramatically. The prediction, of course, is *ceteris paribus*, so to be conclusive, the evidence would have to be net of all cyclical factors, that clearly dominate the "raw" measures.

not well determined. If we assume that a typical plant is equivalent to a median or average productivity plant, something more can be said.

If bargaining strength β increases following a move to industry-level bargaining, the wage mark-up on the outside option rises. This would, for a given productivity distribution, increase wage dispersion, since industry-specific productivity gets more weight in *equation* (7). However, the rates of job destruction and job creation will also change and hence change the productivity distribution, so the model only implies an increase in the wage spread relative to the productivity spread across industries.

The growth rate of marginal wages has a central place in our framework, decisively influencing investment and productivity growth. It is crucial for whether the transition from centralised bargaining to decentralised bargaining mainly takes place through an increase in the flow of high-productivity plants or mainly by slowing down the scrapping of low-productivity plants, as was illustrated in *Figure 1.*

A high rate of growth in outside options would imply a high rate of scrapping. If investment rates are increasing during the transition, we would then expect to observe a fast turnover of employment without much net employment change, as we indeed do.

But the mechanism is also affected by β, since *equation* (7) implies that the real wage will change as it is the β weighted average of the outside option and productivity. If β rises with decentralisation of bargaining, the mark-up on the outside option will increase.

This hinges on unobservable variables, but the bargaining model implies that such changes are reflected in real wages. This allows us to evaluate w_X and β conditional on the bargaining model.

3.2 Empirical results

In this section we take some of the model predictions to our data. More specifically, we estimate equation (7) to derive estimates of bargaining power and the outside option and check whether there, conditional on the simple bargaining model, are any signs of changing patterns after the transition to more decentralised bargaining that help us understand the subsequent development of mining and manufacturing employment.

The median regressions of industry wage costs on industry productivity for each cross-section of industries partly reported in *Figure 9* allow us to compute estimates of the average outside option. According to *equa-*

tion (7), the coefficient on productivity can be interpreted as union bargaining strength β and the intercept as $(1-\beta)\, w_X$. The estimated β rises slightly in the late 1980s and is at the same time also more precisely estimated. Thus, decentralisation does seem to be accompanied by a slightly increasing dependence between wages and productivity at the industry level.

Figure 9: Point estimates of union bargaining power with 95 percent confidence interval. Cross-sectional wage equations 1970–96

The logarithmic change in the estimated outside option is compared to the logarithmic change in nominal annual wage costs in *Figure 10.* Although not identical to wage movements, the pattern is rather similar. The only striking feature is that the relative volatility of the estimated outside option increases so strongly in connection with the transition to decentralised bargaining.[23]

[23] This may reflect that the bargaining model is a reasonable approximation before the decentralisation of bargaining and less so later, but it could also reflect increased macroeconomic turbulence in the 1980s.

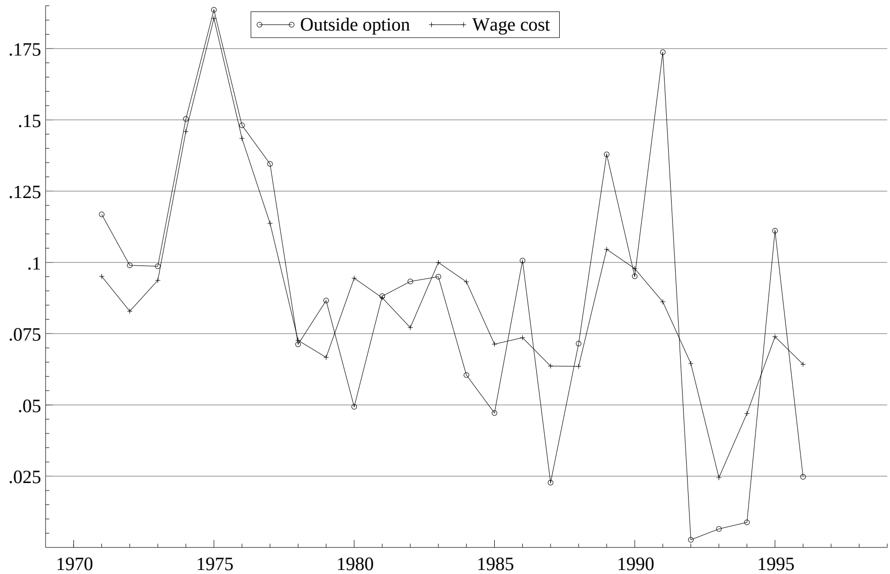

Figure 10: Changes in log nominal wage cost and log outside option 1971–96

Differences in the bargaining situation, in our model summarised in w_X and β, became emphasised as different industries were affected more or less by negative macroeconomic shocks. This would explain the pattern we find in industry wage and productivity dispersion. Wage dispersion across industries, measured as the standard deviation of $\log \bar{w}$, remains more or less constant over time, while the corresponding average productivity dispersion over industries increases after 1983, but this is almost exclusively due to an increased dispersion in the higher half of the distribution (cf *Table 1*). This suggests that the increased wage-productivity correlation has arisen through a structural adjustment that has weeded out low-productivity plants and equalised median productivity between industries, partly, perhaps, by concentrating employment in sub-median plants.

4 Concluding comments

Employment in Swedish mining and manufacturing decreased dramatically during the first years of the 1990s. The decentralisation of wage bargaining that started in 1983 may have contributed to this by making employment more shock sensitive or by increasing wage mark-ups.

In this paper we have used a simple wage bargaining model as a tool to shed light on the dramatic events in the early 1990s. Using micro data, we analyse and interpret the development of the plant productivity structures in Swedish manufacturing from 1970 to 1996. The model encompasses both the Rehn-Meidner idea that centralised bargaining increases the rate of destruction of low-productivity jobs and the idea that half-way decentralisation may increase wage mark-ups.

The data indicate that employment was vulnerable to macroeconomic shocks, since many plants operated near the margin where they could barely cover operating costs. Combining this with a deregulation of capital markets that contributed to persuade Swedish policy makers to abstain from devaluation to accommodate the shocks in the late 1980s, the explosion of unemployment rates in the 1990s is, perhaps, not quite so surprising as it was at the time it happened. The half-way decentralisation of wage bargaining to the industry level may have worsened the situation by increasing the wage mark-up on outside options. At least this seems to be the case in mining and manufacturing.

The prediction implicit in the Rehn-Meidner model that decentralisation of wage bargaining would lead to slower productivity growth is consistent with the aggregate data, but we find this hard to attribute to a concentration of employment to low-productivity industries. The data rather supports the interpretation that an increase in the relative cost of labour—that may be due to higher wage mark-ups induced by decentralisation to the industry level—gave rise to synchronised movements in wages and productivity in manufacturing. This depressed a potential growth of manufacturing employment through new investment by speeding up job destruction.

It is remarkable that we find the form of the industry distribution to be highly stable over time. A Cauchy distribution of employment over the logarithm of labour productivity turns out to be a close fit to the manufacturing distribution during the quarter of a century between 1970 and 1996 in spite of the major economic and institutional changes that have taken place during that period. This strongly suggests that industry structure is more invariant and less malleable than commonly presumed. The explanation for this phenomenon is an interesting question for further research.

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Appendix

A Regressions of wages on productivity

In *Table A1* we reproduce the estimated parameters derived by regressing plant-level wages on plant-level productivity in Swedish mining and manufacturing for the years 1970–96.[24] The estimates in the first column are OLS estimates, whereas the estimates in the third column were derived by a robust regression procedure, which gives lower weights to outliers (we used the `robust` procedure in STATA).

We see that although there is a significant covariation between wages and productivity at the plant level, the coefficients are fairly close to zero (and smaller than the corresponding coefficients at the industry level, see *Table A2*) and there is no tendency for the coefficients to become systematically larger after 1983. Hence, we conclude that there is only a weak relationship between plant-level wages and plant-level productivity both before and after the decentralisation of bargaining to the industry level in the mid 1980s.

The results of regressing median industry wage costs per employee on median industry productivity for each of the years 1970–96 and 27 industries in Swedish mining and manufacturing are displayed in *Table A2*.

Generally, the estimated parameters are larger than their plant-level counterparts in *Table A1*. Looking at the time series pattern of the coefficients, we find that the years prior to the downturn in employment in the early 1990s are indeed characterised by a fairly high pass through of productivity into wages, which according to our theoretical framework would reflect an increase in union bargaining power (β). It is also notable that the parameters are estimated very precisely despite the rather low number (27) of observations.

[24] The wages are annual wage costs per employee, productivity is measured as annual value added per employee.

Table A1: Plant-level regressions of wages on productivity

	OLS estimates		Robust regression estimates	
Year	Point estimate	t-statistic	Point estimate	t-statistic
1970	0.067	38.8	0.140	89.0
1971	0.052	32.0	0.137	86.0
1972	0.053	34.7	0.120	81.3
1973	0.046	31.6	0.089	64.9
1974	0.043	38.8	0.075	58.0
1975	0.066	37.0	0.091	58.6
1976	0.064	33.3	0.099	59.3
1977	0.076	35.0	0.101	56.7
1978	0.062	30.6	0.102	59.1
1979	0.048	27.1	0.094	55.7
1980	0.050	28.2	0.085	54.8
1981	0.052	28.9	0.085	56.0
1982	0.042	25.7	0.076	52.0
1983	0.042	27.2	0.077	54.8
1984	0.043	28.1	0.071	54.9
1985	0.042	28.2	0.085	60.8
1986	0.046	26.6	0.082	55.7
1987	0.053	29.5	0.089	62.9
1988	0.056	29.0	0.091	61.5
1989	0.038	26.4	0.091	69.1
1990	0.047	34.3	0.082	65.1
1991	0.053	33.1	0.078	57.2
1992	0.053	35.2	0.088	61.5
1993	0.058	35.4	0.074	55.5
1994	0.059	38.6	0.073	59.8
1995	0.055	37.2	0.073	61.1
1996	0.062	37.2	0.082	63.1

Table A2: Median industry wages regressed on median industry productivity 1970–96

Year	Point estimate	t-statistic
1970	0.141	6.115
1971	0.123	5.177
1972	0.110	4.895
1973	0.088	4.584
1974	0.082	4.952
1975	0.103	4.424
1976	0.121	4.141
1977	0.107	3.394
1978	0.111	3.164
1979	0.070	2.665
1980	0.130	3.486
1981	0.130	4.623
1982	0.089	3.817
1983	0.085	4.848
1984	0.107	7.467
1985	0.144	7.484
1986	0.118	5.132
1987	0.145	7.534
1988	0.146	6.924
1989	0.110	5.983
1990	0.128	5.328
1991	0.073	2.457
1992	0.109	3.589
1993	0.097	3.597
1994	0.103	6.887
1995	0.075	6.232
1996	0.125	4.412

B Salter curves and estimated Cauchy distributions for Swedish mining and manufacturing 1970–96

In this appendix we present annual *Salter curves* for Swedish manufacturing for the period 1970–96 in *Figures B1–B3* and graphs for selected years of estimated Cauchy distributions in *Figure B4*.

The Salter curves include plants with average labour productivity ranging from the 10^{th} to the 90^{th} percentile. The data have been smoothed using a cubic spline.[25]

The claim in the text that the relationship between plant-level productivity and wages is a weak one is once again clearly borne out by also these graphs.

The estimated Cauchy distributions displayed in *Figure B4* include the distribution of both actual and predicted employment shares over productivity. The actual and predicted values are indistinguishable in the figures, which reflects the fact that the fit is very good; the adjusted R-squared always exceeds 0.999. Furthermore, the parameter estimates (not reproduced) indicate that the shape of the distributions is very stable.[26]

C Total, between-industry and within-industry wage and productivity dispersion in Swedish mining and manufacturing 1970–96

In *Table C1* we give some measures[27] of the development over time of between-industry wage and productivity dispersion.

The wage dispersion, according to all measures reproduced in the table, is very stable over time and overall in magnitude about one third of the productivity dispersion.[28]

[25] The figures have been drawn using the graphics and spline function of Ox 2.20; see Doornik (1998).

[26] Except for an upward drift in the mode of the distribution, reflecting productivity growth over time.

[27] The standard deviations of the logs of the variables as well as some inter-percentile differences between the variables in logs.

[28] Slightly less when we look at the lower end of the distributions as measured by the difference between the 50^{th} and the 10^{th} percentiles.

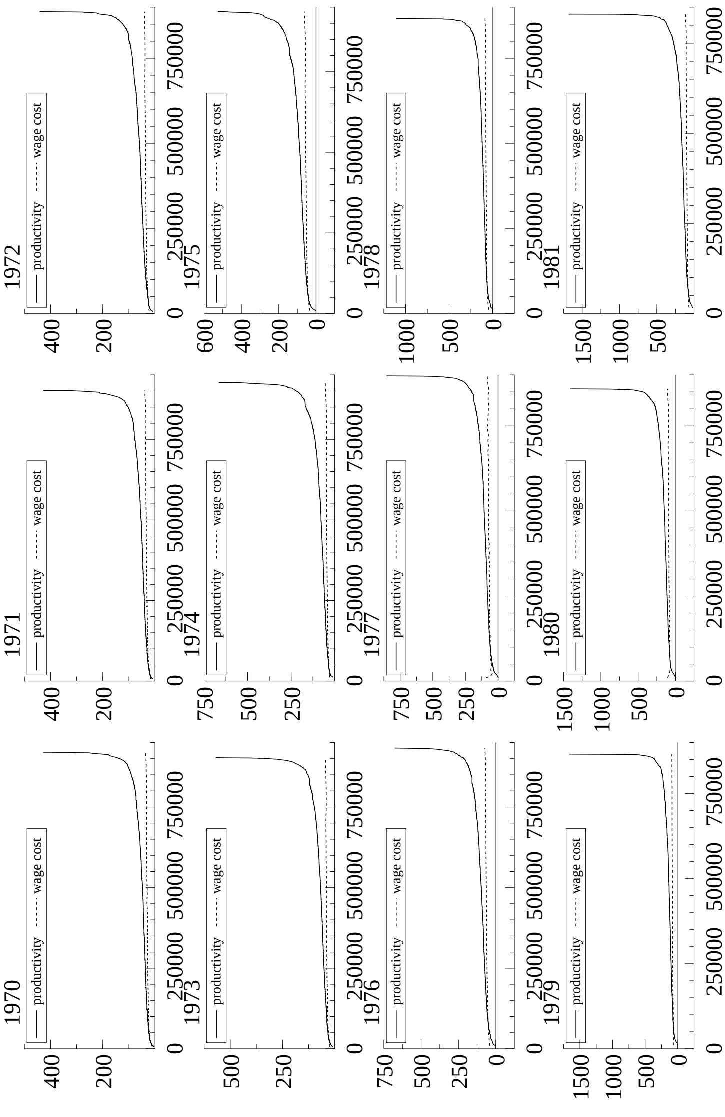

Figure B1: Salter curves for Swedish manufacturing 1970–81

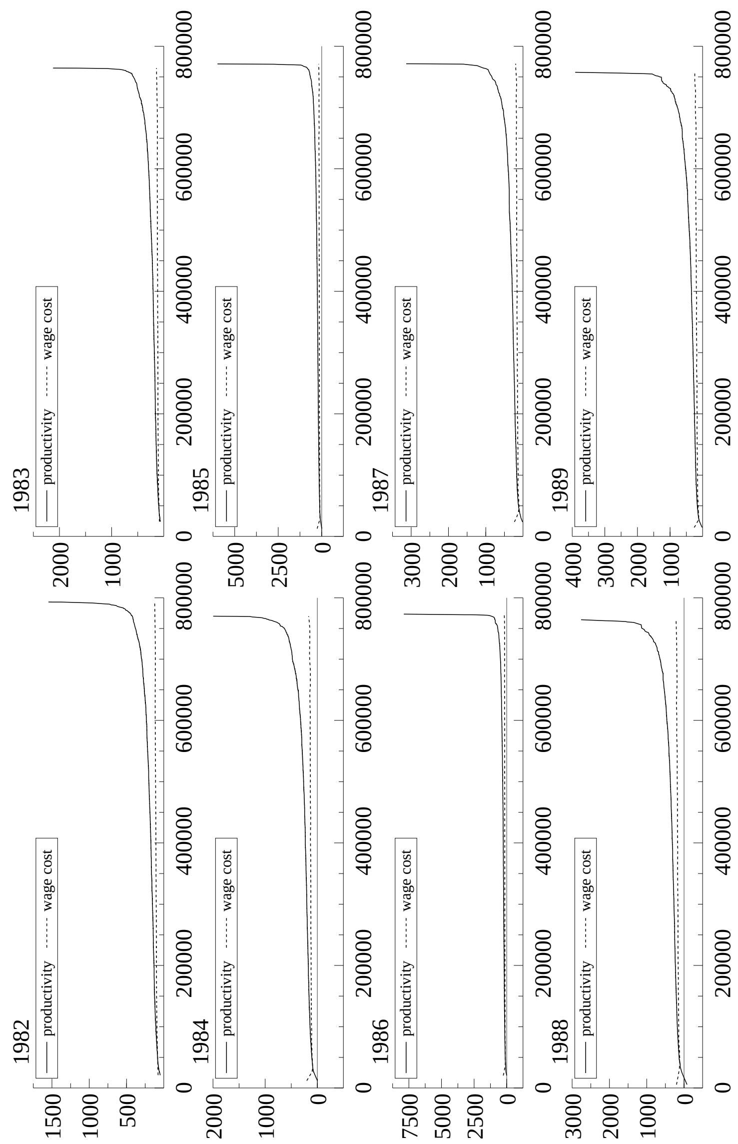

Figure B2: Salter curves, Swedish manufacturing 1982–89

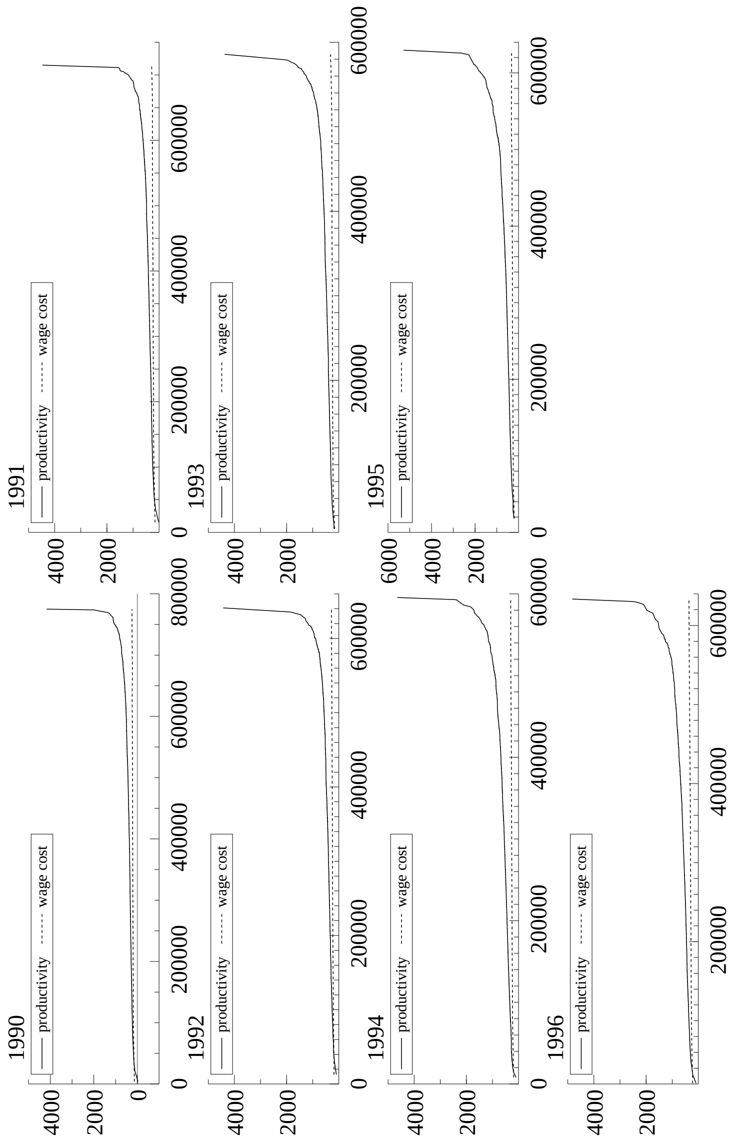

Figure B3: Salter curves, Swedish manufacturing 1990-96

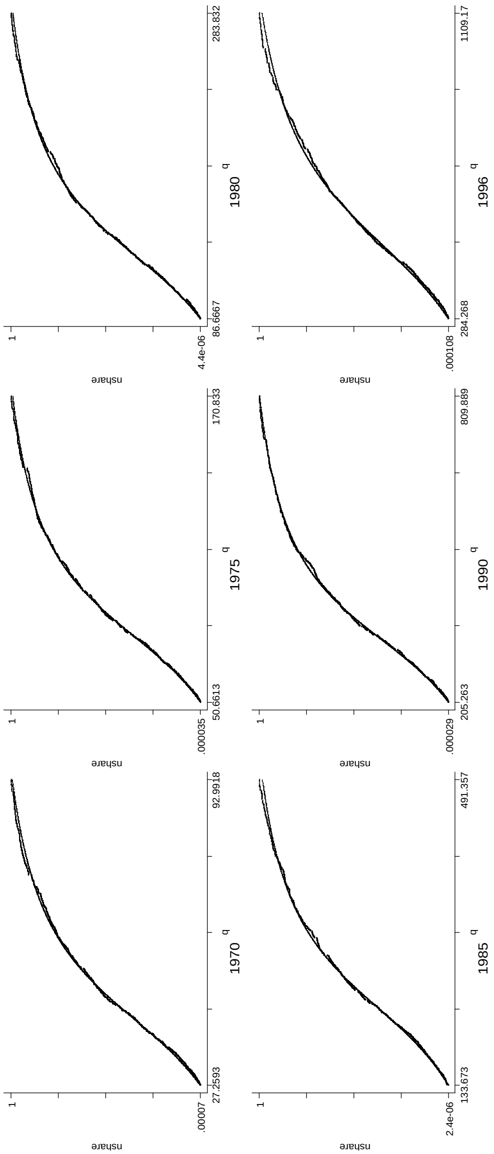

Figure B4: Cauchy distributions for selected years

The productivity dispersion is much more volatile than the wage dispersion. Also, there is a tendency for the dispersion to increase roughly in the second half of the 1980s and the early 1990s. This tendency is most pronounced in the inter-percentile measures, and mainly reflects an increasing dispersion in the upper end of the distribution (the 90-50 difference).

D Employment share in sub-median productivity plants 1970–96

In addition to the previously reported measures of shock sensitivity, we have also computed the employment share in plants with productivity levels below the median. In *Table D1* we show the results of these computations for two measures of the median. In the first column of the table we report the results when the median is computed for the whole of mining and manufacturing. In the second column the median is instead computed by industry.

Both measures clearly indicate that the employment share in sub-median productivity plants rose sharply from the mid 1980s and stayed high through 1993. In this respect, consequently, we find that employment did indeed become more concentrated to low-productivity plants in the late 1980s.

Table C1: Between-industry wage and productivity dispersion 1970–96

Year	sd(w)[a]	sd(q)[b]	w9010[c]	q9010[d]	w9050[e]	q9050[f]	w5010[g]	q5010[h]
1970	0.10	0.37	0.26	0.79	0.11	0.55	0.15	0.24
1971	0.10	0.36	0.25	0.69	0.10	0.46	0.15	0.23
1972	0.09	0.32	0.24	0.74	0.08	0.49	0.15	0.25
1973	0.10	0.38	0.26	0.87	0.11	0.58	0.14	0.29
1974	0.10	0.40	0.25	0.90	0.12	0.62	0.13	0.28
1975	0.10	0.32	0.26	0.92	0.11	0.74	0.16	0.18
1976	0.10	0.35	0.28	0.78	0.14	0.55	0.14	0.23
1977	0.10	0.39	0.28	0.61	0.14	0.42	0.14	0.19
1978	0.09	0.38	0.23	0.66	0.11	0.45	0.13	0.21
1979	0.09	0.44	0.26	0.67	0.12	0.39	0.15	0.28
1980	0.09	0.36	0.27	0.61	0.14	0.35	0.13	0.26
1981	0.09	0.30	0.24	0.62	0.10	0.39	0.13	0.23
1982	0.09	0.36	0.23	0.59	0.10	0.36	0.13	0.23
1983	0.10	0.42	0.24	0.77	0.09	0.45	0.16	0.32
1984	0.10	0.42	0.27	0.91	0.12	0.63	0.15	0.28
1985	0.10	0.42	0.26	0.91	0.14	0.65	0.13	0.27
1986	0.11	0.47	0.32	0.92	0.16	0.63	0.16	0.29
1987	0.11	0.41	0.25	0.80	0.12	0.55	0.12	0.26
1988	0.12	0.36	0.31	0.89	0.16	0.62	0.14	0.28
1989	0.12	0.44	0.30	1.05	0.15	0.72	0.15	0.33
1990	0.11	0.45	0.26	0.91	0.10	0.64	0.16	0.26
1991	0.10	0.43	0.29	0.93	0.14	0.69	0.14	0.24
1992	0.11	0.37	0.30	1.07	0.15	0.83	0.15	0.24
1993	0.10	0.38	0.28	1.20	0.11	0.89	0.16	0.31
1994	0.10	0.37	0.28	1.08	0.12	0.72	0.16	0.36
1995	0.10	0.38	0.27	1.09	0.13	0.74	0.14	0.35
1996	0.11	0.36	0.27	0.90	0.12	0.65	0.15	0.25

[a] Standard deviation of log industry annual wages
[b] Standard deviation of log industry productivity (value added per employee)
[c] log 90^{th} percentile − log 10^{th} percentile industry wages
[d] log 90^{th} percentile − log 10^{th} percentile industry productivity
[e] log 90^{th} percentile − log 50^{th} percentile industry wages
[f] log 90^{th} percentile − log 50^{th} percentile industry productivity
[g] log 50^{th} percentile − log 10^{th} percentile industry wages
[h] log 50^{th} percentile − log 10^{th} percentile industry productivity

Table D1: Employment share in sub-median productivity plants

Year	Sub-median productivity employment share	
	median computed for total manufacturing	median computed by industry
1970	0.357	0.372
1971	0.328	0.361
1972	0.313	0.331
1973	0.303	0.318
1974	0.336	0.363
1975	0.340	0.367
1976	0.374	0.388
1977	0.395	0.384
1978	0.391	0.384
1979	0.367	0.383
1980	0.415	0.397
1981	0.400	0.400
1982	0.386	0.399
1983	0.360	0.366
1984	0.369	0.387
1985	0.361	0.380
1986	0.370	0.403
1987	0.384	0.402
1988	0.406	0.419
1989	0.427	0.441
1990	0.449	0.437
1991	0.443	0.448
1992	0.438	0.438
1993	0.412	0.400
1994	0.349	0.369
1995	0.357	0.376
1996	0.372	0.390

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