EXPLORING THE RELATIONSHIP BETWEEN DOWNSIZING AND PRODUCTIVITY GROWTH: EVIDENCE FROM MANUFACTURING ESTABLISHMENTS IN LOWER SAXONY*

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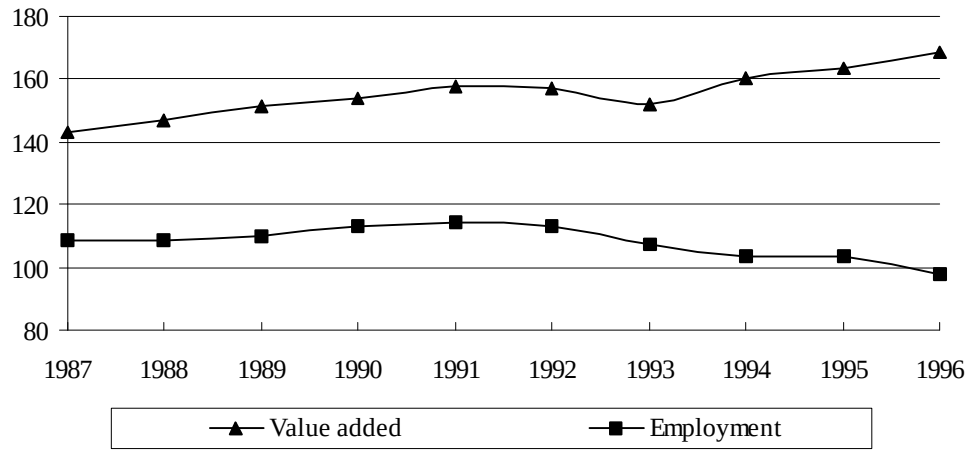
1 Introduction

How do you increase productivity? One easy way is to fire some workers. Following this conventional wisdom, there seems to be a connection between downsizing and rising productivity. Evidence at the macro-level shows that falling employment is often linked with rising productivity. During the last several years several studies have investigated the relationship between downsizing and productivity using firm level data from Finland, France, Japan, the Netherlands and the U.S. Findings have shown that in most of the establishments in Finland and the U.S. rising labour productivity was linked with falling employment, while in the other countries more often rising labour productivity was linked with rising employment. Moreover, there are often significant differences between industries, regions and firms from different size classes. Different arguments are given to explain the connection between downsizing and productivity growth. Some researchers argue that productivity growth is the result of re-engineering with its concomitant lay-off or simply the result of reducing employment following the guideline of 'lean and mean' by improving productivity through dismissals. The others believe that technological progress induces structurally lower levels of manufacturing employment. Or there is a mismatch between desired labour quality and the existing quality of the worker as a consequence of technological progress.

Looking at the macro-level in Germany, there is also a trend of rising productivity and downsizing in the manufacturing sector. For example from 1993 to 1996 the gross value added increased by about 11%, while the number of employees decreased by about 9% in the same period (see also figure 1).

Figure 1: Value added and employment in manufacturing sector in Germany (1987-1996)[*]



[*] West Germany; Value added in prices of 1991; 1970=100; Average number of employment in 100,000
Source: Statistisches Bundesamt (1997, 1995, 1994 and 1992)

On the micro level in Germany, however, studies comparable to the above are lacking. This paper attempts to fill this gap using the Hannover Firm Panel, a data set that is a representative panel covering some 1000 manufacturing firms from Lower Saxony, one of the German States. The paper is organised as follows:

Section 2 presents information about the Hannover Firm Panel. Section 3 defines 'productivity', as it is used here. A description of the changes in the number of employees and productivity between 1993 and 1997 follows. After that the establishments will be divided in four groups. Then a theoretical discussion of the connection between the changes in the number of employees and productivity follows. Section 4 presents results from the empirical analysis. The analysis focuses on the roles of firm size, industrial sectors, exports, R&D and the demand for products and their effect on the relationship between labour demand and labour productivity. Section 5 concludes.

2 The data

This study is based on the Hannover Firm Panel, a data set that is a representative panel covering some 1000 manufacturing firms from Lower Saxony, Germany. This project covers a period of 4 years (1994-1997). The survey contains four waves and is supported by the Volkswagen Foundation. Infratest Sozialforschung (Munich), a leading German survey and opinion research institute, collected the data. Started in autumn 1994, the fourth and last wave was successfully completed in November 1997. Since spring 1998 all waves of the Hannover Panel have been made available for analysis (see Klodt, 1998).

The Hannover Panel covers establishments which had at least 5 employees in 1994 and which, in addition, could be categorised as 'producing', so e.g. service enterprises are excluded. Altogether 1031 establishments answered in at least one wave. 711 establishments (including 4 new entrants through firm divisions) participated the fourth wave. 625 firms answered in all four waves. These establishments build a balanced panel (see Infratest 1998).

The survey is divided into different topics, e.g., general information about the establishments, structure and development of personnel, wages and salaries, determinants of employment, information about product and process innovation, determinants of imports and exports, and the establishment's environmental protection activities. Different priorities were set each wave. The first and third waves directed their attention to 'the labour market, employment and remuneration,' while the second and fourth waves focused on 'international co-operation, market and innovation dynamics, and environmental measures'. English translations of the survey questionnaires for the first and second waves are published in Brand, et al. (1996). German versions of the third and fourth wave questionnaires are published in Klodt (1998). The design of the Panel allows an establishment-proportional weighting, so projections for all manufacturing establishments in Lower Saxony are possible. This will be used in the descriptive analysis, while the econometric part omits weighting.

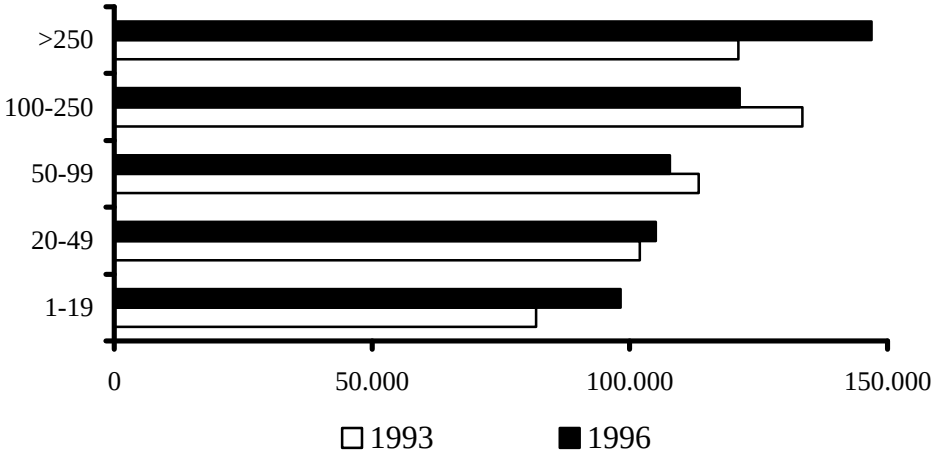
3 Labour productivity and employment

In the Hannover Firm Panel there is no information about the capital stock employed in the firm, that's why in this study we concentrate only on labour productivity instead of Total Factor Productivity (TFP). Labour productivity is calculated as follows: The Hannover Firm Panel provides information about the sales and the number of employees in the firms from 1993 to 1996. First the sales are reduced by the cost of raw materials, consumables and supplies and of purchased merchandise.

Then the sales are deflated to price of 1991. After dividing by the number of employees, we get the average labour productivity per worker and year. To get comparable results overtime, only continuing establishments with complete information provide each year are used. Therefore the 625 firms of the balanced panel are reduced to 337 firms. Due to oversampling of large firms in the Hannover Firm Panel, the descriptive analysis is based on establishment-proportional weighted data.

In 1993 average labour productivity of the firms was about 92,000 DM. Between 1993 and 1996 labour productivity rose by about 12% to approximately 103,000 DM. This is the productivity for all establishments in the manufacturing sector in Lower Saxony. To get a better idea about the productivity the next step distinguishes between firm sizes. The categories are 1 to 19, 20 to 49, 50 to 99, 100 to 250 and more than 250 employees. Figure 2 shows that labour productivity increases with rising employment. One exception to this trend is establishments with more than 250 employees in 1993. Possible reasons for this trend are internal and external benefits because of advantages through organisation or production processes (see Addison/Schnabel/Wagner 1998, 75). Most categories were able to increase productivity from 1993 to 1996 with the exception of the medium-sized (50-250 employees) establishments. In this group there is a downward tendency for labour productivity (see Figure 2).

Figure 2: Average labour productivity 1993 and 1996 by firm size *



* Average firm size (1993 and 1996).
Source: Hannover Firm Panel, 1st and 4th waves, weighted data.

Next we focus on the average number of employees. In each wave the Hannover Firm Panel provides information about the number of employees, including the owner, members of his family and trainees, in the firm at the end of the previous year. No difference is made between full-time and part-time workers. Using information from 1993 and 1996, we see that the average number of employees decreased by about 6% from 46 (1993) to 43 (1996) in the manufacturing establishments of Lower Saxony. Interpreting these results and the following ones we have to take into account, that there may be a survivor bias, because the analysis concentrates only on the continuing firms, i.e. exiters and entrants are not considered.

Over this three year period, labour productivity rose by about 12%, while average employment fell by about 6%. The firms are divided into four types based on their productivity and employment growth from 1993 through 1996. Following a differentiation according to Baily/Bartelsmann/Haltiwanger (1996) the establishments are identified as downsizers and upsizers for decreasing and increasing employment as well as "successful" and "unsuccessful" firms. Successful is equal to rising productivity and unsuccessful stands for falling productivity. For simplification, firms with constant employment belong to the upsizers. Thus the individual firms can be classified into four groups. The first type is called "successful upsizer" or "type A", because these firms are able to increase both labour productivity and the number of employees. "Type B" firms, or rather "successful downsizers" raised productivity, but did so at the expense of employment, while the "unsuccessful downsizers" reduce both productivity and the number of employees (type D). Finally, there are firms of "type C", which experienced falling productivity and increasing employment. This establishments are called "unsuccessful upsizers".

Figure 3: Types of employment and productivity change

"type A" successful upsizer Δ productivity > 0 Δ employment > 0	"type B" successful downsizer Δ productivity > 0 Δ employment < 0
"type C" unsuccessful upsizer Δ productivity < 0 Δ employment > 0	"type D" unsuccessful downsizer Δ productivity < 0 Δ employment < 0

Now a short discussion follows on different economic reasons why firms experience the observed movements in productivity and employment. Firms of type A - **successful upsizers** - face, for example, increasing product demand combined with increasing returns to scale. Alternatively, these establishments could have a technological innovation combined with relatively lower output prices in the face of elastic product demand. Another reason is explained by the hypothesis of compensation. Here increasing labour productivity is linked with an increasing output and income and the latter is linked with growing product demand (see Meißner/Fassing 1989, 74-77).

The second type, B - the **successful downsizer** - might be consistent technological innovation linked with either falling demand or very inelastic demand. Another reason may follow the hypothesis of satiation connected with redundancy. In this case a constant product demand is combined with an increasing production or the product demand increases slower than the rising production. Following the macro-level trend in this category most, of the establishments will be expected here.

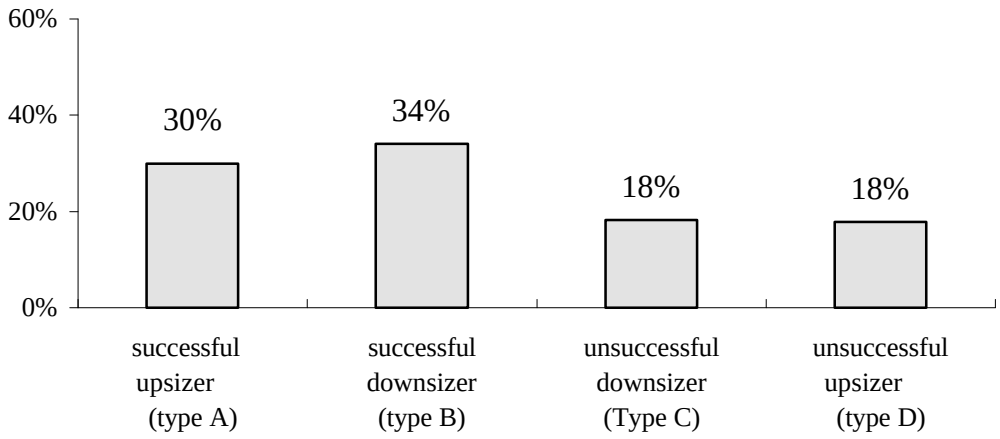
There are several reasons for **unsuccessful upsizers** - type C -. On the one hand this behaviour is consistent with rising demand and decreasing returns to scale. On the other hand negative productivity shocks, like breakdowns of the machines through e.g. fire, accident or strike, meet

inelastic demand. Another reason may be the change of qualification structures of the employees in the firms to a lower level.

Firms of type D - **unsuccessful downsizers** - are those where falling demand is linked with increasing returns to scale, negative productivity shocks are combined with elastic demand, or the firms face falling demand and incomplete adjustment of employment, entailed by adjustment costs which lower the speed of adjustment.

About 64% of the establishments in the manufacturing sector in Lower Saxony increased their labour productivity from 1993 to 1996. More than half of these firms reduced their number of employees at the same time. In 36% of the firms the labour productivity went down, while the trend of employment for types C and D was symmetrical (see Figure 4).

Figure 4: Employment and productivity changes in manufacturing firms of Lower Saxony (1993-1996)



Source: Hannover Firm Panel, weighted data.

Comparing results from Lower Saxony to other studies from Finland (1990-1994), France (1985-1991), Japan (1987-1994), the Netherlands (1980-1991) and the United States (1977-1987 and 1987-1992) it was determined that in all studies most of the firms increased their labour productivity, while the distribution of growing and shrinking numbers of employees is different in the individual countries. In Lower Saxony there is a similar distribution to that in the United States and Finland, while in the other countries "successful upsizers" - type A - were most common. However in Lower Saxony, Finland and the United States most of the establishments are successful downsizers. This confirms the conventional wisdom that a strategy of rising productivity linked with downsizing is used by many firms. One possible reason for the distribution is the relatively unfavourable economic trend which took place, during the analysed period in Lower Saxony. After the reunification boom in 1990/91 and the recession with its depression in 1993 there was a light relaxation in Germany. The value added rose about 2,9% in 1994, about 1,9% in 1995 and around 1,4% in 1996, but especially in the manufacturing sector this light relaxation had no effect on the net value added and orders (see

Niedersächsisches Landesamt für Statistik 1997, 205-206 and 1995, 230-231). In Finland there was a recession, too (see Laaksonen/Teikari 1999), but in comparison to Lower Saxony, Finland has a smaller number of firms with a growing number of employees (see Table 1).

Table 1: Change of employment and productivity: results from different countries

	Share of establishments in %, which are...				
	upsizers		downsizers		
Country	successful	unsuccessful	successful	unsuccessful	$\sum$
Finland (1990-1994)[1)]	15.5	*9.2*	**51.3**	24.0	100
France (1985-1991)[2)]	**37.2**	20.8	29.1	*12.9*	100
Japan (1987-1994)[3)]	**32.7**	24.5	26.6	*16.2*	100
Netherlands (1980-1991)[4)]	**35.0**	25.7	27.7	*11.6*	100
Lower Saxony (1993-1996)[5)]	30.0	*17.8*	**34.0**	18.2	100
United States (1977-1987)[6)]	31.2	16.9	**36.5**	*15.4*	100
United States (1987-1992)[7)]	*19.2*	25.3	**32.6**	22.9	100

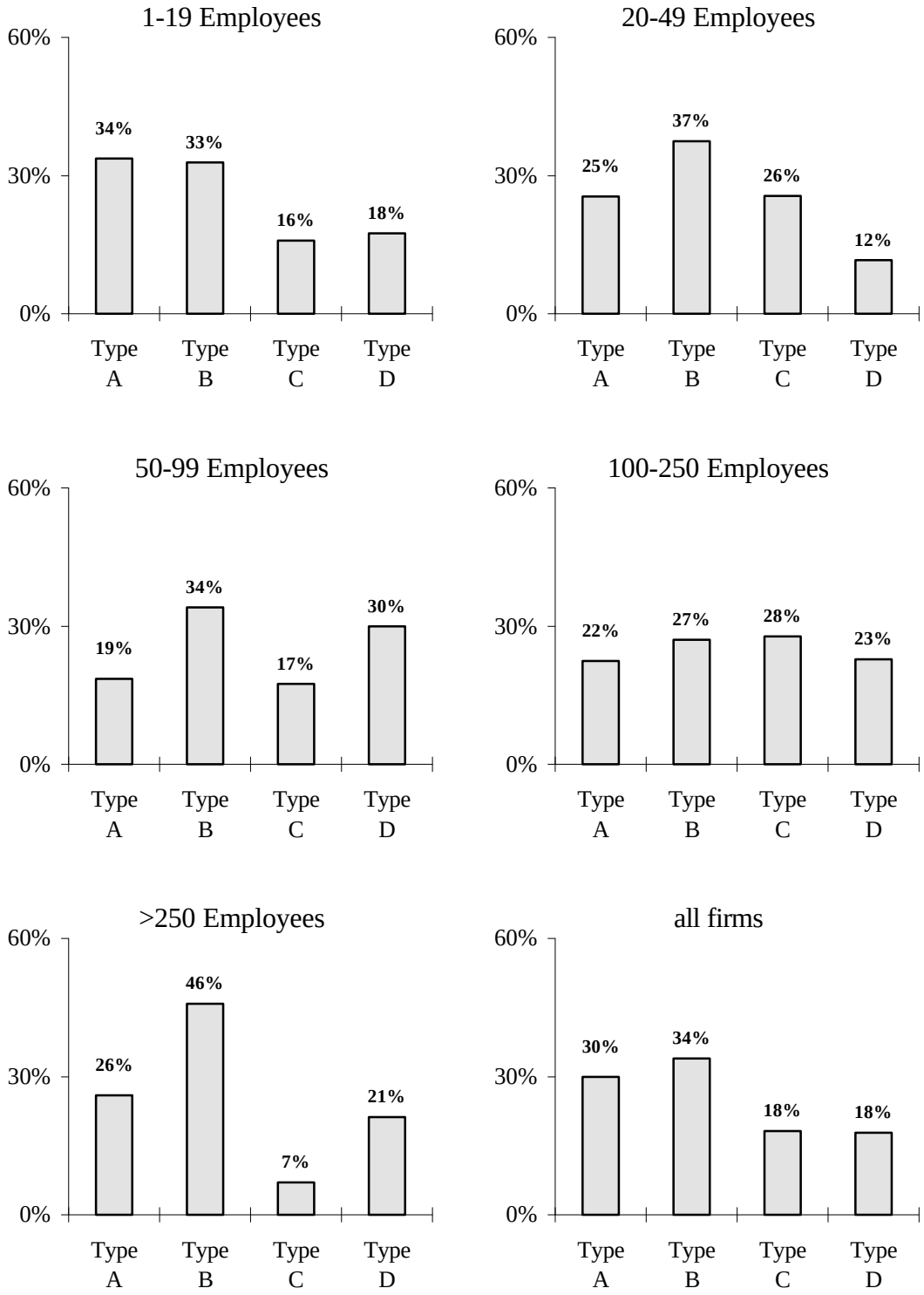
Notes: 2) France: Firms with more than 20 employees; 3) Japan: Firms with more than 100 employees; 4) Netherlands: Firms with more than 10 employees.
Sources: 1) Laaksonen/Teikari (1997); 2), 3) and 7) OECD, 1997; 4) Bartelsmann/Leeuwen/ Nieuwenhuijsen, 1995; 5) Hannover Firm Panel; 1. and 4. Wave; 6) Baily/Bartelsmann/Haltiwanger 1996.

4 Internal influence on employment and labour productivity

4.1 Bivariate analysis

Figure 2 showed differences in labour productivity in different firm size classes. Looking at the four types of firms, are differences visible between types in each size class? Do all firms react in the same way? Figure 5 shows that firms with different sizes have got different distributions for the types. Establishments with more than 250 employees have more than the average "successful downsizers", while "unsuccessful downsizers" are quite rare (7%). Similar results for large-scale firms were found by Laaksonen/Teikari (1999) for Finland, Bartelsmann/Leeuwen/ Nieuwenhuijsen (1995) for the Netherlands and Baily/Bartelsmann/Haltiwanger (1996) for the United States. Moreover 72% of the larger establishments in Lower Saxony increased their labour productivity, while the average for all establishments was 64%. The same was found for the small firms (less than 20 employees). They also increased their labour productivity at an above average rate (67%). Here it was often combined with upsizing. These results are in contrast to Baily/Bartelsmann/Haltiwanger (1996) and Laaksonen/Teikari (1999), where small-scale firms often are unsuccessful upsizers. Establishments with 50-250 employees decreases their labour productivity at an above average rate, while firms with 100-250 employees reduced their number of employees in the same time and firms with less than 100 workers expanded their number of employees.

Figure 5: Changes in employment and productivity (1993-1996) by firm size

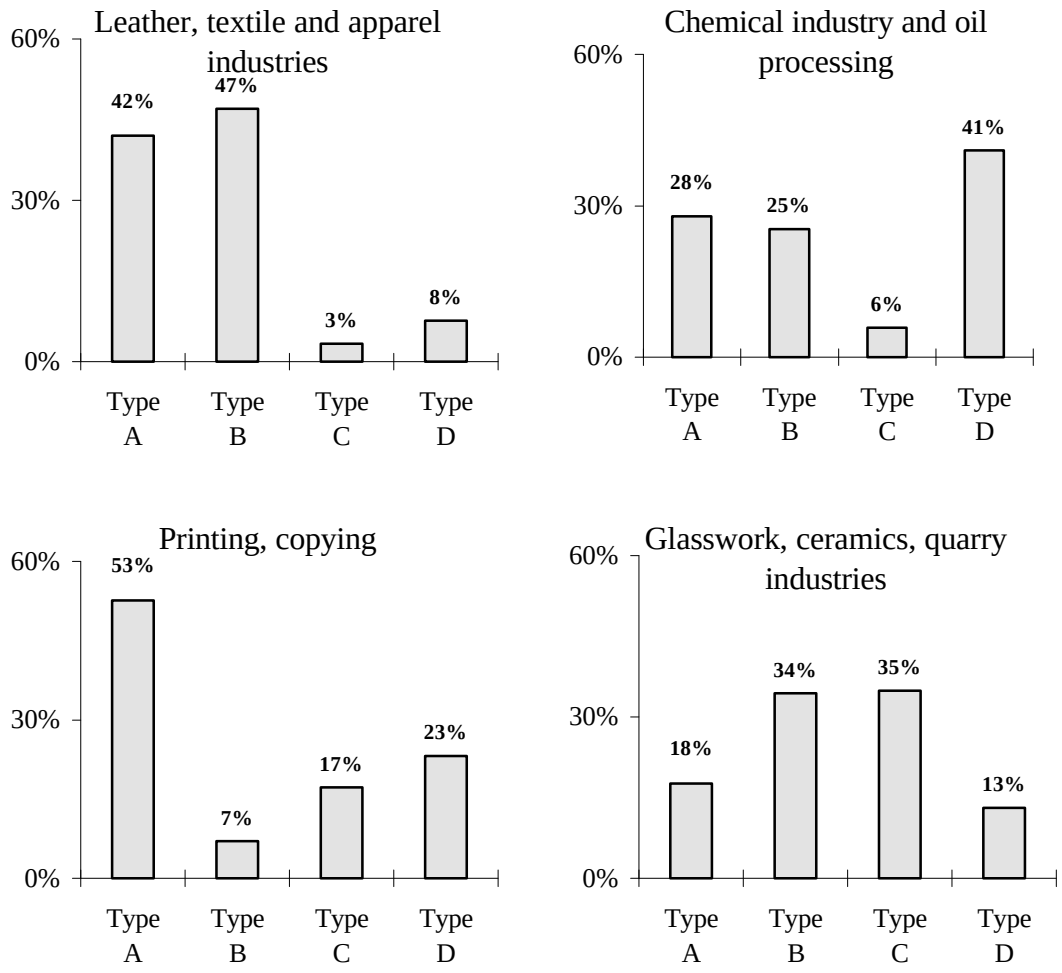


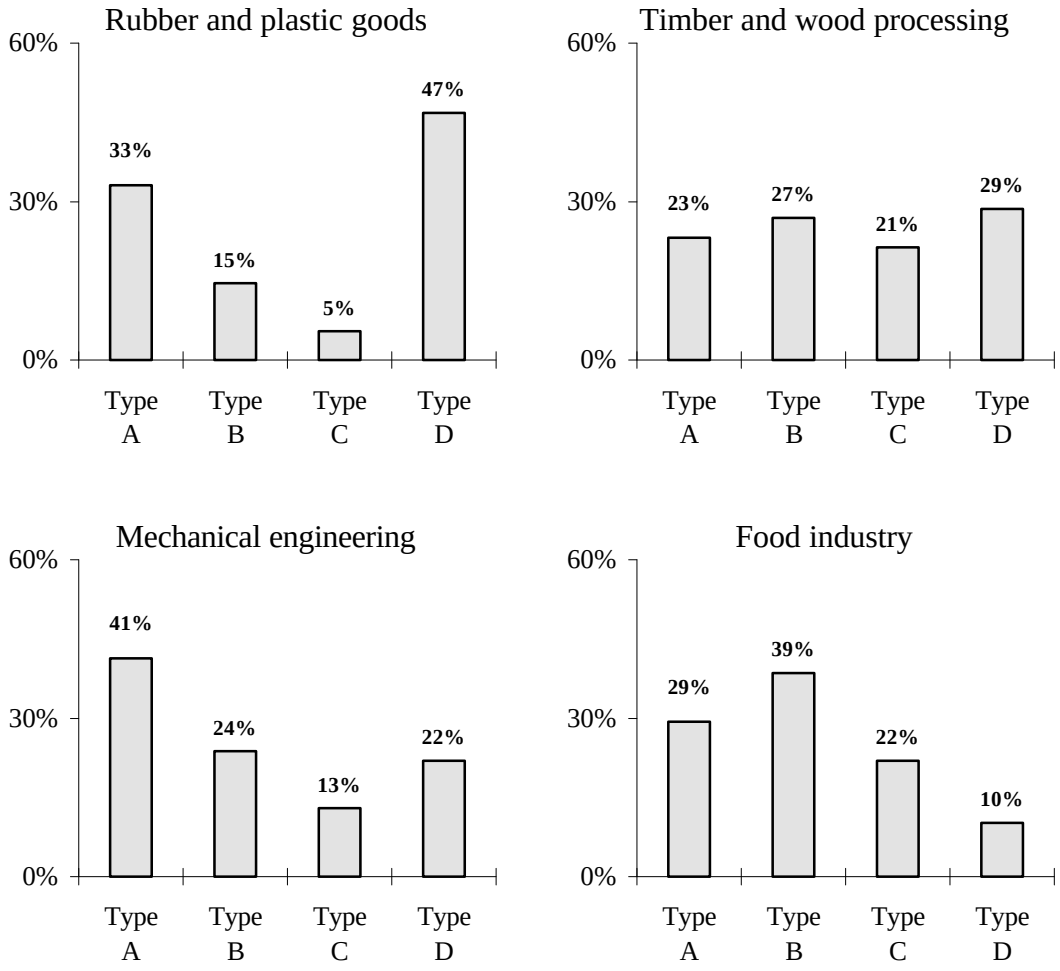
Source: Hannover Firm Panel, 1st and 4th waves, weighted data.

Figure 6 presents the allocation of firms by a selection of industry sectors. Other sectors were not taken in to account, because of small numbers of firms in the non-weighted sample. Firms of the leather, textile and apparel industries raised their labour productivity more often in comparison to all

firms. The usual strategy which is chosen by these firms is downsizing. In other sectors (e.g. chemical and oil processing, printing and copying, rubber and plastic goods, glasswork and ceramics and timber and wood processing) there is an above average share of firms with falling labour productivity. Glasswork and ceramics as well as the food industry have an above average share of firms with falling employment, while the others increased their number of employees by more than the average. These differences confirm results from other studies, which show that there are differences by industry (see e.g. Baily/Bartelsmann/Haltiwanger 1996).

Figure 6: Changes in employment and productivity by selected industry sectors*



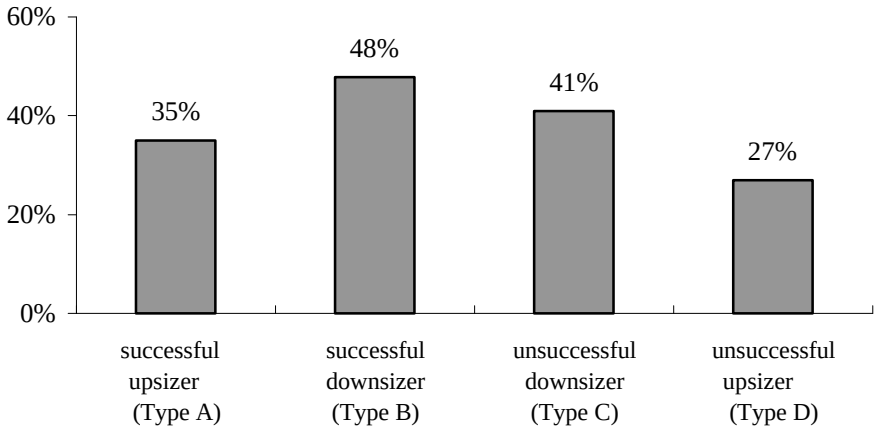


* Leather, textile and apparel industries (n = 610), chemical industry and oil processing (n = 184), printing, copying (n = 812), Glasswork, ceramics, quarry industries (n = 339), rubber and plastic goods (n = 280), timber and wood processing (n = 868), mechanical engineering (n = 870), food industry (n =828).
Source: Hannover Firm Panel, 1st and 4th waves, weighted data.

In the second and fourth waves of the Hannover Firm Panel the firms were asked if they export products. 40% of all establishments in Lower Saxony sell products to foreign countries,[1] while this percentage grows with increasing number of workers (see Wagner 1995, 44). Considering Figure 8, it is noticeable, that especially downsizers are above average exporters, while the share of exporters in the category of successful and unsuccessful upsizers is relatively small. The highest share of exporters (48%) is in the category of successful downsizers. Reasons are, for example that international competition is higher than national competition. Firms are forced to make continuously innovations, and if the demand reacts to higher prices inelastic, firms have to reduce their employment. The high share of type C indicates such processes with the existence of adjustment costs, i.e. the establishments are not able to fire the desirable number of employees, thus the labour productivity will fall.

1 Weighted data, considering all firms analysed for this paper.

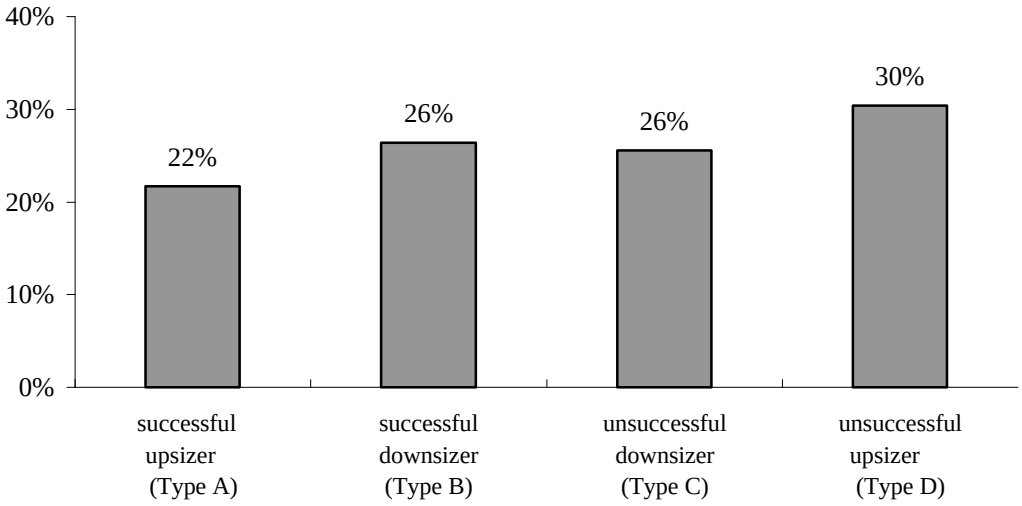
Figure 7: Exports in 1996 and the changes in employment and productivity



Source: Hannover Firm Panel, 1st and 4th waves, weighted data.

Figure 8 shows the share of firms with R&D, differentiated by the individual types of firms. 24% of all establishments in Lower Saxony are doing R&D. Following the assumption that R&D is linked with innovation and therefore with growing productivity, it would be expected that especially successful establishments would have an above average share of R&D. However this assumption can be rejected using the results of Figure 8, because it seems that there is no connection between R&D and growing productivity. The high share of 30% for the unsuccessful upsizers is of note.

Figure 8: R&D 1995 and the changes in employment and productivity



Source: Hannover Firm Panel, 1st and 4th waves, weighted data.

4.2 Multivariate analysis

Next the way internal factors impact the changes in employment and productivity will be discussed. The dependent variable is the different types of firms with the four characteristics successful and unsuccessful downsizers and upsizers. This variable is nominal and cannot be ordered, so we have to use a multinomial logit model (see Greene 1997). The reference category of the model will be type B firms "successful downsizers".

The independent variables are as follows: On the one hand product demand should influence whether firms are successful or not. On the other hand it should also influence the demand for workers. There is no direct information about the product demand, therefore average **capacity utilisation** will be used instead. This follows the assumption that a high capacity utilisation is similar to a high product demand. A positive impact on productivity and employment will be expected. The variable is ordered from 1 = under 85% to 6 = more than 100% of normal working capacity.

Furthermore, we control for **overtime** and **short time work**. Each year the establishments were asked if they had overtime and/or short time work in the first half of the year. This assumes that overtime work will expand the productivity and short time work will reduce it. On the other hand overtime should force increasing employment, while short time work should do the opposite, unless this instrument is used as labour adjustment instead of firing or hiring workers. The variables are defined as follows: 0 = never work overtime or short time; 1/3 = in one year of the period the firm had overtime or short time; 2/3 = in 2 years of the period the firm had overtime or short time and 3/3 = in each year of the study the firm has overtime or short time.

In the Hannover Firm Panel there is no information about the capital stock employed in the firm, but productivity surely is linked with the capital stock and the higher the capital stock the higher the productivity should be. But there is information about the **state of technology**, which will be used instead. The variable is defined as follows: 1 = at the newest level; 2 = Satisfactory, no modernisation is anticipated; 3 = modernisation desired; 4 = no longer satisfactory, modernisation is necessary. In the model the average level from 1993 and 1996 will be used. Additionally, this the **change of the state of technology** is put into the model to take the trend into account. Positive values are connected with an improvement of the technical level, while negative values are equal a worsening of the level.

Furthermore, **export** is taken into account. If firms place themselves into international competition, which may be higher than national competition, they have to innovate continuously. But if the demand reacts to higher prices inelasticly, then firms have to reduce their employment. So the existence of export should decrease the probability that firms are upsizers as opposed to successful downsizers.

R&D should also be linked with increasing productivity. However it can be a reaction of a low productivity working against this. The bivariate analysis shows that R&D is weakly linked with upsizing, so we expect that R&D will raise the probability that firms belong to a category other than successful downsizers.

In addition, **wages per worker** and the **changes in wages per worker** are included. Wages are a cost factor of labour. The higher this factor the more likely it is the firms will try to substitute capital for labour, and vice versa for firms with low wages. The consequence of this will be downsizing or upsizing. A change of wages may be associated with changes in labour quality. That means, if wages rise the quality also rises and the effect of this may be higher productivity. Further, if wages are efficiency wages, then rising wages increase the labour productivity, too.

The model controls for the **numbers of employees** and the **squared number of employees**. The latter tests for non-linear effects of the firm size. **Industry dummies** are included to control for unobserved industry effects like different product demand and different reaction to change. Industry dummies also reflect information about the capital intensity.

Table 2: Impact of Internal factors on changes in employment and productivity (multinomial logit model, reference category: successful downsizer)

	successful upsizer	unsuccessful downsizer	unsuccessful upsizer	Mean StdDev
R&D 1995 (Dummy: yes = 1)	0.342 (0.82)	0.210 (0.48)	0.477 (1.09)	0.507 0.500
Export 1996 (Dummy: yes = 1)	-0.155 (0.35)	-0.106 (0.24)	-0.933** (2.02)	0.626 0.485
Capacity utilisation	0.664*** (3.23)	0.483** (2.16)	0.565*** (2.66)	2.180 1.035
Short time (frequencies of short time : 0; 1/3; 2/3; 3/3)	-2.946*** (2.91)	0.656 (0.95)	-2.902*** (2.68)	0.131 0.247
Over time (frequencies of overtime: 0; 1/3; 2/3; 3/3)	1.391*** (2.61)	1.118** (1.99)	1.899*** (3.18)	0.677 0.375
State of technology (1=at the newest level ...4=no longer satisfactory, modernisation is necessary)	-0.569** (2.11)	0.340 (1.26)	0.127 (0.46)	1.983 0.716
Change of state of technology	0.247 (1.30)	0.151 (0.78)	0.238 (1.26)	0.064 0.951
Average number of employees	3.10e-04 (0.13)	0.001 (0.23)	0.002 (0.67)	132 197
Average number of employees squared	-1.43e-06 (0.58)	-8.16e-06 (0.99)	-2.87e-06 (0.74)	56207 282198
Average wage per worker/1000	-0.060*** (3.67)	-0.018 (1.09)	-0.048*** (2.84)	49.030 14.536
Change of wage per worker	1.765** (2.48)	1.087 (1.53)	1.776** (2.49)	0.992 0.292
Industry dummies (yes = 1)*				
Chemical industry and oil processing	1.460* (1.94)	-1.193 (1.03)	1.579** (2.21)	0.068 0.253
Rubber and plastic goods	1.343** (2.09)	-1.614 (1.43)	0.949 (1.42)	0.092 0.289
Mechanical engineering	1.136* (1.95)	-0.512 (0.84)	0.457 (0.75)	0.137 0.344
Glasswork, ceramics, quarry industries	0.443 (0.61)	-0.541 (0.70)	-0.352 (0.48)	0.086 0.281
Timber and wood processing	-0.180 (0.23)	0.312 (0.49)	0.118 (0.17)	0.086 0.281
Leather, textile and apparel industries	-0.183 (0.24)	0.021 (0.03)	-1.640 (1.40)	0.068 0.253
Food industry	0.556 (0.80)	0.406 (0.56)	-0.153 (0.20)	0.098 0.298
Printing, copying	0.081 (0.11)	-0.120 (0.16)	-0.399 (0.54)	0.068 0.253
Constant	-0.480 (0.41)	-2.960** (2.44)	-2.153* (1.75)	
n		304		
Chi² (57)		140.27***		
Pseudo R²		0.170		
Log likelihood		-342.98238		

notes: * reference category all other industry sectors.
Source: Hannover Firm Panel, 1st and 4th waves.

Table 2 shows the results of the regression. The following independent variables are significant.

In comparison to the successful downsizer ...

- a high capacity utilisation increases the probability that firms are upsizers of type A and D or unsuccessful downsizers, holding all other variables constant.
- short time work decreases the probability that firms are expanding their employment, while overtime rises the probability that firms are successful or unsuccessful upsizers, c.p. The same is valid for the unsuccessful downsizer.
- a high state of technology increases, c. p. the probability that firms are successful upsizers.
- high wages decrease the probability that establishments are upsizers, while raising wages increase the probability that firms belong to the categories of firms with expanding employment, holding all other variables constant. For successful upsizers this confirms the assumption of efficiency wages and growing productivity, but for unsuccessful firms the results are unplausible.

Furthermore it is shown that R&D, export, the number of employees, and the industry dummies have no significant influence at all.

To get a better feeling for the separate influence of the independent variables on the different types of firms, we used the method of discrete change in probabilities described by Long (1997). The change in the predicted probability if the independent Variable x_k changes from x_s (for the starting value) to x_e (for the ending value) is $\frac{\Delta P(y = m \mid x)}{\Delta x_k} = P(y = m \mid x; x_k = x_e) - P(y = m \mid x; x_k = x_s)$, where $P(y = m|x, x_k)$ is the probability that y = m, noting the specific value of x_k (see Long 1997, 166-168).

Table 3 shows the discrete changes of the variables. Holding all variables at their means, the probability of being a successful downsizer is 36%, while the probability of being an unsuccessful upsizer is 22%, the probability of being a successful upsizer is 26% and the probability is 16% that establishments will be unsuccessful downsizers.

For a **change in capacity utilisation** from under 85% to more than 100% the predicted probability of being a successful upsizer changes by 33% and the probability of being a successful downsizer changes by -47%, with all other variables held constant. For a change from no **short time work** to having short time work in each year, the predicted probability of being an upsizer decreases about 24%, while the predicted probability of being a downsizer increases about 30% for unsuccessful and 22% for successful. Whereas a change in **overtime work** from never to each year decreases the predicted probability of being a successful downsizer by 35%, all other variables held constant the predicted probability of being an upsizer rises by 12% (successful) and 18% (unsuccessful). A change in the **state of technology** c.p. from the newest level to no longer satisfactory and modernisation is necessary, the predicted probability of being a successful upsizer decreases by 33%, while the predicted probability of being an unsuccessful downsizer increases by 21%. For a change in the **average wage** of about one standard deviation from the mean, the predicted probability of being a

successful (unsuccessful) upsizer decreases about 12% (6%), while the probability of being a successful downsizer increases by 15%, all other variables held constant. Table 3 shows that R&D, export and the number of employees have got only a weak influence on the distribution of the different types of firms (see average absolute changes in Table 3). The same can be observed for most of the industry dummies.

Table 3: Discrete Change in probability for a multinomial logit model of employment and productivity

Variables	Change	$\bar{\Delta}$	successful upsizer	unsuccessful downsizer	unsuccessful upsizer	successful downsizer
Capacity utilisation	Min → Max	0,24	0.33	0.02	0.12	-0.47
	0 → 1	0,07	0.06	0.03	0.05	-0.14
	Δ 1	0,07	0.07	0.02	0.04	-0.13
	Δ σ	0,07	0.08	0.02	0.04	-0.14
Short time (frequencies of short time: 0; 1/3; 2/3; 3/3)	Min → Max	0,26	-0.29	0.30	-0.24	0.22
	0 → 1	0,26	-0.29	0.30	-0.24	0.22
	Δ 1	0,33	-0.36	0.28	-0.29	0.37
	Δ σ	0,10	-0.11	0.08	-0.09	0.11
Over time (frequencies of overtime: 0; 1/3; 2/3; 3/3)	Min → Max	0,17	0.12	0.04	0.18	-0.35
	0 → 1	0,17	0.12	0.04	0.18	-0.35
	Δ 1	0,17	0.11	0.03	0.20	-0.33
	Δ σ	0,06	0.04	0.01	0.08	-0.13
State of technology	Min → Max	0,16	-0.33	0.21	0.10	0.02
	0 → 1	0,08	-0.16	0.05	0.05	0.07
	Δ 1	0,07	-0.13	0.07	0.04	0.02
	Δ σ	0,05	-0.09	0.05	0.03	0.02
Change of state of technology	Min → Max	0,15	0.16	0.01	0.12	-0.29
	0 → 1	0,03	0.03	0.00	0.02	-0.05
	Δ 1	0,03	0.03	0.00	0.02	-0.05
	Δ σ	0,02	0.03	0.00	0.02	-0.05
Average wage per worker/1000	Min → Max	0,38	-0.51	0.06	-0.25	0.70
	0 → 1	0,00	-0.01	0.00	0.00	0.00
	Δ 1	0,01	-0.01	0.00	0.00	0.01
	Δ σ	0,09	-0.12	0.03	-0.06	0.15
Change of wage per worker	Min → Max	0,33	0.35	-0.05	0.30	-0.61
	0 → 1	0,18	0.17	0.05	0.14	-0.37
	Δ 1	0,18	0.18	0.01	0.16	-0.35
	Δ σ	0,05	0.06	0.00	0.05	-0.11
Average number of employees	Min → Max	0,34	-0.24	-0.07	0.67	-0.37
	0 → 1	0,00	0.00	0.00	0.00	0.00
	Δ 1	0,00	0.00	0.00	0.00	0.00
	Δ σ	0,03	-0.02	0.01	0.06	-0.05
Average number of employees squared	Min → Max	0,34	-0.24	-0.23	-0.22	0.69
	0 → 1	0,00	0.00	0.00	0.00	0.00
	Δ 1	0,00	0.00	0.00	0.00	0.00
	Δ σ	0,15	0.07	-0.27	-0.03	0.23
Dummies (yes = 1)						
R&D in 1995	0 → 1	0,04	0.03	0.00	0.05	-0.08
Export in 1996	0 → 1	0,08	0.03	0.03	-0.15	0.10
Industry Dummies (yes = 1)						
Chemical industry and oil processing	0 → 1	0,19	0.18	-0.16	0.20	-0.22
Rubber and plastic goods	0 → 1	0,17	0.26	-0.17	0.08	-0.17
Mechanical engineering	0 → 1	0,12	0.24	-0.11	0.01	-0.13
Glasswork, ceramics, quarry industries	0 → 1	0,07	0.14	-0.07	-0.07	0.00
Timber and wood processing	0 → 1	0,03	-0.05	0.05	0.02	-0.01
Leather, textile and apparel industries	0 → 1	0,09	0.02	0.05	-0.18	0.10
Food industry	0 → 1	0,07	0.10	0.03	-0.07	-0.07
Printing, copying	0 → 1	0,03	0.04	-0.01	-0.06	0.03
Probability at mean			**0.26**	**0.16**	**0.22**	**0.36**

notes: 0 → 1 is a discrete change from 0 to 1, Δ 1 is the centred change of one unit around the mean; Δ σ is the centred change of one standard deviation around the mean; Min → Max is the change from the minimum to its maximum. All other variables are held at their mean. $\bar{\Delta}$ is the average absolute change.
Source: Hannover Firm Panel, 1st and 4th waves.

5 Conclusion

This paper analyses the connection between changes in employment and productivity using the Hannover Firm Panel. The paper started with a description of the development of employment and labour productivity during the period 1993 to 1996. It shows that about 64% of the firms surveyed expanded their productivity and about 52% reduced their number of employees, with more than one third of the manufacturing establishments in Lower Saxony having expanded their labour productivity while reducing their number of workers. The descriptive empirical exercise is followed by a theoretical discussion of the relationship between the dynamics of labour demand and labour productivity. The descriptive results show that being a successful or unsuccessful downsizer or upsizer is connected with firm size and industry sectors, while in the econometric analysis the influence is (c. p.) partly insignificant. In the descriptive part of the paper it is shown that export is linked with downsizing combined with increasing productivity, while an increase in demand for products is linked with upsizing combined with increasing productivity. On the other hand it is shown that internal factors like overtime work and short time work have got the expected significant influence on the demand for employment, while the influence on productivity is not clear. Finally it was determined that high wages force the firms to downsize while rising wages are connected with upsizing.

Further research will be necessary to validate these empirical results. Therefore it is planned to use another data set which is based on data regularly collected in official surveys by the Lower Saxonian Statistical Office. This longitudinal data set covers all firms that existed in at least one year between 1978 and 1997. This allows further econometric analysis of the relationship between downsizing, productivity growth and the effects of internal factors using Panel econometric methods.

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