THE RELATIONSHIP BETWEEN WAGE AND EMPLOYMENT CHANGES IN INDIVIDUAL FIRMS

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1. The Problem

An optimal allocation of labour in the economy in the short run presupposes a certain amount of labour mobility. In discussions of wage policy therefore, the question has often been raised of the extent to which labour mobility is affected by wage differentials between different firms. The answer to this question is clearly decisive for the type of wage policy chosen.

If labour is thought to be relatively insensitive to short term wage changes, other means than wage differentials would be preferable to bring about the desired movement of labour. This is the position commonly taken by the trade unions.[2] They recommend that a uniform wage be paid for the same job throughout all firms, i.e. a solidaristic wage policy. In this way, they calculate that less productive firms will be forced out and employees pushed away from firms with relatively low productivity to relatively highly productive firms. If, however, it is thought that labour reacts to wage differences even when not excessively large, these differences will be a preferred means to achieve the desired aim. Instead of being pushed away from firms with a low productivity employees are thought to be pulled to firms capable of paying a higher wage. This view can be said to be that held by the employer group.[3]

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[2] See e.g. *Samordnad näringspolitik,* Stockholm 1961.

[3] See e.g. B. Kugelberg, *Lönepolitik i ett progressivt samhälle,* Nationalekonomiska föreningens förhandlingar, häfte 5, Stockholm 1955.

If perfect competition existed between firms, the question of the wage level and labour mobility would theoretically constitute no problem. In that case, it is assumed that labour in a market for a given type of work is homogeneous and fully mobile. All workers in this market would receive the same wage and all labour would be optimally allocated at that wage. For the individual firm, in this case, the supply function for labour would be infinitely elastic with respect to wages.

In reality, however, these underlying assumptions are rarely, if ever, fulfilled. Rather, a certain degree of sluggishness as well as inequalities can be found among workers. This is confirmed by the fact that significant wage differences occasionally exist between firms for the same jobs. In the event, the supply elasticity will not be infinite, and a determined relation between wages and employment within each firm can be assumed to exist. Thus, for example, it appears reasonable that wages, under otherwise unchanged circumstances, will rise when firms have an increased demand for labour. This relationship denotes the supply function for labour which the individual firm faces, in the short run, in the labour market.

The task of this article is to study in greater detail the form of this short run supply function, i.e. how firms change their wages when they change their work force. This will involve a statistical investigation which will be limited to manufacturing industry in Sweden, though certain comparisons will be made with similar investigations in other countries.

2. The Theoretical Relationship

In a labour market, continuous changes in the supply of and the demand for labour can be assumed to occur. Excess demand or excess supply arise entailing changes in the wage as well as the size of the work force. The individual firm takes part in this dynamic process by adjusting employees' wages according to the size of its work force. This adjustment occurs within the framework of the supply function

for labour confronting the firm in the market.[4] For a given firm, this function is assumed to be:

$$w = f(n, \tau), \tag{1}$$

where w constitutes the hourly wage, n the number of employees and τ time. The latter variable has been inserted in the function to indicate that the form of the function can change over time. It is worth noting, moreover, that a firm may possibly employ different types of labour, in which case different supply functions can be conceived of for one and the same firm.

As indicated in the introductory remarks, the above function will be investigated statistically. In the function, however, the variables have the character of absolute quantities, while the calculations in the statistical investigations are based on variables which constitute relative changes over time. The latter calculation can be obtained by differentiating the function (1) and afterwards dividing both sides by w and $d\tau$:

$$\frac{dw}{d\tau}\frac{1}{w} = f_n \frac{dn}{d\tau}\frac{1}{w} + f_\tau \frac{1}{w} \tag{2}$$

The left hand side of this equation clearly corresponds to the relative changes of the hourly wage over time. The first term on the right hand side denotes the product of the relative change in employment and the elasticity of the hourly wage with respect to employment, which appear if the term in question is changed to:

$$f_n \frac{n}{w} \cdot \frac{dn}{d\tau}\frac{1}{n} \tag{3}$$

This term corresponds to that part of the wage change related to the change in employment. The last term in the equation (2) indicates the size of the wage change due to factors other than variations in the number of workers.

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[4] In the dynamic adjustment process, each firm can be viewed as a monopsonist in its limited part of the labour market. See e.g. K. J. Arrow, *Toward a Theory of Price Adjustment, The Allocation of Economic Resources,* Stanford 1961, where a similar approach is taken.

This equation is assumed to apply approximately for measurable changes of w, n and τ, which means that the various differentials are viewed as differences. These differences are thought to indicate the changes between two time periods. Therefore the equation in question can be written as:

$$y = ax + l \tag{4}$$

The quantity a corresponds to the wage elasticity with respect to employment and l the relative shift in the supply function. Both quantities are assumed to be constants. Quantities y and x denote variables corresponding to the relative change in the hourly wage and in employment respectively.

In this way a theoretical relationship has been obtained between the change in the hourly wage, on the one hand, and the change in the number of workers on the other. The relationship is linear and is determined by the elasticity a and the constant l. To ascertain the value of these quantities is the task of the present statistical investigation.

The above relationship between wages and employment, however, is not the only one which could apply for a firm. For a relationship between the same quantities also arises on the demand side. Theoretically, the firm can be thought to vary its employment according to changes in the supply of labour. These supply changes offer a relationship between wages and employment on the demand side which may be written:

$$w = g(n, \tau), \tag{5}$$

where w, n and τ, as before, denote the hourly wage, the number of workers and time respectively. In the same manner as on the supply side, different relations may also be assumed to exist for one firm, where its work force is heterogeneous in composition.

If one now differentiates the above function and otherwise proceeds in a way analogous to the supply case, one arrives at an expression similar to function (4). This function expresses the relationship between relative changes in wages and employment seen from the de-

mand side. As before, a indicates how strong the relation is, and l how wages change over time with employment unchanged.

As a consequence of this, in the statistical calculation of a and l, one cannot be certain whether the relationship obtained applies to the demand side or the supply side. Additional information is required in order to decide this question. A determination that the supply function is, in reality, the one being calculated can be assisted by an idea of how supply and demand change over time.

To begin with, it can be supposed that the supply functions for different firms shift position only in one direction from one time period to another. Workers' wages, at unchanged employment, can be assumed to increase successively over time and, in large measure, equally in all firms. This is due to the fact that an essential factor in determining the supply function is the wage agreement between the two collective bargaining organizations in the labour market. However, the demand for labour can vary between firms, both in a positive and a negative direction, between two time periods. If one compares different firms, as is done here, one encounters the quantities a and l in the supply function.[5]

This is further clarified in Figure 1, which shows the individual firm with a given upward shift in the supply curve and alternative changes in demand. In the starting position A, employment and wages equal n_0 and w_0 while the corresponding quantities at B and C have the values n_1 and w_1 and n_1' and w_1' respectively.[6] The inequality between the alternatives B and C relating to changes in employment is due to the fact that demand, and not supply, changes. Wages differ between the two alternatives because of the slope of the supply curve. If supply and demand shift in the given way, wage and employment changes will reflect the firm's supply function, represented in Figure 1 by the line between points B and C. The same thing is true for a com-

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[5] In the investigations where this problem is treated this is the common justification for the idea that the supply function is the one being calculated. These investigations shall be introduced in greater detail subsequently the article.

[6] Points A, B and C in the figure are thought to constitute points on the supply curve where the employment variable has brought about equality between marginal revenue and marginal cost.

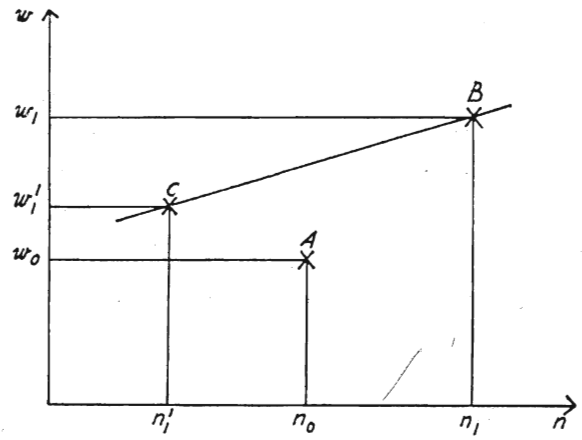

Figure 1.

parison of relative changes in wages and employment between different firms.

As has been suggested, however, the work force of a firm may be assumed to be heterogeneous in composition so that different supply and demand relations exist for one and the same firm. If different firms are compared with each other, the aggregate supply function for a firm will be affected by shifts in the composition of the work force. In other words, the internal wage structure of the firm changes with changes in employment. This problem will be more closely analysed in a section following. Another problem is that a certain interdependence can exist among firms in the supply of and demand for labour. This complication will, however, be disregarded in this article.

3. The Statistical Procedure

Equation (4), which according to its definition, explains how the hourly wage in a firm changes at changes in employment, can be viewed as a regression equation, where y is a dependent variable and x an independent variable. For the ith firm the following regression equation can be formed:

$$y_i = ax_i + l + z_i \quad (i = 1, 2 \ldots N) \tag{6}$$

where z_i is the difference between the observed value for y and the theoretical value according to equation (4).

If the actual values of the variables for N firms are studied, it is possible to calculate the constants in the equation by employing the method of least squares. The values obtained for the regression coefficient a and the quantity l are in agreement with the theoretical values sought if the residual z is not correlated with the independent variable x, an assumption which will be made for the moment.

As has been mentioned earlier, the variables in equation (4) are defined as relative changes from one period to another. The changes observed statistically are changes between different years for different firms. By making comparisons in this way between different firms, regression calculations can be said to be based on cross-section data.

In questions of statistical measurement the independent variable x in the calculations has been formed from the expression:

$$x = (n_1 - n_0)\, n_0^{-1}, \tag{7}$$

where n_1 and n_0 denote the number of workers in the firm during the two relevant years. However, n has not been observed directly, but has been obtained according to the formula:

$$n = (m - o)\, t^{-1} j^{-1}, \tag{8}$$

where m corresponds to the number of hours of work performed, o the number of hours of overtime, t the length of the work week and j the number of weeks worked during the year, which is assumed to remain unchanged from year to year. This expression has then been inserted in (7) whereby the following expression is obtained after dropping j:

$$x = [(m_1 - o_1)\, t_1^{-1} - (m_0 - o_0)\, t_0^{-1}]\, (m_0 - o_0)^{-1} t_0. \tag{9}$$

This expression is used in the calculation of x. The reason why x is not directly calculated from (7) is that data from the firms relating to the number of workers is estimated to be more uncertain than data on the number of hours of work performed.

The dependent variable y, in turn, has been obtained through the formula:

$$y = (k_1 m_1^{-1} - k_0 m_0^{-1})\, k_0^{-1} m_0. \tag{10}$$

In this formula k_1 and k_0 denote the wage total reduced by the overtime premium[7] during the relevant years and m_1 and m_0, as usual, the number of hours of work performed during the same years.

The data upon which y and x are based cover only manual workers including both men and women and adults and minors.[8] Piece work, as well as hourly, wage earners are included. According to (10), y corresponds to the change in the average hourly wage in the firm. It should be noted that this variable is determined not only by changes in the hourly wage but also by changes in the wage structure of the firm.

The data for this investigation has been collected by enquiries among a sample of firms, with more than 25 workers, within manufacturing industry but not mining.[9] The investigation covers the years 1957, 1958 and 1959, and the regression calculations include the periods 1957–58, 1958–59 and the two year period 1957–59.

The calculations have been performed for manufacturing as a whole as well as for different groups of firms.[1] Thus, groupings have been made according to the branch of industry, the size and the geographical position of the firm. The purpose of these groupings is to investigate whether different relations between wages and employment exist for different types of firms.

The material has also been grouped according to other criteria. A

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[7] In the wage total, however, are included shiftwork premiums, holiday pay, vacation pay and other "extras".

[8] The term manual worker embraces foremen who participate in the work, stock workers and drivers, but not forestry and agricultural workers, domestic workers, shop personnel, restaurant personnel and cleaning women. This method of defining the concept of manual worker exactly coincides with that employed in the official wage statistics.

[9] The same data has been used as that in the investigation of the effects of a reduction of hours of work. See Y. Åberg, *Arbetstidsförkortningens verkningar*, SOU 1964: 9 in which a more detailed description is given of the collection of the data and the percentage of replies. For the entire investigation, this percentage remained between 85–90%.

[1] A firm, in this study, means, in principle, each separate work place. In certain cases the concept corresponds to a certain group of workers, which is characterized by the fact that workers within it have the same regular working hours. Because of this the firm will clearly correspond to the observed unit only on hours of work, which, in the overwhelming number of cases, is the same for all workers in the firm.

division has been made according to the direction of the firms change in employment. The results of this will be treated after the results for all the types of employment changes have been discussed. Finally, the relationship between wages and employment has also been studied from certain dynamic aspects, the results of which are presented at the end of this article.

4. All Types of Employment Changes

The results of the regression calculations for all the periods studied, with no reference made to the direction of the firms' change in employment, are given in Table 1. In this table the regression coefficient a, the standard deviation S_a and the quantity h, which is equal to $100 \cdot l$, i.e. the unexplained percentage change in the increase in hourly wages, are given and also, the number of observations, N, in the different groups of firms.

From the values of h it appears that the hourly wage in manufacturing as a whole, at constant employment, rose by about 5.5% during the first period, a good 4% during the second period, and almost 10% during the entire period, 1957–59. This wage increase could have been a result of wage drift as well as negotiation. A certain variation in the size of the wage increase can be found between the different industrial groups, but no special tendency can be discerned in the case of firms of different size or different geographical position.

Coefficient a, with respect to manufacturing as a whole, remained at about zero during all periods of investigation. Consequently, average hourly wages, under otherwise constant conditions, should remain unchanged when firms vary their employment. If hourly wages in the different firms are uniform, the relationship can also be interpreted so that the supply of labour directed to an individual firm is infinitely elastic with respect to the hourly wage.

However, the coefficient varies significantly between the different groups of firms. It is noteworthy that when the deviations from zero are more pronounced, it is always in a negative direction. In the grouping, the standard deviation for the coefficient certainly rises, but the evidence of an overall negative tendency is strengthened by the fact

Table 1. *Regression calculations concerning hourly earnings in manufacturing enterprises employing more than 25 workers, for different years.*

Manufacturing groups Sizes of enterprises Geographical location	1957–1958			1958–1959			1957–1959		
	N	a S_a	h	N	a S_a	h	N	a S_a	h
Total manufacturing	2653	−0.01 0.003	5.47	2532	0.00 0.002	4.13	2482	−0.00 0.002	9.78
Metal and engineering industry	864	−0.01 0.006	5.94	846	0.01 0.003	4.18	831	−0.04 0.008	10.4
Stone quarrying industry	283	−0.02 0.016	5.43	276	−0.01 0.013	4.29	272	0.01 0.017	9.98
Wood industry	323	−0.04 0.014	6.68	302	−0.03 0.015	4.56	299	0.01 0.016	11.37
Pulp and paper industry	191	0.00 0.004	3.41	192	0.01 0.005	3.05	182	0.00 0.002	6.
Printing and allied industries	125	−0.19 0.054	3.34	111	−0.22 0.060	5.19	109	−0.19 0.047	8.47
Food and beverage industry[1]	245	−0.13 0.022	5.26	237	−0.07 0.015	5.09	232	−0.11 0.016	10.77
Textile and ready-made clothing industry	326	−0.10 0.019	5.16	286	−0.13 0.020	3.56	285	−0.08 0.020	8.80
Leather and rubber industry	127	−0.12 0.026	5.55	116	−0.02 0.022	4.33	115	−0.05 0.021	10.24
Chemical industry	169	−0.01 0.012	5.29	166	0.01 0.004	3.44	157	0.01 0.013	8.82
Firms with 25– 50 workers	937	−0.06 0.011	5.29	877	−0.02 0.006	4.29	869	−0.06 0.011	9.77
Firms with 51–100 workers	676	−0.07 0.010	5.49	637	−0.08 0.011	4.66	631	−0.07 0.011	10.29
Firms with 101–200 workers	428	−0.07 0.017	6.14	413	−0.01 0.008	3.82	403	−0.04 0.015	10.32
Firms with 201–500 workers	389	−0.01 0.007	5.29	382	0.01 0.003	3.79	364	−0.01 0.005	9.23
Firms with over 500 workers	223	0.00 0.003	5.25	223	0.01 0.003	3.74	215	0.00 0.001	9.34
Greater Stockholm	259	−0.09 0.023	4.59	241	−0.10 0.021	3.93	238	−0.07 0.023	8.
Greater Gothenburg	133	−0.11 0.031	5.72	125	−0.10 0.029	4.29	124	−0.11 0.028	10.09
Malmö	89	−0.15 0.042	5.48	81	−0.07 0.029	4.20	80	0.01 0.038	9.88
Rest of the country	2172	−0.01 0.003	5.56	2085	0.00 0.002	4.14	2040	−0.00 0.002	9.87

[1] Excl. dairies and enterprises belonging to Swedish Tobacco Inc. and Spirits & Wine Inc.

that it recurs in every period. According to the table, a has a relatively large negative value during all periods within the printing industry, food manufacture and textile. Furthermore, this negative tendency is more pronounced for the smaller firms, under 200 employees, than for the larger firms. Finally, the table shows that the coefficient is more definitely negative in the urban areas than in the country as a whole.

Were labour homogeneous, the negative values for the coefficient would mean that the supply curve for labour has a negative slope. This is most improbable, however, from the purely theoretical viewpoint. Instead, the explanation probably lies with the fact that wages vary between different workers and that firms in increasing the size of their work force tend to hire lower wage workers first. This question will be discussed in greater detail in a subsequent section.

In addition to the calculations presented in Table 1, calculations have been made taking into consideration the wage level of the firm. On the one hand, firms have been grouped according to the height of their wage level and, on the other, the wage level has been inserted as an independant variable in the regression equation together with the variable for employment changes. In none of these cases, however, did the wage level appear to have any significance for the value of the coefficient a. From the calculations, it appeared only that the wage increase as a percentage was somewhat less in high wage firms than in other firms.[2]

As has been mentioned before, investigations of this type have been carried out in other countries. For example, an expert group within the OECD has investigated wage differentials and labour mobility in a number of European countries, the U.S.A. and Canada.[3] Also, W. B. Reddaway[4] and E. H. Phelps-Brown and M. H. Browne[5] have made studies for the United Kingdom.

[2] The tables which show the results of these investigations are available from the Swedish Employers' Confederation (SAF). This also applies to investigations mentioned in the following text but not presented in table form.

[3] *Report of the Expert Group of Working Party No. 4 on Changes in Wage Differentials and Labour Mobility*, OECD, Paris 1964.

[4] W. B. Reddaway, *Wage Flexibility and the Distribution of Labour*, Lloyds Bank Review, October 1959.

[5] E. H. Phelps-Brown and M. H. Browne, *Earnings in Industries of the United Kingdom, 1948–59*, The Economic Journal, September 1962.

All of these investigations, however, differ from the present study in that they are not based on data from individual firms but rather on data from industrial groups. Also, they include, as a rule, changes over a much longer time period than the year to year changes measured in our study.

Nevertheless, these investigations have resulted in conclusions that the relation between wage and employment changes is relatively weak. In Reddaway's study, for example, the elasticity with respect to employment had a value equal to 0.17 for industry as a whole.[6] Otherwise, the relationship in these investigations was occasionally negative and occasionally positive.

In general, however, the relationship in the present study was weaker than that found in the above studies. Reddaway found in his investigation that the relationship became more strongly positive, the more aggregated were the groups of firms upon which the calculations were based.[7] In the OECD study, a similar tendency was evidenced in countries other than the United Kingdom, indicating that the tendency was a general one.[8] The fact that the relationship in the present study was weaker can be explained almost entirely by the fact that our calculations have been based on data for individual firms.

According to Reddaway, the tendency towards a stronger relationship when calculations are based on more aggregated data can be explained by the character of wage negotiations. Often these negotiations apply to large aggregates of firms such as entire industries. If such aggregates are compared, the differences in wage changes, for the most part, are not dependent on changes in employment but rather on the results of the wage negotiations.[9] The OECD report lends further support to the idea that comparisons between different industries, for example, also reflect the differing cyclical development of these industries. Consequently, calculations based on highly aggregated data are disturbed by irrevelant factors.[1]

The fact that the relationship between wages and employment is

[6] Reddaway, p. 41.
[7] Reddaway, pp. 41–43.
[8] OECD Report, p. 102.
[9] Reddaway, pp. 46–47.
[1] OECD Report, pp. 104–105.

weak and occasionally negative with disaggregated data is not subjected to closer analysis in the studies cited. In the OECD report, an indication is given that this could be related to shifts in the internal wage structure of the firm.[2] However, in the OECD report the significance of the wage level for the studied relation was investigated and the same result was obtained as in the present study.[3]

5. Increases and Decreases in Employment

Tables 2 and 3 present the results of calculations dividing the firms into those with increased and decreased employment. Table 2 is for the period, 1957–58 and Table 3 the period, 1958–59. In addition, the size of the average change in employment, x, for the different groups of firms has been presented in these tables.

If one looks at the number of firms, one finds that more than half of all the firms reduced their employment during the first period and more than half increased their employment during the second period. Moreover, one sees that the average decrease in employment was greater during the first period than during the second period, while the reverse was true for increases in employment. These figures clearly reflect the recession during 1958 and the upswing during 1959.[4] Otherwise, the figures show that the variation in the size of employment within firms is greater than what generally has been suggested in the debate about labour mobility.

Furthermore, the distribution of firms with respect to employment changes apparently has very little significance for the coefficient a. Thus, the coefficient for manufacturing industry as a whole has a value hovering around zero during both observation periods, no matter whether the firm has increased or decreased its employment. One sees further that the coefficient largely remains negative for the groups of firms which displayed a negative tendency before the new grouping.

With respect to the residual factor, h, however, one finds that an

[2] Ibid., p. 92.

[3] Ibid., p. 96.

[4] With respect to the different cyclical situations, see e.g. *Konjunkturläget*, November 1960, Konjunkturinstitutet.

Table 2. *Regression calculations concerning hourly earnings in manufacturing enterprises with increasing/diminishing employment. Period 1957–58.*

Manufacturing groups Sizes of enterprises Geographical location	$x \geqslant 0$				$x < 0$			
	N	$\bar{x}$	a S_a	h	N	$\bar{x}$	a S_a	h
Total manufacturing	1294	13.09	−0.00 0.003	4.59	1359	−10.21	−0.03 0.012	6.02
Metal and engineering industry	419	13.18	−0.01 0.007	5.15	445	−11.57	0.03 0.016	7.08
Stone quarrying industry	101	6.89	0.08 0.032	4.30	182	−11.19	−0.03 0.027	5.63
Wood industry	181	9.76	0.01 0.020	5.99	142	− 8.93	−0.10 0.040	6.37
Pulp and paper industry	107	36.23	0.00 0.004	3.25	84	−10.31	−0.06 0.055	2.97
Printing and allied industries	75	8.08	−0.14 0.066	2.89	50	− 5.18	−0.33 0.215	2.64
Food and beverage industry	129	9.73	−0.06 0.032	4.38	116	− 7.36	−0.21 0.061	4.93
Textile and ready-made clothing industry	141	8.70	−0.12 0.044	5.27	185	−10.47	−0.06 0.037	5.62
Leather and rubber industry	53	9.20	−0.02 0.044	4.11	74	− 7.78	−0.15 0.062	5.63
Chemical industry	87	17.10	0.01 0.019	4.67	82	−11.67	−0.03 0.026	5.37
Firms with 25– 50 workers	500	10.19	0.00 0.021	4.38	437	− 9.87	−0.10 0.025	5.16
Firms with 51–100 workers	329	11.29	−0.04 0.017	4.78	347	− 9.78	−0.06 0.025	5.91
Firms with 101–200 workers	204	8.29	0.04 0.025	4.82	224	− 9.48	−0.07 0.040	6.52
Firms with 201–500 workers	167	13.62	−0.00 0.007	4.68	222	−10.65	0.01 0.026	5.84
Firms with over 500 workers	94	44.29	−0.00 0.002	5.00	129	−13.04	0.07 0.024	6.28
Greater Stockholm	130	8.00	−0.07 0.054	4.24	129	−10.31	−0.04 0.045	5.35
Greater Gothenburg	70	10.20	−0.04 0.075	4.35	63	−10.87	−0.03 0.058	7.21
Malmö	42	10.61	−0.27 0.091	7.52	47	− 7.48	−0.17 0.079	4.63
West of the country	1052	14.01	−0.00 0.003	4.74	1120	−10.28	−0.02 0.013	6.06

Table 3. *Regression calculations concerning hourly earnings in manufacturing enterprises with increasing/diminishing employment. Period 1958–59.*

Manufacturing groups Sizes of enterprises Geographical location	$x \geqslant 0$				$x < 0$			
	N	$\bar{x}$	a S_a	h	N	$\bar{x}$	a S_a	h
Total manufacturing	1401	16.23	0.01 0.002	3.27	1131	− 9.63	−0.01 0.013	4.92
Metal and engineering industry	469	20.12	0.02 0.003	2.88	377	−10.12	−0.08 0.024	4.73
Stone quarrying industry	158	13.15	−0.01 0.020	4.01	118	−10.86	0.04 0.027	5.13
ood industry	148	10.04	−0.01 0.027	4.06	154	− 8.49	−0.01 0.029	5.03
Pulp and paper industry	107	30.25	0.01 0.006	2.97	85	−12.52	0.01 0.050	3.14
Printing and allied industries	60	6.39	−0.17 0.120	4.55	51	− 6.15	−0.11 0.136	6.21
Food and beverage industry	142	11.06	−0.06 0.020	5.05	95	− 8.97	−0.06 0.050	5.19
Textile and ready-made clothing industry	157	10.54	−0.26 0.032	5.20	129	− 9.11	0.05 0.046	4.94
Leather and rubber industry	66	13.34	0.02 0.024	3.18	50	− 8.64	0.01 0.078	5.54
Chemical industry	94	21.34	0.01 0.004	3.08	72	−10.25	−0.01 0.035	3.71
Firms with 25– 50 workers	500	13.43	−0.00 0.007	3.18	377	− 9.46	0.04 0.027	6.07
Firms with 51–100 workers	356	11.93	−0.04 0.015	4.12	281	− 9.20	−0.13 0.031	4.23
Firms with 101–200 workers	229	10.76	−0.00 0.009	3.27	184	− 9.17	−0.01 0.025	4.34
Firms with 201–500 workers	195	25.84	0.02 0.004	3.05	187	− 9.95	−0.03 0.024	3.99
irms with over 500 workers	121	35.29	0.01 0.003	3.80	102	−11.69	0.09 0.022	4.66
Greater Stockholm	116	11.16	−0.08 0.031	3.43	125	− 9.78	−0.12 0.059	3.9
Greater Gothenburg	65	7.54	−0.12 0.051	3.97	60	− 8.35	−0.01 0.059	5.4
Malmö	48	8.70	−0.08 0.052	4.44	33	− 5.77	−0.12 0.068	3.7
Rest of the country	1172	17.52	0.01 0.002	3.33	913	− 9.83	−0.00 0.014	4.9

essential difference existed during both periods between firms with increased employment and firms with decreased employment. In the former group, for manufacturing as a whole, this factor amounted to more than 4.5% during the first period but approximately 6% for the latter group during the same period. During the second period the corresponding values were more than 3% and almost 5% respectively. This tendency towards lower values of h for firms with increased employment, could be found according to the tables in almost all the groups of firms.

In the same way as in the case where the direction of employment changes were excluded, firms have been divided according to the height of their wage level. Moreover the firms have been divided according to the size of the increase or decrease in employment. However, this change did not significantly change the statistical picture. In all these cases, coefficient a, among others, had approximately the same value as before the division.

Concerning the residual factor h, the differences between the firms can be interpreted in such a way that the low wage employees are, for the most part, the first to be employed when employment increases and the first to be laid-off when employment declines. In other words, the mobile part of the labour force within industry—a part which, as has been indicated above, is not entirely insignificant—consists of workers with especially low wages.[5] It is worth noting, however, that this does not prevent wages for the individual worker from rising through a change in the work place.[6]

In this way, we obtain evidence that the relation between hourly wages and employment is weak because of the fact that the wage structure of the firm does not remain constant when the number of workers changes. If the wage structure had remained constant, nothing would have prevented a clear positive relation being obtained in the calculations. The relationship can also be interpreted so that there

[5] Compare K.-O. Faxén, *Monetary and Fiscal Policy under Uncertainty*, Stockholm 1957, Ch. VI, where it is shown theoretically that the low wage workers are prominent among job changers.

[6] See e.g. B. G. Rundblad, *Arbetskraftens rörlighet*, Stockholm 1964. It appears there (Ch. 5) that even if labour is insensitive to wage differences, wages play some role in voluntary movements.

are different types of workers directing their supply to the firm and that each of these supplies has a positive elasticity with respect to the wage. What the present study shows is that the firm selects from among different labour supplies in such a way that the total supply for each individual firm will be independent of the wage or even vary inversely with that quantity.

Because of the indicated variation in the wage structure, wage drift at any given contractual increase, tends to be higher with declining demand than with increasing demand for labour. This was true for the years involved in the periods of observation. Negotiated piece work and hourly wages increased by 2.4% during 1958 and 1.8% during 1959.[7] The actual increase in wage earnings for the firms studied amounted to 5.5% and 4.1% respectively during these years. Thus wage drift amounted to 3.1% during the recession year 1958, while during 1959, a year of improved business activity, it remained at about 2.3%.

This is a result that clearly contravenes the common understanding, that wage drift increases with increasing demand for labour.[8] If one looks to other years than those encompassed by this investigation, one can find that wage drift increased during certain periods of high business activity. For example, this was true for the cyclical upswing during the years 1953–55. However, wage drift in these instances need not necessarily have been related to the developments in the labour market. It quite possibly could have been caused instead by an increase in productivity, an increase reflected in piece work wages in that instance.

The fact that the calculations in this article do not reveal the supply function for a given homogeneous group of workers can also be said to be due to the existence of a certain stratification in the data. The condition that the residual z shall be uncorrelated with the indepen-

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[7] See statistics from The Swedish Confederation of Trade Unions (LO) and The Swedish Employers' Confederation (SAF).

[8] Compare e.g. B. Hansen and G. Rehn, *On Wage-Drift. A Problem of Money-Wage Dynamics*, 25 Economic Essays In Honour of Erik Lindahl, Stockholm 1956, in which it appears that the conditions on the labour market have greater significance for wage drift than productivity developments. Again, the Hansen–Rehn study was based on industry-wide data and not firm data.

dent variable x in the basic regression equation (6) is thus not satisfied. This problem, can be solved, however, by inserting a variable in the regression equation which is correlated with the original independent variable. With such a variable, which, in the present case, would correspond to the change in the wage structure of the firm, the effect of the heterogeneous composition of the work force will be eliminated.

An attempt has been made to construct a variable of this kind, formed so that it gives the shift in the distribution between hourly wages and piece work wages in the firm.[9] The construction has been arranged so that the variable rises with a shift to a greater number of high wage employees, which, as a rule, are piece work employees. It appeared quite natural that a certain positive relation exists between this distribution variable and wage changes. However, no correlation could be found between the variable mentioned and the change in the number employed. As a result, the relation between the wage changes and the employment changes remained unchanged with the insertion of the distribution variable.

This result, however, by no means invalidates the hypothesis that the relationship between wage and employment is influenced by shifts in the wage structure. The analysis shows only that this relationship is not dependent on shifts between piece work and hourly wage employees. The relationship could possibly be affected instead by changes within both groups of employees. The statistical data, however, does not allow a closer investigation of this question.

6. The Lag Relation

As has been mentioned before, certain relationships between wages and employment over time have also been examined. The hypothesis has been that the change in the wage for a given period is dependent

[9] The variable used is:

$$u = \frac{\left(\frac{k_{T0}}{m_{T0}} m_{T1} + \frac{k_{A0}}{m_{A0}} m_{A1}\right)(m_{T0} + m_{A0})}{(k_{T0} + k_{A0})(m_{T1} + m_{A1})} - 1,$$

where k and m have the same meaning as in (10) and where indices T and A indicate hourly wages and piece-work wages respectively.

not only on the change in employment during the same period but also the change in the wage and employment during an earlier period. This relation, which is calculated with regression techniques, is as follows:

$$y_0 = ax_0 + by_{-1} + cx_{-1} + l, \tag{11}$$

where y_0 and y_{-1} denote the wage change in a given firm during the periods 1958–59 and 1957–58 respectively and x_0 and x_{-1} the change in the number of workers during the same periods. The different coefficients in turn denote the partial elasticity of the wage with respect to the wage and employment during different periods. From this equation, a reduced equation has also been calculated, in which the independent variable x_{-1} has not been included. In Table 4 the results of both these calculations are presented, where h as usual corresponds to $100 \cdot l$, i.e. the residual factor expressed as a percentage, and N the number of observations.

To begin with, one can observe in this table that the coefficient a in both calculations has approximately the same value. Also one can see that the coefficient does not differ significantly from the corresponding coefficient in Table 1 for the period 1958–59, the closest point of comparison. This indicates that the relationship between wages and employment during a given period is not influenced by the changes either in wages or employment during an earlier period. Apparently, the OECD investigations gave similar results.[1]

If one moves on to coefficient b, one finds that a clear negative value existed for almost all groups of firms in both calculations. According to the table, the value for industry as a whole, for example, amounted to -0.18. Consequently with an unchanged number of workers, a large wage increase in a firm during a given year should, as a rule, be followed by a more moderate increase during the subsequent year and vice versa. In other words, the wage development in the individual firm has the character of a cycle. One explanation for this is that firms compare their respective wage position with each other and adjust their wage level when it exceeds or is exceeded by the standard prevailing throughout the industry. Moreover, as is shown in another

[1] OECD Report, pp. 106–107.

Table 4. *Regression calculations concerning hourly earnings for the period 1958–59 with lagged effects from 1957–58.*

Manufacturing groups Sizes of enterprises Geographical location	N	$y_0 = ax_0 + by_{-1} + 1$			$y_0 = ax_0 + by_{-1} + cx_{-1} + 1$			
		a S_a	b S_b	h	a S_a	b S_b	c S_c	h
Total manufacturing	2482	−0.00 0.002	−0.18 0.020	5.14	−0.00 0.002	−0.18 0.020	0.00 0.003	5.13
Metal and engineering industry	831	0.00 0.003	−0.29 0.039	5.94	0.00 0.003	−0.29 0.039	0.00 0.007	5.9
Stone quarring industry	272	−0.02 0.014	−0.11 0.071	4.88	−0.01 0.014	−0.10 0.071	0.04 0.019	4.99
Wood industry	299	−0.03 0.015	−0.07 0.055	4.98	−0.03 0.014	−0.04 0.054	0.06 0.015	4.73
Pulp and paper industry	182	0.00 0.004	−0.15 0.052	3.39	0.00 0.004	−0.15 0.052	−0.00 0.003	3.3
Printing and allied industries	109	−0.22 0.058	−0.27 0.087	5.96	−0.21 0.059	−0.28 0.093	−0.03 0.058	6.08
Food and beverage industry	232	−0.07 0.015	−0.11 0.056	5.69	−0.07 0.015	−0.11 0.061	−0.00 0.022	5.71
Textile and ready-made clothing industry	285	−0.13 0.020	−0.15 0.062	4.38	−0.13 0.020	−0.11 0.064	0.05 0.024	4.30
Leather and rubber industry	115	−0.03 0.023	−0.12 0.121	5.10	−0.03 0.024	−0.08 0.132	0.03 0.044	4.94
Chemical industry	157	−0.01 0.014	−0.25 0.073	4.82	−0.01 0.014	−0.24 0.071	0.04 0.012	4.68
Firms with 25– 50 workers	869	−0.08 0.011	−0.20 0.036	5.49	−0.08 0.011	−0.20 0.037	0.01 0.013	5.44
Firms with 51–100 workers	631	−0.09 0.011	−0.26 0.042	6.12	−0.09 0.011	−0.24 0.043	0.03 0.013	5.99
Firms with 101–200 workers	403	−0.04 0.013	−0.06 0.038	4.25	−0.04 0.013	−0.03 0.038	0.05 0.014	4.1
Firms with 201–500 workers	364	0.01 0.003	−0.12 0.043	4.32	0.01 0.003	−0.12 0.044	−0.01 0.007	4.33
Firms with over 500 workers	215	0.01 0.003	−0.23 0.067	4.95	0.01 0.003	−0.23 0.067	0.00 0.002	4.95
Greater Stockholm	238	−0.10 0.021	−0.16 0.075	4.70	−0.10 0.021	−0.12 0.077	0.07 0.029	4.54
Greater Gothenburg	124	−0.11 0.028	−0.23 0.061	5.62	−0.11 0.028	−0.20 0.064	0.04 0.026	5.45
Malmö	80	−0.07 0.030	0.00 0.087	4.18	−0.06 0.030	0.01 0.086	0.05 0.027	4.09
West of the country	2040	−0.00 0.002	−0.19 0.022	5.18	−0.00 0.002	−0.19 0.022	0.00 0.003	5.18

context, the high wage firms as a rule increase their wages proportionately less than the low wage firms.

Finally, from the table it appears that coefficient c, like a, had a value equal to zero for industry as a whole. The change in the number of workers in a firm, thus, should not have any lagged effect on wages. If one breaks down this finding for the different groups of firms however, one finds that the coefficient c, as a rule, displays a more positive tendency than a. This will be expressed most clearly in the case of groups with the larger negative values for a, e.g. firms with less than 200 workers, and firms in large urban areas, in which groups c has a relatively large positive value. Thus, in these groups of firms, an increase in the number of workers should bring about an increase in hourly wage with a certain lag. This lag can probably be explained by the fact that shifts occur in the wage structure of the firm, for example through increasing the piece-work rate, and that these shifts are particularly marked for the firms in question.

In order to give further illumination to the dynamic aspects of the process of wage determination, firms have been divided according to the direction of the change in employment, and the division has been made with respect to both x_0 and x_{-1}. The results of these calculations relating to industry as a whole are presented in Table 5, where N, a, b, c, and h in that order are given on the left and S_a, S_b and S_c on the right in every square. The table has been constructed so that in the bottom square on the right, the same data is given as in Table 4 concerning industry as a whole.

One can see from this table that firms with employment changes in the same direction during both periods have significantly lower negative values for the coefficient b than firms with different changes in direction, namely -0.03 and -0.07 to -0.21 and -0.39. In accordance with this, the wage increase from year to year should vary more greatly in firms which increased and decreased their number of workers during different years than in those firms in which the number of workers changed in the same direction during the whole period. This relationship can clearly be traced back to the fact that firms regulate their work force by employing and laying off the lower wage workers in the first place.

Table 5. *Regression calculations concerning hourly earnings in manufacturing enterprises with increasing and diminishing employment during different periods.*

	$x_{-1} \geqslant 0$		$x_{-1} < 0$		all x_{-1}	
$x_0 \geqslant 0$	708		666		1374	
	−0.05	0.011	0.01	0.003	0.01	0.002
	−0.03	0.043	−0.21	0.036	−0.14	0.028
	0.03	0.009	0.00	0.015	0.01	0.005
	4.26		4.05		4.05	
$x_0 < 0$	504		604		1108	
	−0.04	0.020	−0.01	0.017	−0.01	0.013
	−0.39	0.047	−0.09	0.035	−0.22	0.028
	−0.00	0.004	0.07	0.020	0.00	0.003
	7.01		5.80		6.14	
all x_0	1212		1270		2482	
	−0.04	0.007	0.01	0.003	−0.00	0.002
	−0.19	0.032	−0.15	0.026	−0.18	0.020
	0.00	0.003	0.03	0.012	0.00	0.003
	5.54		4.86		5.13	

Also there were strikingly large differences in the value for the residual factor h between firms which first increased and then decreased their employment and firms whose employment changed in the reverse direction. In the former case, the residual factor amounted to approximately 7 %, while in the latter case it remained at only about 4 %. This, however, only serves to emphasize the idea that the low wage workers constitute the most mobile part of the firms work force.

Concerning coefficients a and c, however, the division of the firms with respect to x_0 and x_{-1} according to the table indicate no large changes. One might have expected at least that employment changes which extended over more than one period would probably have effected an increase of the hourly wage. From the table, however, it appears that the coefficient a never assumed a positive value with such a change in employment. Indeed, a negative tendency was more noticeable in that case. The fact that a continues to hover around zero in this way is related to the phenomenon that the relationship between wages and employment is weak not only when employment is changed temporarily but also at more permanent changes.

7. Summary and Conclusions

According to this investigation, the relationship between wages and employment in a firm can be identified as the supply function for labour facing the individual firm. Purely theoretically, one could expect, given a homogeneous work force, that this relationship is positive, so that the hourly wage in the firm increases with an increase in employment. In the present study, however, this relationship has shown itself to be extremely weak with respect to manufacturing industry as a whole. Indeed certain groups of firms, for example, smaller firms and firms within urban areas, displayed a negative relation.

Dividing the firms with respect to the direction of the change in employment it was found that the wage increase as a rule was larger in firms with a reduced number of workers than in firms with an increased number of workers. This indicates that, with an increase in the number of workers, firms will first hire low wage workers and with a decrease tend to lay-off the same type of workers first. Consequently, the weak relation between wages and employment can be explained by the fact that the wage structure of the firm changes simultaneously with changes in employment.

Clearly, this investigation allows the conclusion to be drawn that the average wage in the firm need not be increased in order to bring about a reallocation of labour between firms. A firm has the possibility of attracting employees without creating larger wage differences between it and other firms, by changing the share of low wage employees with a change in employment. When the share of low wage workers shifts in the same direction as employment, wage drift can rise in a recession and decline in an upswing. A study of the size of wage drift during the periods of observation shows that this was empirically true.

Since this observed relation between wages and employment covers the entire work force of the firm, it is affected by the fact that the work force is heterogeneous in its composition. Consequently, there is nothing in this investigation that precludes the possibility that a clear positive relation could be obtained were the composition of the

groups of workers homogeneous. An attempt has been made to minimize the significance of heterogeneity by taking into consideration shifts between hourly and piece work wage earners, but no change occurs in the relationship. This shows that one must have access to individual statistics in order to eliminate the effects of heterogeneity entirely.

Finally, from the dynamic viewpoint, it appears that the relationship between wages and employment was independent of earlier changes in wages as well as employment. However, with respect to the size of the wage increases, a certain relationship could be found between different periods. Thus, a large wage increase in a firm during a certain year is followed, as a rule, by a lesser increase in the succeeding year and vice versa. This means that one cannot solve the problem of wage drift by raising contractual wages for different firms during a given year in inverse relation to the actual wage increase during the previous year. Such an approach—one which has occasionally been discussed—would clearly only aggravate the problem. However, since the length of the period is vital in this connection, the problem could possibly be solved by the above approach, if the intervals between the negotiated wage changes were less than a year.