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MICRO AND MACRO LEVEL WAGE RIGIDITY: LESSONS FROM FINLAND*

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The paper explores wage flexibility in Finland. The study covers the private sector workers by using three data sets from the payroll records of employers' associations. The data span the period 1985–2001. The results reveal that there has been macroeconomic flexibility in the labour market. Average real wages declined during the depression of the early 1990s and a large proportion of workers experienced real wage cuts. However, the evidence based on individual-level wage change distributions shows that real wages, especially, are rigid downwards. In particular, during the late 1990s, individual-level wage changes regained the high levels of real rigidity that prevailed in the 1980s, despite the continued high (but declining) level of unemployment. (JEL J30, J33)

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1. Introduction

This paper evaluates wage adjustment in Finland by using data from the payroll records of employers' associations. The Finnish case provides a particularly interesting environment in which to examine the wage flexibility for three reasons. First, there was an unprecedented collapse in aggregate economic activity during the early 1990s. Output fell by 14 % in the years 1990–1993. The unemployment rate increased in three years (1991–1993) to almost 20 % from an average of around 5 % during the 1980s. Thus, Finland suffered its worst depression of the twentieth century not in the 1930s but in the early 1990s (e.g. Honkapohja and Koskela, 1999; Böckerman and Kiander, 2002; Koskela and Uusitalo, 2006; Gorodnichenko *et al.* 2009). It is possible that this shock to unemployment caused changes in the way labour markets work and affected the strictness of constraints to the downward rigidity of wages.

Second, Finland has been a high-inflation country, where the rapid rate of inflation was compensated for by the frequent devaluations of currency to regain competitiveness in export sectors. This traditional pattern of macro-level adjustment changed when the Bank of Finland adopted inflation targeting after the depression of the early 1990s and the country joined the third stage of the Economic and Monetary Union in 1999. In February 1993 the Bank of Finland adopted a target rate of 2 % per annum for the core inflation rate to be attained by 1995. The target was low, given the inflation history of the previous three decades. The average inflation in Finland was 4.9 % during the 1960s, 11.4 % during the 1970s, and 6.8 % during the 1980s. Disinflation provides an interesting setting, because Nickell and Quintini (2003) argue that low inflation, together with downward nominal rigidity, prevents the downward adjustment in real wages.

Third, the structure of wage bargaining involves a high degree of co-ordination between both unions and employers, with a framework agreement being determined centrally on a one- or two-year basis, followed by union-level bargains (e.g. Vartiainen, 1998; Asplund, 2007). Hence, collective bargaining dominates wage formation and the coverage of collective bargains is roughly 95 % of all workers, one of the highest rates in the OECD (e.g. Layard and Nickell, 1999). As one outcome of the binding collective agreements, wage compression is high. Despite discussions and pressures for changes in the institutions, the wage-setting practices can be described as stable over the period of analysis (1985–2001).[1]

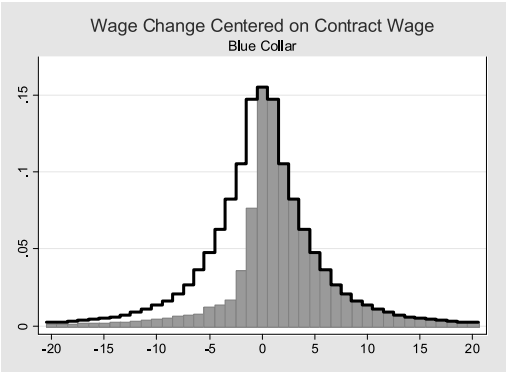
The article is structured as follows. Section 2 provides descriptive evidence on wage change distributions. Section 3 reports results on the incidence of wage cuts. Section 4 analyses the micro-level rigidity of wages using specific measures for downward nominal and real wage rigidity. Downward nominal wage rigidity prevails when some workers obtain a zero nominal wage change due to nominal wage rigidity when they would suffer a nominal wage cut in the absence of nominal wage rigidity. Downward real wage rigidity means that workers who would receive wage increases below expected inflation without rigidity obtain wage increases equal to expected inflation due to rigidity. Section 5 focuses on the consequences of wage rigidity for macro-economic adjustment, especially unemployment. The last section concludes.

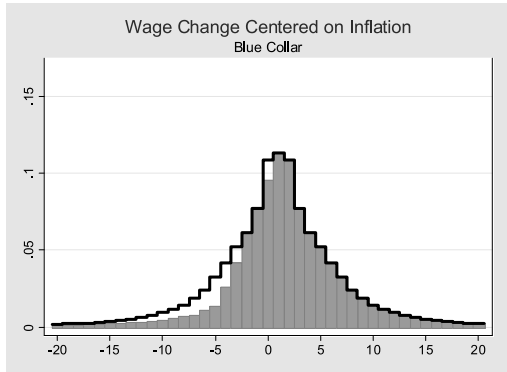
2. Wage changes

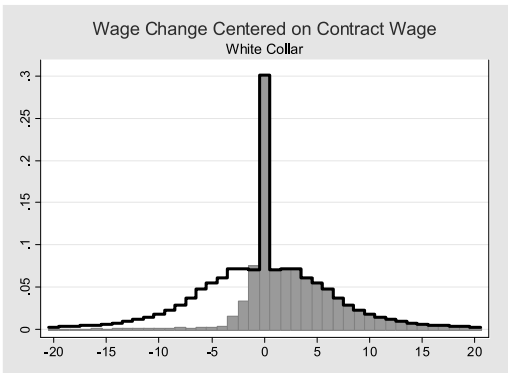
We use three separate data sets for the private sector workers obtained from the payroll records of employers' associations for the period 1985–2001.[2] The observed wage change distributions are presented in Figures 1–6. The annual distributions are first centred around the contract wage change or actual inflation each year and then averaged over the years. The figures also include a symmetrical distribution around the median bin of the averaged distribution. For the contract wage this median bin is always the zero

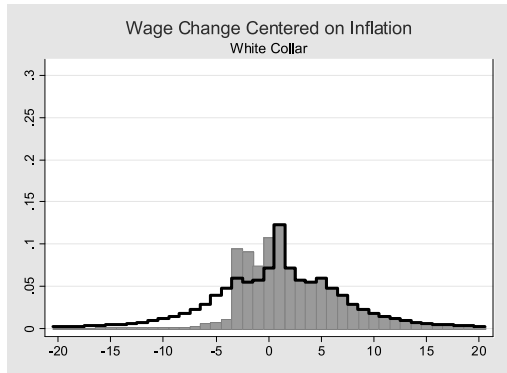
[1] *The centralized framework was abandoned only during the 2008–2009 wage negotiations. Employers' associations repealed their central organization's right to agree upon wage contracts with a corresponding workers' organization.*

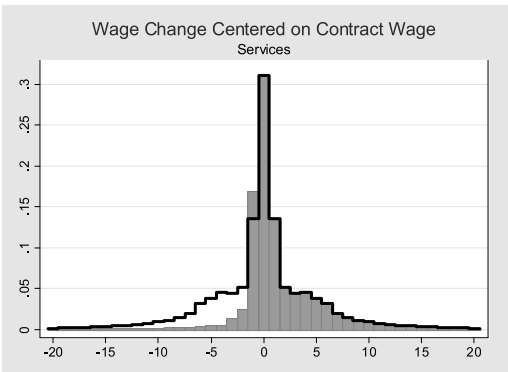
[2] *Appendix 1 provides a description of the data sources. Uusitalo and Vartiainen (2008) examine the changes in wage structure in Finland by using the same data.*

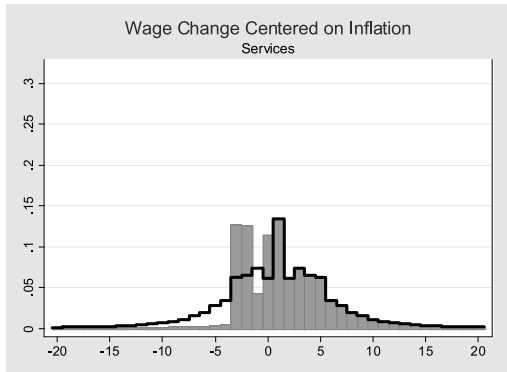












Figures 1–6. Wage change distributions

bin. For inflation the median bin is 1 percentage point above the bin including the inflation rate, reflecting real wage growth for median worker. The contract wage increases are the percentage wage changes implied by the contracts signed in each bargaining round as reported in Marjanen (2002) and they can be different for the three sectors.

There is a peak in all sectors in the distribution at the level of the nominal wage increase stipulated in the collective agreements. The share of observations below the contract wage rise is substantially less than in a symmetric distribution. Hence, there is a cut-off in the distribution at the contract wage rise or just below it, and missing mass below that point. Compared with a similar distribution centred on inflation it is obvious that the contract wage rise determines the concentration of observations more than inflation. For the inflation-centred distribution the median bin is above the inflation bin, and there are excess observations several percentage points below the inflation rate (for blue-collar workers this excess is smaller). Thus, the shape of the wage change distribution mainly depends on the general wage increase that is agreed upon in the collective agreements, and it might be dubbed as contract wage rigidity. Alternatively, these features indicate that the centralized bargaining institutions are the means that effectively produce real wage rigidity in wage setting. These same institutions may, however, also be the means to secure concerted macro-level wage moderation during the recession, as discussed below.

There is not much evidence for nominal wage rigidity in annual distributions, since there are no spikes at the *zero* wage change for manual workers, and only very small spikes for non-manual and service sector workers.[3] However, during the depression years of 1992 and 1993 there was a wage 'freeze' due to a centrally bargained extension of the previously prevailing contracts. This centralized wage freeze created a large increase in zero nominal wage changes in those years (which was more prominent for non-manual manufacturing workers and service sector workers; for the service sector this freeze also continued to 1994). The distributions for the non-manual manufacturing and service sector workers are highly asymmetric below the zero nominal wage change, and suggests the presence of downward nominal wage rigidity. However, this lack of nominal wage cuts can also be induced by real rigidity. The small zero spikes suggest that this is most likely the case.

There have been four industry-based contracts during the data period (in 1988, 1994, 1995 and 2000). The distributions in these years have not been very different from the histograms in the surrounding years with centralized contracts, but there is some tendency that the support of the mode of wage changes is wider. This is consistent with somewhat more variation across industries in the 'average' wage change in the years of industry-level contracts. For both manual and non-manual manufacturing workers it is notable that after the depression the distributions are different from those before the depression in the sense that the distributions have become more concentrated during the late 1990s. The reason is that the Income Policy Agreements were more comprehensive during the late 1990s as a consequence of macroeconomic difficulties, which has led to the compression of wage changes around the level of centralized agreements.

Along with the general rise, the collective agreements also include low-wage or female allowances with the purpose of increasing the wages for some groups more than according to the general rise. In addition, a mixed pay rise formula (X % or Y euros at minimum) is often applied, which produces wage compression. To examine the solidarity aspects, we regressed the annual wage changes at the individual level in the current year to the wage levels of two years earlier, because measurement error would produce a negative effect when one used the wage levels of one year earlier. We include a full set of year and industry indicators to focus on wage compression across individuals within industries. There is evidence of a negative relationship that supports the prevalence of solidaristic wage setting in all sectors (Table 1). Hence, low-wage workers tend to get higher wage rises within industries. For example, for manual manufacturing workers the results imply that about 0.6 % of the gap between the median and the first quartile of

3 Böckerman et al. (2006) document the annual distributions.

Table 1. Sensitivity of wage changes to the lagged wage level

Dependent variable: Log wage change (*t*)	Manual manufacturing	Non-manual manufacturing	Service sector workers
Log wage level (*t*-2)	-0.044***	-0.008***	-0.037***
t-value	(-94.02)	(-44.59)	(-71.46)
N	815 976	877 749	1 162 380

Notes: t-values in parentheses. Significance indicated by *** (1 %), ** (5 %), * (10 %). All models include a full set of unreported indicators for industries and years.

the wage distribution (approximately 13 log-%) is closed within one year. The effect is much smaller for the non-manual manufacturing workers, because individual-level wage bargaining is more important among them. It is also possible that the average wage level of non-manuals is so high that the solidarity aspects do not cover them. It is likely that wage compression biases real rigidity measures downwards, because some individuals are raised above the real rigidity zone, rather than to the zone, in the wage change distribution.

The median wage change has been strongly pro-cyclical in all sectors, and the development of the medians over time strongly reflects the evolution of inflation (Figure 7). Fluctuations in the medians have also been, in other respects, largely similar across sectors. This is not a great surprise, because the period is dominated by collective agreements that have produced fairly similar real wage rises across sectors, based on the average rate of productivity growth in the economy. This is often referred to as the "wage norm". The median worker experienced real wage declines during the early 1990s. This contributed to a decline in the labour share of the total income (e.g. Sauramo, 2004; Kyyrä and Maliranta, 2008). The median worker's real

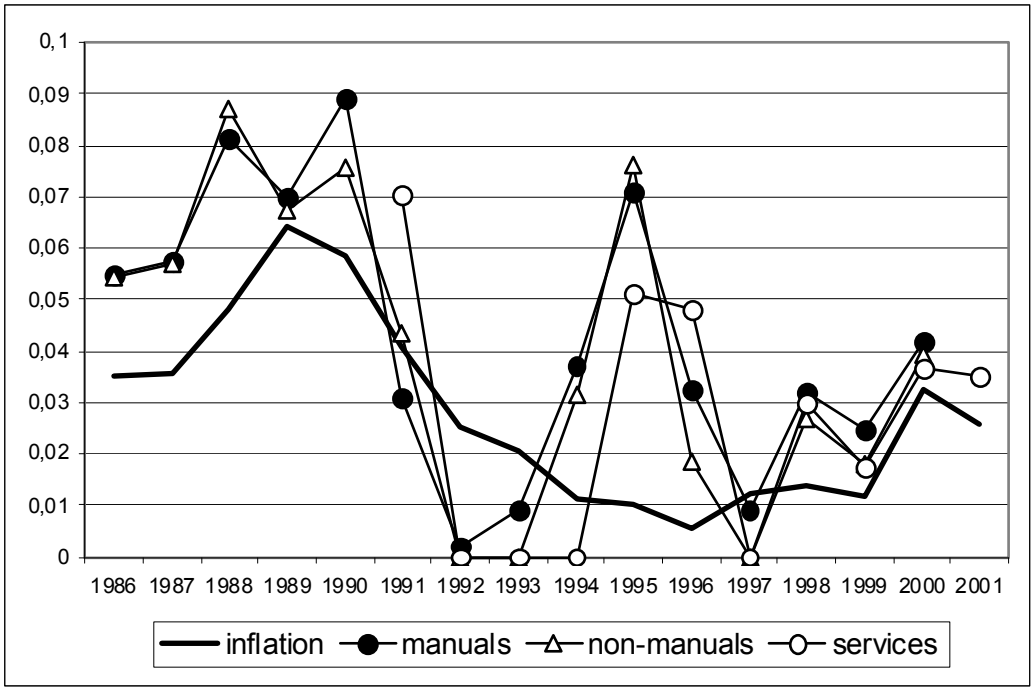


Figure 7. Actual inflation and the median nominal wage change by sector

wage increases were also smaller in the late 1990s compared with the late 1980s, which reflected the macroeconomic difficulties of the 1990s.

3. Wage cuts

It is a general presumption that centralized collective bargaining leads to compression in both wage levels and wage changes. There is evidence for this in Finland, but there is still considerable heterogeneity in wage changes. One indication of this is the existence of nominal wage cuts and the differences in their incidence across sectors. For non-manual workers in manufacturing and for the service sector workers, nominal wage cuts are rather rare, in spite of the depression, with an annual incidence of nominal wage cuts in the range from 1 to 5 per cent (Table 2). In contrast, nominal wage cuts are much more frequent for manual workers in the manufacturing sector, the incidence reaching 36 per cent in 1991–1992, and above 20 per cent in 1992–1993 and 1996–1997. The main reason for the difference in the amount of nominal wage cuts among manual manufacturing workers vs. service sector workers is probably that in the manufacturing sector wages include more personal and firm level merit wages than in the private service sector where the actual wages are much closer to the binding minimum contract wages (see Böckerman and Uusitalo, 2009, for a service sector). There is also evidence that during the depression years downward wage adjustment started earlier for manual workers and continued longer in the service sector compared with non-manual workers.

The share of workers experiencing real wage cuts behaves remarkably similarly across sectors, being very high (60–80 %) in 1991–1993. This pattern emerges from a large number of nominal wage increases that lie between zero and the inflation rate. This holds especially for the non-manual and service sector workers, which explains the larger difference between the shares of real and nominal wage declines for these groups. Nominal wage moderation with the positive inflation rate during the depression made it possible to implement real wage cuts for a large share of workers without implementing aggregate nominal wage cuts by means of the

Table 2. The share of workers who have experienced negative wage changes

	Nominal wage			**Real Wage**		
	Manufacturing Manual workers	Manufacturing Non-manual workers	Services	Manufacturing Manual workers	Manufacturing Non-manual workers	Services
	Hourly pay	Monthly pay	Monthly pay	Hourly pay	Monthly pay	Monthly pay
1990-1991	16.9	2.0	2.4	60.1	47.8	20.8
1991-1992	36.4	2.7	5.4	69.5	87.2	81.5
1992-1993	20.6	5.4	3.9	57.8	74.4	83.1
1993-1994	8.4	1.4	4.7	11.8	14.5	69.8
1994-1995	5.0	1.2	2.7	6.5	2.3	4.2
1995-1996	10.4	3.3	2.8	12.3	4.8	4.0
1996-1997	23.3	2.7	4.8	48.2	61.3	74.3
1997-1998	11.4	1.3	3.4	18.7	6.4	5.7
1998-1999	11.4	3.5	3.9	17.5	7.6	6.1
1999-2000	6.8	1.6	3.4	33.7	34.9	38.6

Notes: Real wage change is based on actual inflation measured as the annual change in the cost-of-living index by Statistics Finland.

[4] *There was an attempt by the social partners to cut nominal labour costs by 7 % in 1991 in order to avoid currency depreciation. (The proposition to cut labour costs by 7 % included a 3 % cut in nominal wages and a 4 % transfer of pension contributions from employers to workers.) However, this attempt failed because two major unions delayed their support for the pact and the financial markets forced the Bank of Finland to abandon the fixed exchange rate in November 1991. After that episode the labour market organizations did not accept any cuts in nominal wages, but agreed, for the first time since the Second World War, to a two-year social pact without any nominal pay rises.*

collective agreements. Hence, centralized bargaining allowed for at least some downward adjustment of real wages.[4] The brief economic slowdown that started in 1996 provides corroborating evidence for this. The bargaining system responded to this slowdown by postponing wage rises in 1997, which is shown in the substantial number of real wage cuts from 1996 to 1997.

The estimates from probit models can be used to evaluate the factors that have contributed to wage cuts. The models reported in detail in Böckerman *et al.* (2007) include individual characteristics (such as gender, age and working hours) and employer characteristics (such as plant size and industry) as explanatory variables for the probability of the individual worker experiencing a wage cut. The results show that full-time workers have a lower likelihood of nominal and real wage decline. The service sector workers who work less than 30 hours weekly are around 4 per cent more likely to experience a nominal wage cut. The effect is even larger for real wage reductions, which are around 9 per cent more likely for part-time workers compared with full-time workers. These effects are in the range of 1–3 per cent for manuals and non-manuals in manufacturing. The pattern is consistent with the efficiency-wage explanation and the fairness standards as an obstacle to wage cuts (Bewley, 2007). Full-time workers are more important for the productivity of a firm compared with part-time workers and hence they have a stronger bargaining position to prevent a wage cut, and firms are more afraid of a reduction in their productivity. Fairness standards can also be tighter for full-time insiders because of stronger attachment to the firm.

Wage cuts are also more common in small plants. Depending on the sector, real wage cuts are around 5–8 per cent more likely in small firms compared with large firms. For nominal wage cuts this firm size effect is about 1–5 per cent. This result is in disagreement with fairness as an obstacle to wage cuts. Fairness standards should be stricter in small plants, because there are more repeated personal interactions between the employer and the workers. However, it is possible that the effective bargaining power of unions is weaker in small plants. Thus, unions are less able to resist wage cuts in small plants that concern firm-specific wage components that do not compromise the minimum standards stipulated in the collective agreements. More wage cuts in small firms would also be consistent with some type of gift exchange between the employer and workers. For example, workers are more willing to accept wage cuts in exchange for less layoffs in downturns. This type of "implicit agreement" may be easier to accomplish and monitor in small firms.

4. Micro-level rigidity

We use the protocol developed in the International Wage Flexibility Project (IWFP) to measure nominal and real rigidities in individual-level wage changes (see Appendix 2, for a brief description). The model assumes that, in the absence of rigidity, log wage changes have a symmetric two-sided Weibull distribution, which is referred to as the notional wage change distribution. Therefore, all deviations from the symmetry are caused by nominal and real wage rigidities. The rigidity measures are proportions of workers who are actually subject to a particular type of rigidity of those workers who are potentially subject to the rigidity considered. A fraction of the population is subject to *downward real wage rigidity*, if their notional wage change is below the expected rate of inflation, and they receive a wage change equal to that expected rate of inflation rather than equal to their notional wage change. Because inflation expectations vary across population, the mean and standard deviations of the expected rate of inflation in each year are also parameters that are estimated separately for each year by the protocol. A fraction of the population is also potentially subject to *downward nominal wage rigidity*. Such workers who have a notional wage change less than zero and who are not subject to downward real wage rigidity, but who receive a wage freeze instead of a nominal wage cut, are affected by downward nominal rigidity. Nominal wage rigidity measures the fraction of workers who are not affected by downward real wage rigidity, but who are affected by downward nominal wage rigidity. The measures for wage rigidities vary between 0 and 1. A value of 0 indi-

cates perfect flexibility (no one is subject to rigidity) and 1 indicates perfect rigidity (all workers potentially subject to rigidity are affected by it).

We describe the results for rigidities as average values over several years, because there have been substantial fluctuations in the measures from year to year. One reason for the fluctuations is that it may be difficult to distinguish the effect of real wage rigidity from the effects of collective bargaining on wage determination. Centralized wage bargains set a floor for wage changes while allowing decentralized firm-level changes above the floor, often called "wage drift". The spike will then reflect the negotiated minimum real wage change rather than only the expected rate of inflation. The protocol restricts the expected rate of inflation to fall within reasonable bounds. Then owing to wage drift, it is possible to estimate considerable real wage rigidity in years when the floor falls within a preset range for expected inflation, but not in years when the floor is above that range. Another reason is that it may be difficult to separate nominal and real wage rigidity from each other during the years of very low inflation, i.e. during most of the late 1990s. However, this distinction is less relevant when inflation is very low, because the effects of nominal and real rigidities on wages are essentially the same.

We use three periods: the late 1980s (1986–1990), the depression years of the early 1990s (1991–1993/1992–1994), and the late 1990s (1994–2000/1995–2001). The results show that the amount of nominal rigidity has been quite low in all sectors, but it rose considerably during the depression (Table 3, Panel A). This reflects the nominal wage freeze implemented by the collective agreements during the depression. The level of nominal rigidities was highest in the service sector, and lowest in the manual manufacturing sector. In contrast, the averages reveal that the extent of real rigidities in wage changes has been smallest during the depression (Table 3, Panel B). The level of real rigidities was lowest in manual manufacturing and service sectors during this period. Real rigidities have been highest for non-manual manufacturing workers in the late 1980s and the late 1990s. It is also notable that in the late 1990s the level of real rigidity has increased back to the levels of the late 1980s, despite a much higher level of unemployment during the late 1990s. On the other hand, this pattern over time in real rigidity and unemployment makes it difficult to argue that real wage rigidities are the direct cause of unemployment.

All in all, there has been a great deal of either real or nominal rigidities in all sectors in most years. However, the constraint of real rigidity on wage determination was relaxed during the depression. On the other hand, nominal rigidity increased and therefore formed the ultimate limit to downward wage flexibility.

Table 3. The amount of nominal and real wage rigidities (averages over several years)

Panel A. Nominal wage rigidities			
	Manual manufacturing	Non-manual Manufacturing	Services
The late 1980s	0.00	0.29	..
The depression of the early 1990s	0.44	0.69	0.98
The late 1990s	0.06	0.31	0.25
Panel B. Real wage rigidities			
	Manual manufacturing	Non-manual Manufacturing	Services
The late 1980s	0.29	0.73	..
The depression of the early 1990s	0.04	0.23	0.00
The late 1990s	0.60	0.70	0.47

Notes: The late 1980s are 1986–1990, the depression years are 1992–1994 for services and 1991–1993 for other sectors. The late 1990s are the years 1994–2000 (1995–2001 for services). The estimates are calculated by using the protocol by Dickens *et al.* (2006). Rigidity measures are missing for the service sector because the data for the service sector is available only for the period 1991–2001.

Table 4. Nickell and Quintini type regressions for the manufacturing manual workers

Dependent variable: The share of negative real wage changes		
Median of real wage change	-5.42**	-4.36**
	(-4.26)	(-3.86)
Dispersion of real wage changes (P75–P35)	-0.96	1.39
	(-0.22)	(0.38)
Inflation rate	1.49	1.61*
	(1.54)	(2.01)
Change in inflation rate	-1.55	-0.43
	(-1.15)	(-0.36)
Dummy for the recession years (1991–1993)	..	0.13**
		(2.70)
N	19	19
Adjusted R^2	0.80	0.86

Notes: t-values in parentheses. Significance indicated by ** (5 %), * (10 %).

5. Macro-level flexibility

To explore the real consequences of downward nominal wage rigidity and inflation Nickell and Quintini (2003) regress the share of negative real wage change on the inflation rate. The control variables, that affect the proportion of real wage reductions in the absence of nominal rigidity at zero, include the median of real wage changes and the dispersion of real wage changes. Median real wage change measures the position of the distribution and is expected to reduce negative real wage changes. It should be close to the labour productivity growth rate, and thereby related to expected real wage growth. Higher dispersion of wage changes is expected to increase the proportion of negative wage changes. Finally, change in inflation is added to control for possible effects from surprise inflation on proportion of negative wage changes to the extent that surprise effects are different in different parts of the wage distribution. Nickell and Quintini (2003) show by using the UK New Earnings Survey over the period 1976–1999 that an increase in the rate of inflation produces an increase in the share of workers who experience negative real wage change, controlling the median, dispersion and surprise inflation effects. This result implies that downward nominal rigidity and low inflation together prevent the downward adjustment in real wages.

We estimate Nickell and Quintini type regressions for manual manufacturing workers.[5] The baseline model shows that the rate of inflation is not statistically significant in explaining the share of workers who have experienced negative real wage changes (Table 4, Column 1). This is not surprising, because the share of negative real wage changes was particularly high in manufacturing during the depression when inflation was declining (Table 2). Hence, the result could be an anomaly related to the depression and associated disinflation. When we include an indicator for the years 1991–1993 the relationship between inflation and the share of workers who experience negative real wage changes is positive and statistically significant at the 10 % level (Table 4, Column 2). The quantitative magnitude of the impact is about twice as large as the one reported by Nickell and Quintini (2003) for the UK. This magnitude may still be too modest to provide an argument for raising the long-run inflation target, but it suggests that the lower inflation (target) together with downward nominal wage rigidity has created some real wage rigidity during normal years. However, during the severe recession years this mechanism was not fully in effect, and there was more real wage reductions than usual.

We also estimate simple Phillips curves or wage equations to learn about the macroeconomic flexibility of wage setting (e.g. Pehkonen, 1999, provides earlier estimates for Finland). That is, we regress the average changes in nominal wages on unemployment, productivity

[5] *We use the data for manual manufacturing workers, because the data are available for a longer period (1981–2000) only in this sector, which is necessary to have enough variation in inflation.*

Table 5. Sensitivity of wage changes to unemployment

	Observed mean	**Estimated mean**
Unemployment (t)	-0.440**	-0.426**
	(-5.33)	(-4.24)
Productivity growth (t-1)	0.485**	0.503**
	(4.11)	(3.50)
Expected inflation (t)	-0.144	-0.222
	(-0.60)	(-0.76)
Industry-level bargain	0.018**	0.020**
	(3.35)	(2.96)
N	41	41
Adjusted R^2	0.75	0.67

Notes: Unreported indicators for the sectors and a constant are included. t-values in parentheses. Significance indicated by *** (1 %), ** (5 %), * (10 %). The estimated mean and expected inflation are calculated by using the IWFP protocol of Dickens *et al.* (2006, 2007).

growth and expected inflation. In particular, we use these regressions to evaluate the idea that downward rigidity of wages makes the adjustment of wages to economic conditions less flexible. Since downward wage rigidities mean that wage change distributions become asymmetric by shifting the negative nominal and real wage changes upward in the distribution, it means that the average wage change is higher with rigidities than without them. If the average wage change responds negatively to unemployment, the wage changes will become more constrained from below by rigidities when unemployment is higher. This implies that the response of the average wage change to unemployment is smaller than without rigidities. We explore this effect by using the mean wage change from the estimated notional wage change distribution as the dependent variable in addition to the observed mean wage change. As noted earlier, the notional wage change distribution is a counterfactual distribution that would appear in the absence of rigidities for wage changes. It is symmetric around the mean change. If downward rigidities in wages prevent the adjustment of wages to economic conditions, the unemployment coefficient should be larger (in absolute value) in a regression for the estimated mean of notional wage change distribution, compared with the coefficient for the observed mean. The estimated mean of notional wage changes and expected inflation originate from the protocol of IWFP.

We report the results from the data in which we have pooled all sectors in Table 5. The lagged productivity growth is more significant than the current one, so we use it. The past observed productivity growth is probably taken into account in wage negotiations rather than the expected productivity growth during the contract period. For the service sector productivity growth is lagged two years, as it seemed to work best. This indicates that the wage setting in services follows that of the manufacturing sector's by a one-year lag. The most important finding is that a significant negative relationship between wage growth and unemployment emerges. The effect of unemployment on the observed mean wage change is -0.4 in Column 1. The estimate is very close to what has been reported for Finland earlier (Uusitalo, 2005). We also find that the effect of unemployment on the estimated mean wage change in Column 2 is almost the same as that of the observed mean wage change. This is in contrast to the idea that the responsiveness of wages to unemployment is prohibited by downward wage rigidities. The observed wage changes seem to adjust to unemployment in the same way as the notional wage changes that are not affected by rigidities.[6] Productivity growth affects wage changes positively, with a coefficient of 0.5 in both of the models. The industry-level bargains increase wage growth by 2 percentage points compared with years with centralized bargains, a result consistent with the earlier evidence (Uusitalo, 2005).

[6] *We have also estimated all models with observed median wage change. The results are very close to those with observed mean.*

The measures for wage sweep-up capture the extra amount of wage growth that arises because of downward wage rigidity. They can be included as additional variables in explaining unemployment to learn about the consequences of micro-level rigidities (see Dickens *et al.* 2006, 2007). The average wage sweep-up can be interpreted as the increase in average labour costs due to downward wage rigidity. If firms are sensitive to unit labour costs, then a higher average wage sweep-up should be associated with lower employment or higher unemployment, as predicted by the model of Akerlof *et al.* (1996). In our baseline estimations that pool all sectors, sweep-up due to nominal rigidity obtains the expected positive coefficient but sweep-up due to real rigidity obtains a negative coefficient (Table 6, Columns 1–2). However, the time pattern of sweep-up measures shows that their behaviour is related to the changes during the early 1990s. The sweep-up measures seem to reflect the reaction of collective bargaining to the changes in unemployment rather than the effects of rigidities on unemployment. A nominal wage freeze emerged as a reaction to the increase in unemployment in the early 1990s. This led to higher nominal sweep-up but to lower real sweep-up as real wage rigidities were relaxed. Consistent with this interpretation, the amount of real wage sweep-up gradually increased during the late 1990s as unemployment gradually decreased. After adding indicators for the wage freeze years, all the statistically significant results regarding the sweep-up measures disappear (Table 6, Columns 4–6). This confirms that the significance is driven by the depression years. (The results using the sweep-up measures that are based on different assumptions about the expected value and the variance of inflation produce similar findings.)

Taken together, we do not find any evidence that the notional mean wage change is more sensitive to unemployment than the observed mean wage change. Furthermore, the extra wage growth due to wage rigidities is not correlated with any extra unemployment. These results indicate that, although the measured micro-level real rigidity is high, it does not notably undermine the adjustment of average wage changes to economic conditions, and does not create additional unemployment.

Table 6. Sensitivity of unemployment to sweep-up due to nominal and real wage rigidity

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Inflation	-2.20***	-2.29***	-2.34***	-2.14***	-2.16***	-2.24***
Wage freeze indicators	..	..	..	0.03**	0.02*	0.03***
S-up-N	0.72*			-0.26		
S-up-R		-0.91**			-0.18	
Sum			-0.33			-0.90
N	41	41	41	41	41	41
Adjusted R^2	0.75	0.76	0.72	0.77	0.77	0.78
Overall R^2	0.79	0.80	0.76	0.81	0.81	0.82

Notes: S-up-N is the magnitude of sweep-up due to nominal rigidity computed as -nx(average notional wage change for those with notional wage changes less than or equal to zero)x(fraction with notional wage changes less than or equal to zero). S-up-R is the magnitude of sweep-up due to real wage rigidity assuming that the median of the observed wage change distribution is equal to the mean of the notional wage change distribution, and that the mean of the true wage change distribution is equal to the mean of the observed wage change distribution. It is computed as (mean wage change - median wage change - nominal sweep-up). Sum is the sum of S-up-N and S-up-R. The estimates for the amount of sweep-up are calculated by using the protocol by Dickens *et al.* (2006). Wage freeze indicators in models 4–6 obtain value one for the years 1992, 1993 and 1997 in manufacturing and for the years 1993, 1994 and 1997 in services. Unreported indicators for the sectors and a constant are included. Significance indicated by *** (1 %), ** (5 %), * (10 %).

6. Conclusions

This paper studied the micro- and macro-flexibility of wages in Finland. We covered the private sector workers by using three data sets from the payroll records of employers' associations. Two main conclusions emerge. First, there has been macroeconomic flexibility in the labour market. This means that average wage changes negatively respond to an increase in unemployment and the downward real rigidity measure declined during the worst years of the depression of the early 1990s. Consistent with this, a large number of workers experienced a decline in their real wage as unemployment soared. This was put into effect by wage moderation through collective agreements. However, nominal wage rigidity increased during the depression and formed the ultimate limit to downward wage flexibility. Accordingly, we found that lower inflation exacerbates the real consequences of downward nominal wage rigidity. Second, the evidence based on individual-level wage change distributions reveals that real wages are, in general, very rigid. Because of the dominance of collective bargaining, the contract wage rise constitutes a clear cut-off in the distributions. Hence, it is difficult to separate real wage rigidity from contract wage rigidity. Alternatively, this indicates that the centralized bargaining institutions are the means that effectively produce real wage rigidity. However, the same institutions have allowed for average wage changes to respond to economic conditions, for example, during the 1990's recession. Our results indicate that in normal years unions prevent real wages from falling but they can be accepted during recessions. While nominal wage cuts are resisted even during recessions. It is important to note that wages can be flexible at the macro level, but rigid at the individual level if average wage changes respond to changes in unemployment, but the individual wage change distributions are still highly asymmetric. This is indeed the pattern that we observe. The evidence also points out that individual-level wage changes have regained the high levels of real rigidity during the late 1990s that prevailed in the 1980s, despite the continued high (but declining) level of unemployment.

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Appendix 1. Data description

We use 'wage surveys' of two Finnish employers' associations. Manual (hourly paid) blue-collar workers and non-manual (salaried, monthly paid) white-collar workers of the manufacturing sector are covered by TT (*Teollisuus ja työnantajat*). The private service sector workers are covered by a survey carried out by PT (*Palvelutyönantajat*). Wage information in these surveys directly originates from companies' payroll records. Thus, they can be characterised as administrative or register-based data. These data are very accurate, and the measurement error in surveys of individual workers, like recall or rounding error, is not a significant problem.

The survey frame of the data consists of the member firms of both associations in each reference period. Although the survey is mandatory for firms with over 30 workers (the limit varies somewhat by industry), some non-response will occur. This is concentrated on smaller firms that are also less often members of the associations. The coverage of the TT data is better than that of PT, since service firms are smaller on average. To identify employers in TT data there are firm codes and 'response-unit' codes. There has been a break in the firm coding system during our observation period, but the response unit codes are consistent over time. Thus, we use those to identify the employer of individuals. The response-unit refers to the establishment of a firm. In the service sector only the firm code exists in the data, so we use it.

The data are well representative at the worker level, since the TT/PT firms have good electronic systems for collecting wage data. There are some missing or erroneous identity codes. Those individuals are excluded from wage changes. However, since the early 1980s these problems have been very rare.

The structure of these data is quite similar across sectors. They provide information about wages and working time, and some information about workers' individual characteristics (such as age and gender). However, there are two major differences in these data sets across the sectors: the timing of observations and the wage concept. For manual manufacturing workers the data covers the situation during the last quarter of each year for the period 1981–2000, but the situation during one month of each year for non-manual (salaried) manufacturing workers (September before 1993 and December in and after 1993) for the period 1985–2000 and the private service sector workers (August before 1995 and October in and after 1995) for the period 1990–2001. This change-over causes no major problems because the observation month is delayed and there is a point of normal contractual wage increase between the two observations (or, otherwise, we might overestimate downward rigidity). We might underestimate the rigidity by lengthening the observation interval if more than the usual one or two annual contract wage rises fell during the interval. However, this is not the case for either sector. The observation interval changes only by two or three months, so the change-over years should be comparable to other years.

The wage concept differs across sectors. *Hourly rate* has been applied for manual workers in manufacturing, whereas *monthly rate* (salary) for non-manual workers in manufacturing and for service sector workers. The monthly rate for non-manual workers in manufacturing is defined as *'the fixed basic monthly salary paid for regular working time'*. This fixed salary is based on the 'demands' of the job or tasks performed in it and the contract-based wages determined for these 'demand classes' of jobs, and an additional person-specific component based on personal competence. Respectively, in services the monthly rate is defined as the *'personal wages paid for regular working time'*, which is very close to the former definition. It includes such *personal and 'task' specific bonuses* (merit pay), which are paid at the *same amount in each month*. These monthly wages exclude such components of wages, which are inherently changing or are not part of a person's 'basic wage'. Among those excluded are overtime pay, shift work, evening or Sunday bonuses, fringe benefits, and performance-based payments, commissions, 'profit sharing' and similar payments. It should be noted that the monthly wage is not simply a 'minimum' salary based on contracted wage scales, but includes a person-specific component. Firms and local unions can also

agree on firm-specific wages that exceed the minimum requirements of national contracts. Such firm-specific arrangements can be reduced by the mutual consent of the firm and local union. These person- and firm-specific components in wages provide opportunities for both upward and downward flexibility in wages.

For measuring the hourly rate for manufacturing manual workers there are two options: the wage per hour for regular working time, or the wage per hour for straight time work (time-rate). We use the time-rate, because it is a better measure of the person's 'basic' wage. The regular-time measure includes compensation covering all types of pay, that is, time-rate, piece-rate and performance-based pay. Therefore, it can change if the structure of the hours of work performed as time work, piece-rate work or performance work change. Such wage changes reflect changes in a person's work effort, which is problematic for the purposes of studying the downward rigidity of wages. A wage cut arising from fewer hours or less effort in piece-rate work is not what is meant by flexible wages, which refers to changes in persons' 'basic wage'. Therefore, we use the hourly wage measure for time-rate work. It is *calculated by dividing the wage bill for time-rate hours by hours worked on time-rate*. Wages and hours are those earned and worked during the fourth quarter of each year. This hourly wage measure excludes piece-rate and performance work, overtime pay (and hours), and shift work, evening, night and Sunday bonuses, as well as bonuses based on working conditions. It includes any firm-specific wages paid above minimum contracts, and any 'personal bonus' incorporated in each person's individual 'wage rate per hour' that is used in remuneration for his/her time-work. Again, these person- and firm-specific components in wages provide opportunities for both upward and downward wage changes, and deviations from the wage changes in centrally negotiated contracts.

One drawback of using the time-rate hourly wage is that it leads to the omission of small numbers of individuals from the data who are 100 % paid on piece-rate or performance pay. The straight time hourly wage can also be based on a few hours, but it is not clear whether this should produce any problems as such, as long as the wage bill and hours data are otherwise accurate.

The wage changes are constructed for job stayers; that is, only workers who have the same employer and the same occupation during the two consecutive years are included. It is standard in micro-level studies of wage rigidity to focus on the wage changes of persons who remain in the same job (e.g. Bewley, 2007). Wage changes related to job promotions or demotions and employer switches reflect changes in job tasks, working conditions and location amenities, which contaminate the measurement of wage rigidity. To control for the variation arising from changing working hours for non-manual and service sector workers' monthly wages, it is necessary for the "regular weekly hours" to be the same in both years.

Appendix 2. IWFP protocol for estimating wage rigidity measures

Dickens *et al.* (2006, 2007) and Dickens and Goette (2005) present the methods used in this paper. The first stage is a correction for measurement error, which extracts the true, error-free wage change distribution, from observed wage changes. The second stage is the estimation of wage rigidity measures using the 'true' wage change distribution. It involves comparing true wage changes with the so-called notional wage change distribution, which represents the counterfactual situation where wage rigidities would not hinder the adjustment of individuals' wages.

Measurement error creates spurious variance in wage changes and therefore obscures the assessment of wage rigidity. For instance, a proportion of negative wage changes, caused by measurement error, are not true wage cuts. The amount of measurement error is an empirical matter. The correction technique applied in the IWFP protocol is based on the following relationship between true and observed wage changes

(1) $f^o = T f^t,$

where f^o is a vector of observed frequencies in each cell of the wage change histogram, f^t is a similar vector for the true frequencies and T is a transition matrix whose columns are the percentages of observations in each cell of the true distribution that will end up in each cell of the observed distribution owing to measurement errors in wages. The observed and underlying true wage change distributions are assumed to be discrete. Inverting T and multiplying both sides of equation (1) by that inverse, gives

(2) $T^{-1} f^o = f^t.$

Hence, if the transition matrix T can be estimated, the true wage change distribution can be recovered from the observed distribution. This requires assumptions about the structure of errors, which affect the structure of T. The method assumes that errors, when made, are independent and have a two-sided Weibull distribution. It is also assumed that the probability of making an error is independent over time and that the true wage change is not autocorrelated. These assumptions imply that all autocorrelation in wage changes is due to measurement error, and the variance of measurement error can be estimated from the negative autocorrelation of observed wage changes. These assumptions are consistent with the findings of Abowd and Card (1989) who show that the best characterization of the stochastic process generating individual wages in US panel data is an MA(1) in first differences. Measurement error with no serial correlation added to a random walk generates this sort of process.

The method-of-moments is used to estimate the parameters of the error distribution, and the estimated true wage change distribution (i.e. the elements of f^t). Additional moments, that allow the identification of parameters, are obtained from predictions about the frequency that individuals with wage increases (decreases) larger than some value receive wage decreases (increases) smaller than another value. These 'switcher moments' reflect measurement error, and the method minimizes a quadratic distance measure between actual and predicted fraction of individuals switching.

To quantify the amount of nominal and real wage rigidities it is necessary to make additional assumptions about the way in which wage rigidities transform the notional wage change distribution to the 'true' observed distribution. It is assumed that without rigidities a symmetric wage change distribution would be observed, which is called the notional distribution.[7] The idea is that firms and occupations face a large number of idiosyncratic demand and supply shocks that create symmetric notional distribution. However, a fraction of the population is subject to *downward real wage rigidity*, if their notional wage change is below the expected rate of inflation, and they receive a wage change equal to that expected rate of inflation rather than equal to their notional wage change. Because inflation expectations vary across population, the mean and standard deviations of the expected rate of inflation in each year are also parameters that are estimated by the protocol separately for each year. Furthermore, a fraction of the population is also subject to *downward nominal wage rigidity*, if they have a notional wage change less than zero, but they receive a wage freeze instead of a nominal wage cut, and they are not subject to downward real wage rigidity. Finally, the model also allows for symmetric nominal wage rigidity as predicted by menu costs, avoiding to overestimate nominal rigidity. The generalized method of moments is used to fit this model of wage changes to the error-corrected (true) wage-change histograms for each data set and each year to estimate the extent of nominal and real wage rigidity and other parameters of the model. The method essentially uses the fraction of observations in each cell of the discrete wage change histogram as the observed moments and their covariance matrix as weights. We implement this IWFP protocol separately for each three sectors and each year that we have data for.

[7] *The counterfactual notional distribution of wage changes is assumed to be Weibull distribution, because wage change distributions are more peaked and have fatter tails than the normal distribution. Furthermore, the upper half of the wage change distribution (above median), which is presumably not affected by wage rigidities, is well approximated by a Weibull distribution.*