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Wage rigidity, institutions, and inflation

by Steinar Holden and Fredrik Wulfsberg

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Wage Rigidity, Institutions, and Inflation*

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Abstract

A number of recent studies have documented extensive downward nominal wage rigidity (DNWR) for job stayers in many OECD countries. However, DNWR for individual workers may induce downward rigidity or "a floor" for the aggregate wage growth at positive or negative levels. Aggregate wage growth may be below zero because of compositional effects, for example that old, high-wage workers are replaced by young low-wage workers. DNWR may also lead to a positive growth in aggregate wages because of changes in relative wages. We explore industry data for 19 OECD countries, over the period 1971–2006. We find evidence for floors on nominal wage growth at 6 percent and lower in the 1970s and 1980s, at one percent in the 1990s, and at 0.5 percent in the 2000s. Furthermore, we find that DNWR is stronger in country-years with strict employment protection legislation, high union density, centralised wage setting and high inflation.

JEL: J3, J5, C14, C15, E31
Keywords: Wage inflation, downward nominal wage rigidity, OECD, wage setting

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A number of recent studies have documented extensive downward nominal wage rigidity (DNWR) for job stayers in many OECD countries, see e.g Dickens et al. (2007), Dessy (2002), Knoppik and Beissinger (2005) and Lebow et al. (2003). Consistent with this, Akerlof et al. (1996) and Bewley (1999) report strong evidence of DNWR based on interviews and surveys of employees and employers. Prevalent DNWR is also likely to induce downward rigidity in aggregate wages, as found by Holden and Wulfsberg (2008a). However, from the outset, it is not clear that any rigidity will be most important at zero growth, i.e. constant nominal wages, as one would expect at the micro level. There are several mechanisms that might transform DNWR at zero nominal wage growth for individual workers to a "floor" for the industry level wage growth that is different from zero. The most important is probably compositional changes in the labour market, for example if old high-wage workers are replaced by younger workers with lower wages, or if jobs are shifted over from high-wage firms with rigid wages to other firms with lower wages. Combined with individual DNWR at zero percent, this might lead to a deficit of industry level wage changes below negative growth rates for example –2 percent, i.e. a "floor" at –2 percent.

On the other hand, there are also mechanisms by which DNWR at zero for individual workers leads to a positive wage growth at more aggregate levels. One mechanism, emphasised by macro and labour economists in the 1960s and 1970s (see Tobin, 1972), is that changes in relative wages, for example due to sector specific shocks, induce aggregate wage growth if DNWR prevents wage reductions in labour markets with excess supply. Downward rigidity might also involve a ratchet effect, where workers with rigid wages and secure jobs use threats of reduced work effort to enforce a rise in nominal wages (see Moene, 1988, Cramton and Tracy, 1992, and Holden, 1997). In this case the DNWR at zero percent for individuals would manifest in a deficit of wage changes below some positive rate, say below 2–3 percent growth. The overall effect of DNWR on aggregate wage growth is thus ultimately an empirical question, which we aim to explore in this paper.

The issue of whether DNWR might lead to a floor for the aggregate wage growth is of great importance for monetary policy. Tobin (1972), Akerlof et al. (1996, 2000) and Holden (1994) argue that if inflation is so low that DNWR binds, the result will be excess wage pressure and higher unemployment. Thus, one would want the inflation target to be sufficiently high so that the risk of widespread binding DNWR is small. If there is a floor for wage growth above zero, a target of, say, two percent inflation may involve the risk of pervasive binding DNWR, unless productivity growth is so high that it provides sufficient scope for wages to grow faster than prices. On the other hand, if a floor is below zero, an inflation target of two percent may involve only a small risk of binding DNWR. Downward rigidity of nominal wages may also be of considerable policy relevance within the EMU, where the target of union-wide inflation below two percent implies that inflation will be considerably lower in countries with a weaker cyclical situation and lower inflation than the union average. In such situations a floor for the wage growth may induce excessive wage pressure even if the floor is below zero.

The possible existence of downward nominal rigidity of industry wages is also relevant for business cycle research. Carlsson and Westermark (2008) show that DNWR has important implications for the cyclical response of the economy, and thus also for the optimal monetary policy. Again, the rate at which a floor binds determines for which inflation rate the floor is of practical relevance.

Gordon (1996) and Mankiw (1996) argue that the extent of DNWR depend on the macroeconomic environment. Referring to the experience from the Great Depression in the 1930s, they claim that "nominal wage reductions would no longer be seen as unusual if the average nominal wage was not growing" (Gordon, 1996, p.62). It is therefore interesting to investigate the existence of wage floors at non-zero levels and its possible correlation with the inflation rate using data for the recent period of low and stable inflation.

In order to investigate the existence of wage floors in the aggregate economy, we explore industry data for 19 OECD countries, over the period 1973–2006. More than 13,000 observations from 604 country-year samples, i.e. an average of 23 industries per sample. To explore whether there is a floor on wage growth, we extend the method we have used in our previous work on DNWR (Holden and Wulfsberg, 2008a). Roughly, the test goes as follows. We construct the assumed distribution of wage changes under flexibility (i.e. without DNWR, referred to as the "notional" wage change distribution), on the basis of observations from country-years when the wage growth is high, and thus DNWR is not likely to bind. By comparing empirical and notional country-year specific wage change distributions for different floors, we can construct country-year specific estimates of the extent of DNWR, given by the deficit of wage changes below the floors in the empirical samples. Given our estimates of DNWR for some 600 country-year samples, we proceed by exploring how DNWR is related to economic and institutional variables like unemployment, inflation, employment protection, union density, etc. Our large data set with a broad span across countries and over time gives us a good opportunity to detect the possible effect of these variables on the extent of DNWR.

Compared to the existing literature on DNWR, this paper makes two main contributions. First, we explore the extent of DNWR at non-zero growth rates – an issue that has received scant attention in previous work.[1] Second, we extend the empirical analysis in Holden and Wulfsberg (2008a) to include the years from 2000 to 2006.

To preview our results, we find evidence of floors on aggregate wage growth as high as 5–6 percent in 1970s. According to our point estimates, around 40 percent of the notional industry wage changes in the 1970s below 5 percent were pushed up above 5 percent. In the 1980s, the floors were at somewhat lower levels, yet 20 percent of all wage changes below 4 percent were pushed up above 4 percent. In the 1990s, the floors

[1] Holden (1998), analysing wage setting at central level for the manufacturing sectors in the Nordic countries, find evidence of a floor on nominal wage growth given at 2–3 percent in the decades from 1960s to 1980s.

fell down to about zero, with a fraction of notional wage cuts prevented by DNWR of about 20 percent. In the 2000s, we find evidence of a floor in the Nordic countries at 0–1 percent wage growth, and also some evidence for Southern European countries as well as for the OECD as a whole.

The paper is organised as follows. In section 1, we discuss the link between DNWR and aggregate wage growth. Section 2 presents the data and empirical approach, while section 3 contains the main results as to the extent of DNWR. In section 4, we explore whether the variation in DNWR across countries and time can be explained by institutional and economic variables. Section 5 concludes. The appendices contain supplementary material on data and results.

1 DNWR and floors for aggregate wage growth

The observational unit in our study is the change in the average hourly earnings in an industry (see description of the data in section 2 below). The change in the average earnings is affected both by the average change for job stayers, and by compositional effects due to differences in wages between new hires and the workers that leave the industry. If DNWR binds for some job stayers in the industry and pushes their wage change above zero, this will also reduce the likelihood that the industry wage change is below zero. As noted in the introduction, however, there are also a number of mechanisms that could transform DNWR at zero for individual workers to a floor for nominal wage growth at more aggregate levels that is different from zero.

Several effects may give rise to some downward flexibility. At the individual level, even if base wages are rigid, it might be possible to reduce bonus schemes, fringe benefits, etc. Wage rigidity for some groups of workers or in some firms, might also cause jobs to move to other groups of workers or other firms, where wages are flexible and lower. Furthermore, turnover might give rise to considerable downward flexibility. Over time, old, high-wage workers retire, and they are replaced by younger workers usually with lower pay. In situations where redundancies are required, firms may have some discretion in choosing whom to lay off, and they may then choose to lay off workers with high wages. Note, however, that even if these mechanisms may all involve a reduction in aggregate wages, yet the existence of individual DNWR may nevertheless imply that there is a floor below zero on the aggregate nominal wage growth.

On the other hand, DNWR at the individual level may also lead to nominal wage growth in the aggregate. One reason (see Tobin (1972) and Akerlof et al. (1996, 2000)), is that the need for changes in relative wages requires growth in average wages if there is downward rigidity of nominal wages. A second mechanism, analysed by Moene (1988), Cramton and Tracy (1992) and Holden (1997), is based on the assumption that employment contracts are incomplete. As argued by Moene (1988), employees under a fixed wage contracts may impose a cost on the firm without violating the employment contract, for example by meticulously adhering to the exact words in the employment contract. Such behaviour is well known as "work-to-rule" in wage negotiations in many industrialised economies. Holden (1997) shows that the outcome of the wage setting will be a nominal wage increase if workers can impose a larger cost on the firm than vice versa during a work-to-rule.

Growth in nominal wages might also be a consequence of firms' attempt to induce higher effort from the employees. In many countries, a large part of the employees are hired under fixed nominal wage contracts, with fairly stringent employment protection. In such situations, it might be difficult for the firm to ensure that employees provide sufficient effort. One way of ensuring high effort might be to give nominal wage increases to workers who supply high effort.[2]

Overall, if there exist positive or negative floors on nominal wage growth in aggregate data, they are likely to vary between countries, industries, and over time, depending on the legal and institutional setting, remuneration systems, the views of employees and employers, inflation expectations, etc. Further, the possible existence and levels of such floors is clearly an empirical issue.

As noted above, we are looking for a deficit of wage changes below various floors, that is caused by DNWR. However, a deficit of wage changes below certain floors might also be caused by other mechanisms. For example, if there are systematic cyclical compositional changes in the workforce, so that the share of low-skilled workers decreases in recessions, this will dampen the downward pressure on wages in the recession (Solon et al., 1994). However, these mechanisms would be in real terms, and lead to a deficit of real wage changes below certain levels, and not to a floor for nominal wage growth as we are looking for. Possibly, floors on wage growth may also be caused by bargaining systems or minimum wages. If such floors are in nominal terms, they would still imply that the rate of inflation affects relative wages via the effect on the wage change distribution, as do other forms of DNWR. In section 4, we explore to the link between labour market institutions and macro variables on DNWR.

Some of the mechanisms discussed above, for example the work-to-rule mechanism, seem better tested on micro data than more aggregate data. Incidentally, Nickell and Quintini (2003), who focus on DNWR at zero, report that there are employees "who would have had a negative nominal wage changes without the distortion who, in fact, have significantly positive, rather than zero, nominal wage changes". This is exactly what is predicted by the work-to-rule story mentioned above. However, micro studies would have more difficulty in capturing whether positive wage growth induced by DNWR for some workers leads to lower wage growth for other workers, possibly offsetting the aggregate effects. In contrast, such effects might show up in studies on more aggregate data, as in our study.

[2]Clearly, there exists other mechanisms to provide incentives for effort, like bonus schemes and piece rates. However, it is an empirical fact that on many work-places, employers do choose a fixed wage system. Furthermore, in an inflationary setting, nominal wage increases to workers who provide high effort might be a simple and useful incentive scheme.

2 Data and empirical approach

We use an unbalanced panel of industry level data for the annual percentage growth of gross hourly earnings for manual workers from the manufacturing, mining and quarrying, electricity, gas and water supply, and construction sectors of 19 OECD countries in the period 1973–2006. The countries included in the sample are Austria, Belgium, Canada, Germany, Denmark, Spain, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, New Zealand, Portugal, Sweden, the UK and the US. The main data source are wages in manufacturing from the ILO and harmonised hourly earnings in manufacturing from Eurostat. One observation is thus denoted Δw_{jit} where j is index for industry, i is index for country and t is index for year. There are all together 13,694 observations distributed across 604 country-year samples, on average 23 industries per country-year. More details on the data are provided in Appendix A.

The location and dispersion of the wage change distributions vary considerably between countries and over time, see Figure 1. The location of the wage change distributions is likely to depend on variables like inflation, productivity growth and unemployment, while the dispersion is affected by among other things the size and dispersion of industry specific shocks in that country-year. Wage cuts happened more frequently in the latter half of the sample than in the first half, see Figure 2.

To explore the existence of floors on nominal wage growth, we extend the method that we have used previously, see Holden and Wulfsberg (2008a). The basic approach is to construct a distribution of "notional" wage changes (i.e. the wage changes that would take place in the absence of DNWR) and then detect DNWR in the empirical wage changes by comparing the empirical and notional distributions of wage changes. If there is a floor to nominal wage growth, it would compress the distribution of wage changes from below, implying that there would be a lack of observations below this floor, relative to a notional distribution. To illustrate the basic idea, consider the distribution of wage changes within a given country-year sample, as in Figure 3 which displays a histogram of the nominal wage changes in 16 industries in Norway in 1998. The asymmetric shape of the histogram might suggest that in the absence of downward rigidity, there would have been some observations of wage changes below five percent, consistent with the idea that DNWR has pushed wage changes above this floor. However, to assess this conclusion formally, we must make more specific assumptions about how the country-year wage change distribution would have looked if there had been no downward rigidity, i.e. the notional distribution of wage changes.

In line with previous work on this method (see e.g. Card and Hyslop, 1997; Knoppik and Beissinger, 2003; or Nickell and Quintini, 2003), the Holden and Wulfsberg (2008a) method constructs the country-year notional distributions on the basis of the empirical wage distribution in high inflation years, when DNWR is less likely to be binding and thus affect the observations. Specifically, we assume that absent any DNWR, the notional nominal wage growth in industry j in country i in year t, Δw^N_{jit}, is stochastic with an

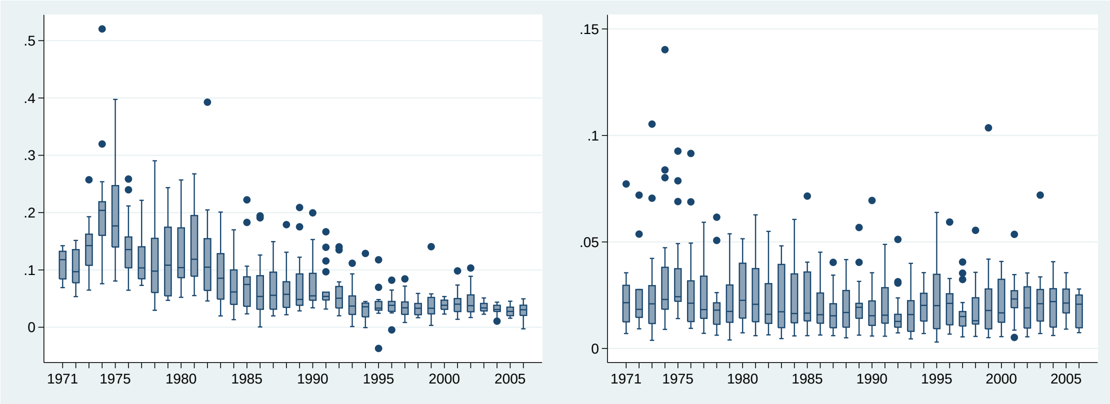

Figure 1: Box plots of the variation in country-year median wage growth (left) and the inter percentile range (right). The boxes extends from the 25th to the 75th percentile, with the median inside the box. The whiskers emerging from the box indicate the tails of the distributions, and the dots represent outliers.

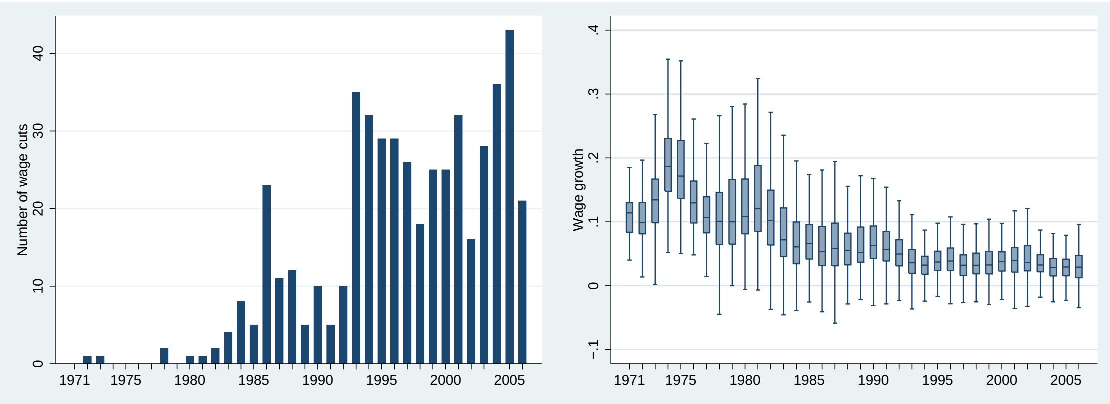

Figure 2: The absolute number of wage cuts over time (left), and box plots of wage growth over time (right).

unknown distribution G, which is parameterized by the median nominal wage growth, μ_{it}^N, and the dispersion, σ_{it}^N; $G(\mu_{it}^N, \sigma_{it}^N)$. Thus, we allow the location and dispersion of the notional wage growth to vary across countries and years, to capture the large variation that exists across countries and across time with respect to monetary policy, wage setting, and industry structure, while imposing the same structural form (or shape) of G in all country-years. This structural form is constructed on the basis of a subset of 1,605 observations from 66 high wage growth country-year samples, selected on the basis that both the median nominal and the median real wage growth in the country year are in their respective upper quartiles over all country-years.[3] Imposing the same structural form across countries and years is a strong assumption. However, it is also very useful, as it makes it possible to construct the notional distribution from only high wage growth years, which should not be affected by possible DNWR. Furthermore, the results from several alternative specifications of G reported below document that our

[3]Using the 66 country-year samples with median wage growth in the upper quartiles is clearly arbitrary. However, as shown in our previous work (Holden and Wulfsberg, 2008a), the results are robust to variations in this assumption.

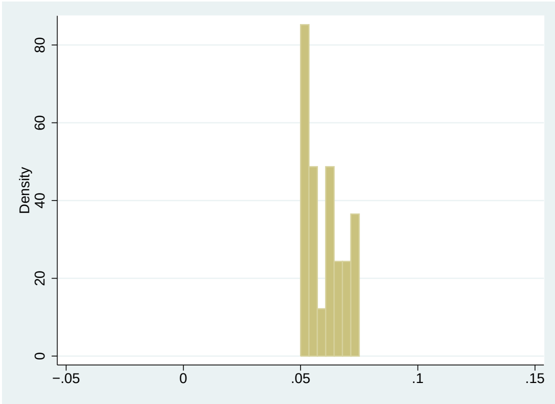

Figure 3: Histogram of wage growth in Norway, 1998.

findings are robust.

The formal procedure is as follows. First, we construct an underlying distribution of wage changes, G, where the 1,605 empirical observations from the high wage growth samples are normalised with respect to the observed country-year specific median, μ_{it}, and inter percentile range, $(P75_{it} - P35_{it})$,

$$x_s \equiv \left(\frac{\Delta w_{jit} - \mu_{it}}{P75_{it} - P35_{it}} \right), \qquad s = 1, \ldots, 1605 \tag{1}$$

where subscript s runs over all j, i and t in the 66 country-year samples. We use the inter percentile range between the 75th and the 35th percentiles as our measure of dispersion, following Nickell and Quintini (2003), to avoid that DNWR has an effect on the measure of dispersion. The calculated x_s should thus be thought of as observations from the standardised underlying two-parametric distribution $X \sim G(0, 1)$.

Second, for each of the 604 country-years in the full sample, we compute the country-year specific distribution of notional wage changes by adjusting the underlying wage change distribution for the country-specific observed median and inter percentile range

$$Z_{it} \equiv X\Big(P75_{it} - P35_{it}\Big) + \mu_{it}, \qquad \forall\ i, t. \tag{2}$$

Thus, we have constructed 604 notional country-year distributions $Z_{it} \sim G(\mu_{it}, P75_{it} - P35_{it})$, each defined by $S = 1605$ wage-change observations $z_s^{it} \equiv x_s\Big(P75_{it} - P35_{it}\Big) + \mu_{it}$. In effect, we have constructed a two-parametric distribution G, where the two parameters of the distribution, $(\mu_{it}^N, \sigma_{it}^N)$, take the value of their empirical median and inter-percentile range, $(\mu_{it}, P75_{it} - P35_{it})$, while the shape or structural form is the same across all country-years, based on the wage changes in the 66 country-year samples with high wage growth. The left panel of Figure 4 displays the underlying distribution of wage changes, with zero median and inter-percentile range of unity. Compared with the normal distribution (not specified in the diagram), our underlying distribution has greater peak and fatter tails. Furthermore, it is skewed with the mean at –2.3 percent.

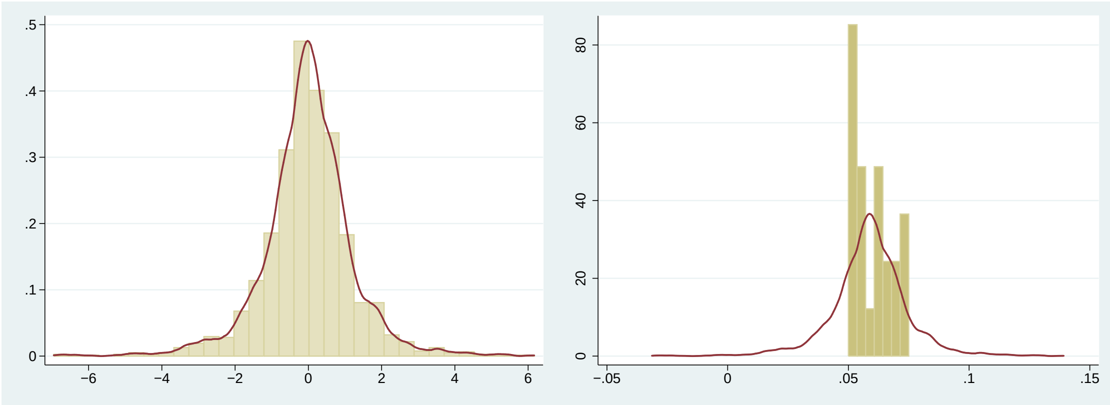

Figure 4: Left: Histogram and kernel density of the normalised underlying distribution of wage changes. Right: Histogram of observed wage changes and the notional wage change distribution in Norway 1998.

The right panel of Figure 4 compares the empirical distribution (histogram) for Norway in 1998 with the corresponding notional country-year distribution. By construction the two distributions have identical median and inter percentile range, but the shapes differ, as the notional distribution is based on the shape of the underlying distribution. We observe that the country-specific notional distribution indicates a considerable probability of wage changes below 5 percent, in contrast to the empirical outcome.

As we are looking for the existence of possible positive or negative floors for the wage growth, we look for a deficit of wage changes below floors in the range from -5 to 7 percent. For each floor $\phi \in \{-5, -4.5, -4, \ldots, 7\}$ percent, we estimate the extent of DNWR by comparing the incidence rate of notional wage changes below the floor with the corresponding empirical incidence rate. For each floor, ϕ, the incidence rate of notional wage cuts is given by

$$\tilde{q}(\phi)_{it} \equiv \frac{\# z_s^{it} < \phi}{S}, \tag{3}$$

Likewise, the empirical incidence rate is

$$q(\phi)_{it} \equiv \frac{\# \Delta w^{it} < \phi}{S_{it}}. \tag{4}$$

where S_{it} is the number of observed industries in country-year it. An often-used measure of DNWR is the fraction of wage changes below a certain floor that is prevented, FWCP(ϕ), calculated as FWCP$(\phi)_{it} = 1 - q(\phi)_{it}/\tilde{q}(\phi)_{it}$. If, for example, the incidence of wage changes below floor ϕ in the empirical sample is half of that in the notional distribution, then the FWCP$(\phi) = 0.5$.

As there are only on average 23 industries in each country-year sample, there may be stochastic disturbances to the country-year specific variables $\mu_{it}, P75_{it} - P35_{it}$, and q_{it}, which may induce considerable noise in $\tilde{q}_{it}$ and FWCP$_{it}$. Thus, estimates of FWCP in single country-years will be imprecise. However, averages of FWCP$_{it}$ for groups of country-years will be much more precise. Thus, we will present estimates of the FWCP for regions and periods.

Under the null hypothesis of no DNWR, the notional country-year specific incidence rate $\tilde{q}(\phi)_{it}$ is a measure of the probability that a wage change observation in that country-year is below the floor ϕ. Thus, using the notional country-year specific incidence rates we can compute the probability distribution for the number of wage cuts in each country-year under the null hypothesis of no DNWR directly by employing the formulae for binomial distributions. However, for the full sample with some 600 country-years, this is computationally infeasible. Therefore, we use the simulation method proposed in Holden and Wulfsberg (2008a). Specifically, for each country-year it, we draw S_{it} times from a binomial distribution with the country-specific notional probability $\tilde{q}(\phi)_{it}$. We then count the number of simulated notional wage changes below ϕ, $\hat{Y}(\phi)$, and compare these with the total number of observed wage changes below ϕ in the corresponding empirical distribution, $Y(\phi)$. For example, to test for a floor of 1 percent in Portugal, we compare the simulated number of notional wage changes below 1 percent for all years in Portugal, with the corresponding empirical number. We then repeat this procedure 5000 times, and count the number of times where we simulate more notional wage changes below ϕ than we observe for each floor, denoted $\#(\hat{Y}(\phi) > Y(\phi))$. The null hypothesis is rejected with a level of significance at 5 percent if we in less than 5 percent of the simulations simulate more wage changes below the floor than the corresponding empirical number, i.e. if $1 - \#(\hat{Y}(\phi) > Y(\phi))/5000 \leq 0.05$.

As we condition on the empirical median and inter-percentile range, we can only measure the effect of DNWR in the left part of the wage change distribution, below the 35th percentile. In a country-year where the effect of DNWR is more extensive, so that the 35th percentile is pushed up by DNWR, also the notional distribution, which is constructed using the 35th percentile, will be compressed from below. This will reduce the estimated notional probability of observing a wage change below the floor, inducing a downward bias in the estimated DNWR. To mitigate this downward bias we exclude country-year samples where the distribution of wage changes is so far to the left that the 35th percentile would have been affected by the floor that we look for. Specifically, when we look for the existence of a floor at, say, 4 percent wage growth, we include only country-year samples in which the 35th percentile is above 4 percent. This procedure implies that our estimates of the FWCP are conditional on the wage distribution being sufficiently far to the right relative to the floor. For example, if we find a FWCP of 0.5 below a floor of 4 percent wage growth, it says that in country-year samples where the wage growth is sufficiently high that the 35th percentile is above 4 percent, DNWR is likely to prevent half of the wage changes below 4 percent, thus pushing up wage growth further.

This conditionality removes some of the downward bias in our estimates, but not all, as it may still be the case that DNWR at higher growth rates pushes up the 35 percentile. For example, if there is a floor at four percent wage growth, this would affect the notional wage change distribution in country-years where the 35 percentile is at or below 4 percent. As these country-year samples are included when we look for floors below 4 percent, say zero percent, there will be a downward bias in our estimate of the extent DNWR at zero. However, removing even more country-years would also reduce the number of observations, which would reduce the precision of the estimates. We prefer to have a known bias, working against finding DNWR, rather than reducing the number of observations leading to more imprecise estimates.

The downward bias in our method is likely to be more severe in country-years with low inflation, as DNWR may affect individuals in *all* industries when inflation is low, also in industries with high average wage increase. In that case DNWR may push the whole wage change distribution to the right, which we don't detect with our method. We shall return to this issue in the interpretation of our results.

3 Estimates of DNWR

In Figure 5 we present estimates of the FWCP at floor levels of every half percentage point between –5 and 7 percent for each decade in the sample. A significant estimate at the 5 percent level is marked by a "×" in the figure. Some of these estimates relate to very few observations in the far end tails of the distributions.[4] In order to visualize the estimates based on more data, we have connected with lines the estimates where the number of notional wage changes is at least one percent of the relevant population. Figure 5 shows extensive DNWR at a wide range of wage growth rates for the first three decades. The downward slope of the FWCP-curves implies that relatively less wage changes are pushed upwards for higher rates of wage growth. The leftward shift in the FWCP-curve over time implies that a given FWCP apply to lower wage growth for each decade.

For the 1970s, we find that DNWR affected wage changes in the range between 1 and 7 percent wage growth. The FWCP at 1 percent is 0.74, implying that three out of four notional wage changes below 1 percent are pushed up above 1 percent. Even at the 7 percent floor the FWCP is 0.32. The figure shows that the estimates of the FWCP below the 1 percent floor are also significant, but, as noted above, based on very few observations. In the 1980s, the estimates indicate that DNWR has been binding at least between –2 and 6 percent, with a FWCP of 0.63 and 0.17 at the two extremes. Similarly, we see that in the 1990s, DNWR binds between –5 and 1 percent, with a FWCP between 0.47 and 0.10. In the 2000s we only find statistically significant DNWR at the 0.5 percent floor, with a FWCP equal to 0.12.

The downward slope of the FWCP-curve is consistent with the theoretical bargaining model of DNWR in Holden (2004). Intuitively, the deficit of wage changes below a floor at 4 percent wage growth will be smaller than the deficit below a floor at 2 percent growth, because some of the notional wage changes below the 2 percent floor are pushed up,

[4]For example, in the 1970s we simulate 26.5 notional wage cuts. Compared to only 4 observed wage cuts, the estimate of the FWCP at 0 percent is thus 85 percent. However, since these numbers are obtained from a sample of 3331 observations, the estimate of the FWCP relates to the distribution below the 0.8 percentile. Hence, we really don't have much data in this range during the 1970s.

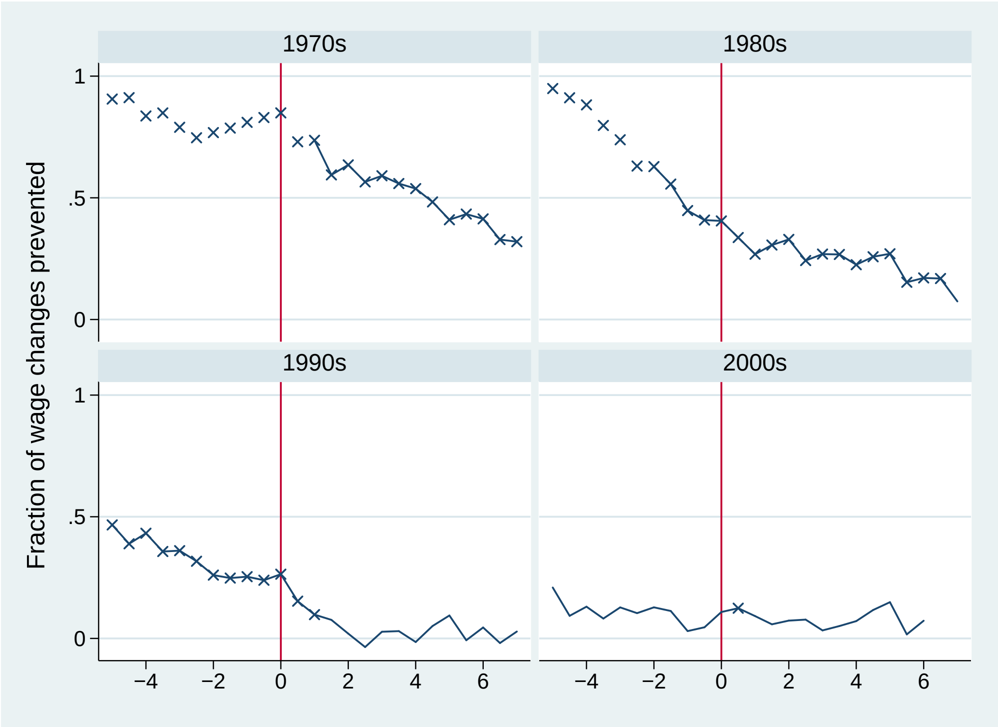

Figure 5: Fraction of wage changes prevented at different floor levels by periods. Significant estimates at the 5 percent level is marked by a "×". Estimates based on at least 1 percent of the sample are connected with lines.

filling up some of the deficit of wage changes below the 4 percent floor.

Note, however, that even if DNWR binds at lower wage growth rates over time, and the FWCP are lower, there is also an opposing effect when it comes to the economic importance of DNWR. As inflation falls over time, implying that the wage change distribution moves to the left, more wage change observations are potentially affected by DNWR at any given floor. Yet it turns out that the former effect dominates, so that the number of industry-year wage change observations that are affected by DNWR is somewhat higher in the 1970s and 1980s than in the 1990s and 2000s. In the 1970s and 1980s, around 1.5–2 percent of all industry-year wage changes are pushed up by the floors around 4–5 percent wage growth, while in the 1990s and 2000s, about 1–1.5 of the industry-year wage changes are pushed up above the significant floors around zero, see the figure in Appendix B.

To show the cross sectional variation in DNWR, Figure 6 displays the results for four regions; Anglo (Canada, Ireland, New Zealand, the UK and the US), Core (Austria, Belgium, France, Germany, Luxembourg and the Netherlands), Nordic (Denmark, Finland, Norway and Sweden) and South (Italy, Greece, Portugal and Spain). These regions by and large consist of countries with rather similar labour market institutions (see discussion in Holden and Wulfsberg, 2008a). For all regions, there is substantial evidence of DNWR at both positive and negative growth rates. The highest estimated FWCPs for all floors are in the South region, followed by the Nordic and then the Core region. However,

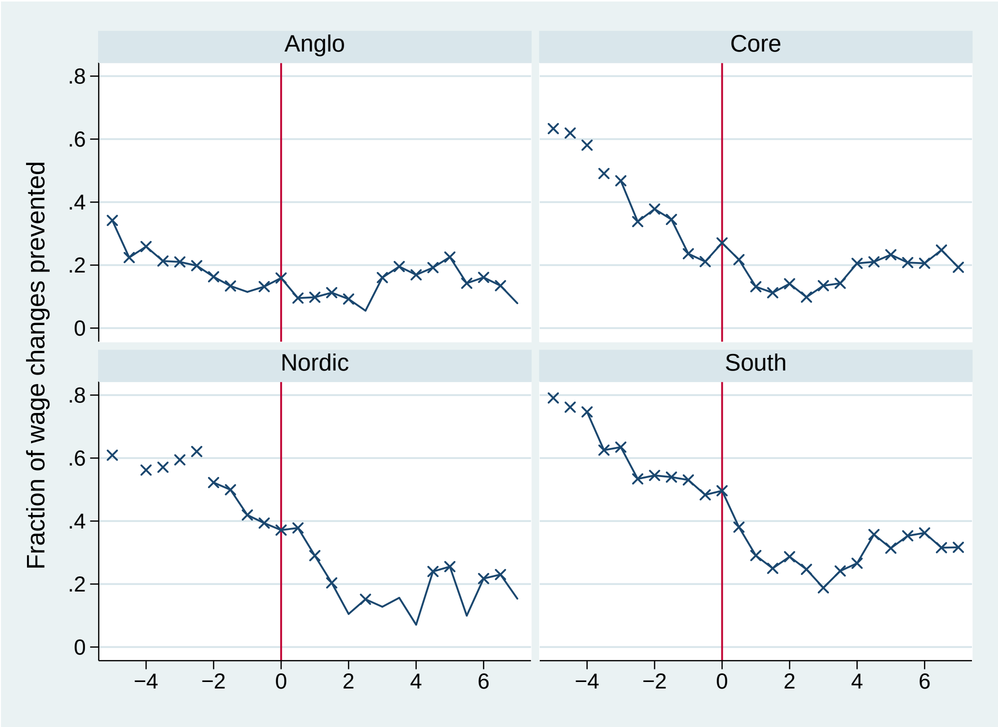

Figure 6: Fraction of wage changes prevented at different floor levels. Significant estimates at the 5 percent level is marked by a "×". Estimates based on at least 1 percent of the sample are connected with lines.

as these estimates are aggregates over time when inflation has varied a lot, we focus our discussion on the results for each decade within each region, as presented in Figures 7–10.

The big picture is fairly similar across regions. In the 1970s, we find significant DNWR in the form of floors for nominal wage growth around 3–4 percent in the Anglo region, and for wider intervals in the other regions, with associated FWCP of 0.50 or more. In the 1980s, the floors apply to somewhat lower growth rates, but over a fairly wide interval for all regions. In the Anglo and Core regions, the FWCPs are around 0.30, as compared to FWCPs above 0.50 for some floors in the Nordic and South regions. In the 1990s, there are significant floors around zero and negative rates in all regions, with FWCPs ranging from 0.20 percent in the Anglo regions to 0.50 percent in the South. In the 2000s, there are significant floors in two regions only; at 2 percent in the South, and from minus 2.5 to 1 in the Nordic, with FWCPs from 0.20 (South) to 0.30–0.50 (Nordic).

The weaker evidence of DNWR in the 2000s is consistent with Gordon's conjecture that the DNWR will weaken over time in periods with low inflation. However, one should also note that there is evidence of DNWR in the Nordic countries and in the South, even in the 2000s, in spite of a long period with low inflation in these countries. Furthermore, caution is also warranted due to the feature discussed above that the downward bias in the estimates is likely to be stronger in country-years with low inflation.

We do not have enough data to estimate FWCP-curves by periods for separate countries, but in Appendix C we report results by country for testing DNWR at zero percent

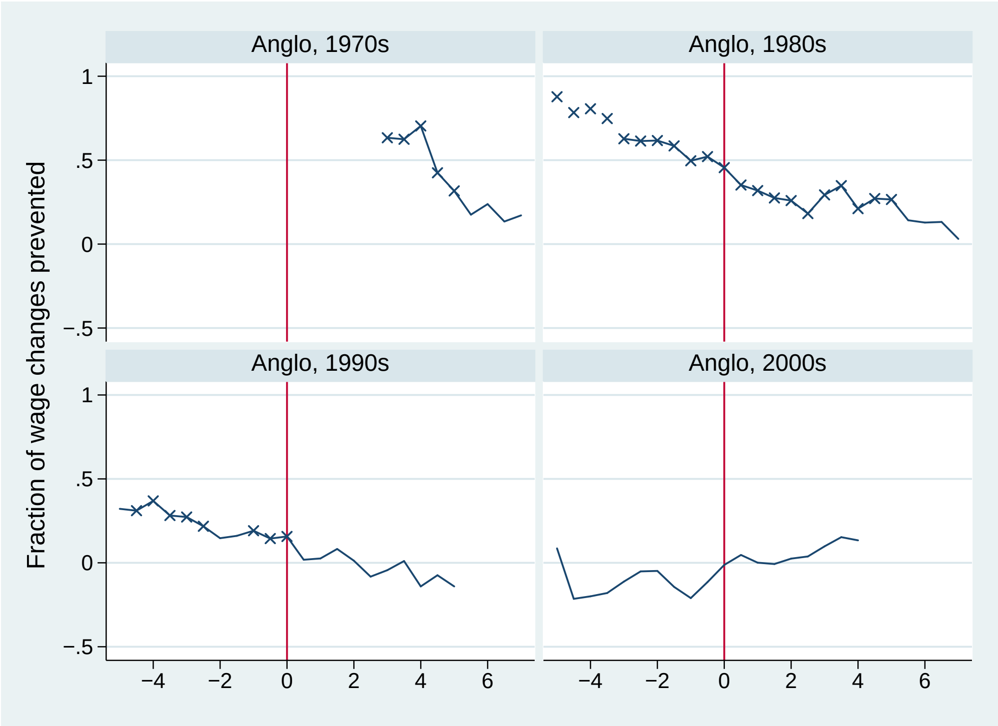

Figure 7: Fraction of wage changes prevented at different floor levels for the Anglo countries by period. Significant estimates at the 5 percent level is marked by a "×". Estimates based on at least 1 percent of the sample are connected with lines.

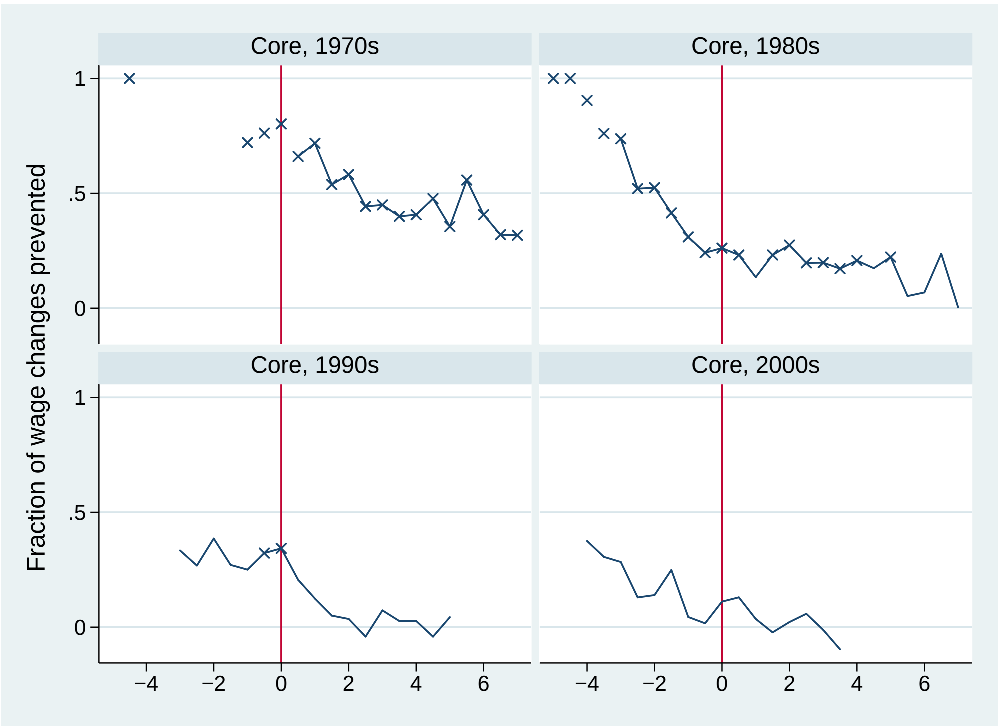

Figure 8: Fraction of wage changes prevented at different floor levels for the Core region by period. Significant estimates at the 5 percent level is marked by a "×". Estimates based on at least 1 percent of the sample are connected with lines.

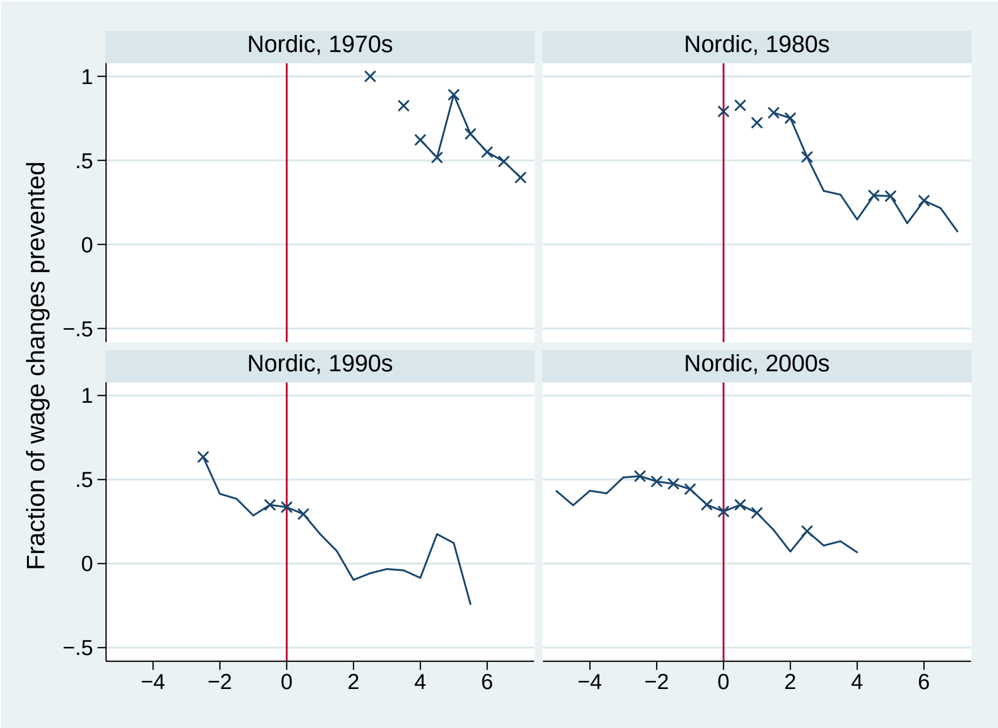

Figure 9: Fraction of wage changes prevented at different floor levels for the Nordic region by period. Significant estimates at the 5 percent level is marked by a "×". Estimates based on at least 1 percent of the sample are connected with lines.

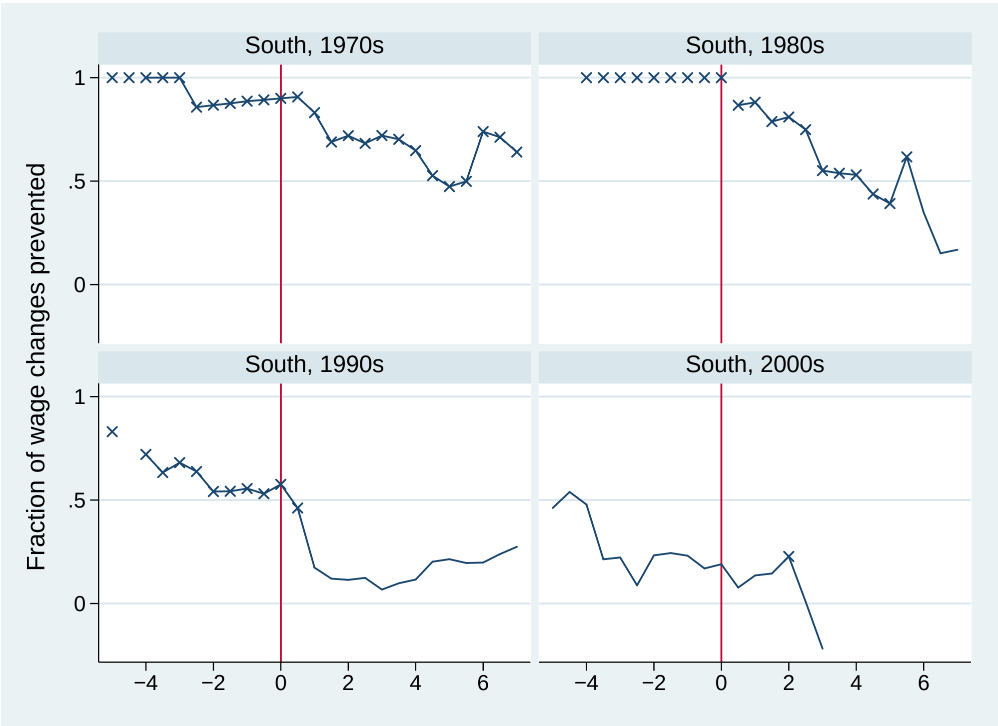

Figure 10: Fraction of wage changes prevented at different floor levels for the South region by periods. Significant estimates at the 5 percent level is marked by a "×". Estimates based on at least 1 percent of the sample are connected with lines.

($\phi = 0$). We find significant DNWR at zero percent in Austria, Finland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal and Sweden. The FWCP is highest in Italy, Portugal, Norway, and Greece, and lowest in Spain, Canada, Belgium, and France.

3.1 Robustness

In this section we consider the robustness of the results for the common shape assumption, by undertaking three alternative ways of constructing the underlying distribution. First, we use alternative cross-sample restrictions as to the structural form of the underlying distribution. As the industry structure and wage setting system clearly vary across countries, we construct country-specific underlying distributions, G_i, based on all observations for each country, i.e. allowing for differences in the structural form across countries. Then we proceed with the method as before. We also construct period-specific underlying distributions, G_τ, one for each decade, based on all observations within the decade, to allow for effects of structural changes over time (e.g. due to increased trade and globalization). Again, we then proceed with the method as before. However, these alternative underlying distributions are constructed using a selection of country-year samples which includes samples with low median wage growth, where DNWR may bind. Thus, there is a risk that the shape of the underlying and notional distributions is compressed, leading to a downward bias in the estimated DNWR.

Finally, we undertake the analysis with a symmetry assumption inspired by Lebow, Stockton, and Wascher (1995) and Card and Hyslop (1997). Here, the notional distributions are constructed from the empirical ones by replacing observations below the median with observations from the upper half of the distribution in the same country-year. Thus, all country-year notional samples are symmetric, but the shape of the distributions differs across country-years. Observe that the symmetry approach involves no assumptions of equal shape across country-year samples. In contrast, our main approach makes no assumptions regarding symmetry. Thus, these two approaches are based on orthogonal assumptions, involving a strong test of the robustness of our analysis. Note that also the symmetry approach may involve a downward bias in the estimated DNWR, if firms respond to DNWR by attenuating high wage increases, so as to reduce the risk that DNWR is binding in the future (Elsby, 2006).

Figures D1–D6 in Appendix D compare our preferred estimates with estimates from the country specific and symmetric alternatives. As can be seen from the diagrams, the results of the alternative specifications turn out to be very similar to the results from the main specification. The estimated FWCP are somewhat lower, as should be expected due to the possible downward bias in the alternative specifications. Yet the results from the different specifications provide a clear indication of the robustness of our findings.

In the present paper, we only consider the possibility of nominal floors for the wage growth. In contrast, several studies have found empirical evidence for the existence of considerable downward *real* wage rigidity in a number of OECD countries, mostly based on micro data, see Dickens et al. (2007), Barwell and Schweitzer (2004), Bauer et al. (2007), and Christofides and Li (2005). In general, there is a problem of distinguishing between real and nominal downward rigidity. However, given that we only include country-years where the 35th percentile of the wage change distribution is above the floor, the nominal floors we consider in the present paper are generally considerably below the rate of inflation in the associated country-year. Thus, we view the floors that we identify as chiefly the result of nominal lower bounds on the wage change process. In Holden and Wulfsberg (2008b), we explore the possible existence of downward real wage rigidity in the same industry data.

4 DNWR, inflation and institutions

In this section we explore to what extent economic and institutional variables are correlated with the variation in FWCP across countries and time. Holden (2004) shows that the prevalence of DNWR is likely to decrease with inflation (in a non-linear way), as well as depend on institutional variables like the strictness of the employment protection legislation (EPL) and union density. Also other institutional variables like centralisation and coordination of wage setting, or minimum wages, may potentially affect the extent of DNWR. Furthermore, high unemployment may weaken workers' resistance to nominal wage cuts. Thus, we regress the extent of DNWR as measured by the FWCP at each floor in each country-year sample on inflation, inflation squared, unemployment, and institutional variables to test whether these variables are related to DNWR. We also control for the floor level, ϕ.

Regrettably, the data for institutional variables apply to each economy as a whole, and not to the specific sectors in our data. This can be seen as measurement errors in the left hand side variables, which will lead to a downward bias in the coefficient estimates. However, if we do find an effect, it seems likely that it will be the relationship that we are interested in.

Technically, we undertake Poisson regressions where the number of observed wage changes below floor ϕ in each country-year sample, $Y(\phi)_{it}$, depends on the average number of simulated wage cuts for each country-year sample, $\hat{Y}(\phi)_{it}$, and the explanatory variables mentioned above, $\mathbf{x}_{it}$. A Poisson regression seems appropriate, as $Y(\phi)_{it}$ is the number of times we observe an event (see Cameron and Trivedi, 1998). The conditional density of the number of observed wage cuts in country-year it in the Poisson model is

$$f\left(Y(\phi)_{it} = y(\phi)_{it} \mid \hat{Y}(\phi)_{it}, \mathbf{x}_{it}\right) = \frac{e^{-\lambda_{it}}\lambda_{it}^{y(\phi)_{it}}}{y(\phi)_{it}!}. \tag{5}$$

Furthermore, we assume that the Poisson parameter, λ_{it}, is given by

$$\lambda_{it} = \hat{Y}(\phi)_{it} e^{\mathbf{x}'_{it}\boldsymbol{\beta}}, \qquad \text{if } \hat{Y}(\phi)_{it} > 0. \tag{6}$$

Table 1: Pooled regressions.

	$(1 - \text{FWCP}(\phi))$			Incidence rate		
	No dummies	Country dummies	Time dummies	No dummies	Country dummies	Time dummies
Floor, 1970s	0.239***	0.257***	0.444***	0.332***	0.330***	0.505***
	(0.023)	(0.020)	(0.032)	(0.025)	(0.021)	(0.040)
Floor, 1980s	0.420***	0.370***	0.364***	0.494***	0.441***	0.402***
	(0.019)	(0.017)	(0.018)	(0.024)	(0.021)	(0.020)
Floor, 1990s	0.376***	0.349***	0.348***	0.477***	0.427***	0.407***
	(0.024)	(0.021)	(0.021)	(0.027)	(0.023)	(0.025)
Floor, 2000s	0.338***	0.386***	0.362***	0.405***	0.405***	0.398***
	(0.029)	(0.032)	(0.024)	(0.030)	(0.032)	(0.029)
Employment protection	−0.399***	−0.263	−0.226***	−0.400***	−0.203	−0.251***
	(0.058)	(0.164)	(0.047)	(0.069)	(0.184)	(0.057)
Union density	−1.829***	−2.027**	−0.402*	−1.539***	−2.116**	−0.345
	(0.276)	(0.889)	(0.210)	(0.302)	(0.993)	(0.241)
Centralisation	−0.191**	−0.266**	−0.234***	−0.196**	−0.254**	−0.283***
	(0.085)	(0.116)	(0.067)	(0.093)	(0.128)	(0.079)
Coordination	0.164**	0.251**	0.193***	0.132	0.311**	0.219***
	(0.078)	(0.109)	(0.064)	(0.088)	(0.125)	(0.073)
Inflation	−0.513***	−0.351***	−0.267***	−0.585***	−0.439***	−0.295***
	(0.025)	(0.036)	(0.041)	(0.034)	(0.034)	(0.039)
Inflation squared	0.014***	0.007***	0.005**	0.016***	0.010***	0.006***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)
Unemployment	−0.053***	0.063***	0.039***	−0.022*	0.079***	0.045***
	(0.011)	(0.019)	(0.011)	(0.012)	(0.022)	(0.013)

Note: Robust standard errors clustered by country in parentheses. The estimates are marked with * if $p < 0.1$, with ** if $p < 0.05$, and with *** if $p < 0.01$.

where $\boldsymbol{\beta}$ is the parameter vector we want to estimate. Using the definition of the FWCP and that $\lambda_{it} = \mathrm{E}\left(Y(\phi)_{it} \mid \hat{Y}(\phi)_{it}, \mathbf{x}_{it}\right)$ we get

$$1 - \text{FWCP}(\phi) = \frac{Y(\phi)_{it}}{\hat{Y}(\phi)_{it}} = e^{\mathbf{x}_{it}'\boldsymbol{\beta}+\varepsilon_{it}}, \qquad \text{if } \widehat{Y}(\phi)_{it} > 0 \tag{7}$$

where ε_{it} is an error term.

In the first three columns of Table 1 we present pooled estimates of (7) reporting robust standard errors where the observations are clustered by country. We include country dummies in the second column, and time dummies in the third column. The restriction that $\mathrm{E}(Y_{it} \mid \widehat{Y}_{it}, \mathbf{x}_{it}) = \mathrm{Var}(Y_{it} \mid \widehat{Y}_{it}, \mathbf{x}_{it}) = \lambda_{it}$, an implicit assumption by the Poisson distribution, is accepted easily. We allow the slope of the FWCP-curves to vary between periods as seen from Figure 6 by interacting the floor variable with a period specific dummy. The positive coefficients on the floor variables pick up the downward slope of the FWCP-curves seen in most of the Figures 5–10 (note that the dependent variable is $1 - \text{FWCP}$, i.e. the fraction of wage cuts realised).

There is a strong positive correlation between inflation and the FWCP. The positive correlation between inflation and the FWCP is consistent with the bargaining model of DNWR in Holden (2004); under high inflation, nominal wage cuts are usually small, and a high proportion are prevented by DNWR. Under low inflation, nominal wage cuts are larger, and while DNWR works to reduce the size of the cuts, a larger fraction of them are nevertheless realised. As expected, we also find a negative effect of unemployment on the FWCP, at least when country or time dummies are included (without any dummies, the unemployment variable is presumably capturing time or country effects and the coefficient changes sign).

More strict EPL, higher union density and more centralisation are positively correlated with DNWR. Overall, the effects are robust to the inclusion of country and time dummies. The effect of union density, however, is smaller when time dummies are included, and the effect of EPL is not significant when we include country dummies. The latter result is not surprising, bearing in mind the limited time variation in the EPL-variable. More coordination in wage setting is negatively correlated with the FWCP, while we find no effect of minimum wages. More strict EPL, higher union density and more centralisation are thus associated with an upward shift in the FWCP-curves, while more coordination shifts the FWCP-curve downwards. The effects of EPL and union density are consistent with, although somewhat stronger than, the results in our previous work (Holden and Wulfsberg, 2008a), and also consistent with the theoretical arguments in Holden (2004). That centralisation leads to more DNWR is consistent with previous findings that centralisation of wage setting leads to wage compression (see Wallerstein, 1999). Our finding indicates that centralisation also leads to compression of wage changes, in the sense that low nominal wage changes are pushed up towards the median. In contrast, coordination of wage setting seems to induce less downward wage rigidity. This is in line with the idea that coordination of wage setting is about ensuring overall wage moderation, without necessarily affecting relative wages. Countries with both centralisation and coordination of wage setting thus have about the same DNWR as countries with neither centralisation nor coordination.

As a further test of the effect of institutions on DNWR, we exploit that in the absence of DNWR, the institutional variables should not be able to explain the country-year variation in the empirical incidence rate of wage changes below each floor. Thus, we do the same regressions as above, but without including the notional incidence rates in the regressions. While this involves loss of information, it also has the advantage that it does not rely on a specific distribution of the notional wage changes, making it complementary to the former regressions. Thus, we estimate the effects of the explanatory variables on the empirical incidence rate of wage changes (below each floor), instead of the fraction of wage changes realised. In other words, in this model we let the expected number of wage cuts, λ_{it}, depend on the number of observations (industries) in the country-year sample, S_{it}, instead of $\widehat{Y}_{it}$:

$$\lambda_{it} = S_{it} e^{\mathbf{x}'_{it}\boldsymbol{\gamma}}. \tag{8}$$

Since $\lambda_{it} = \mathrm{E}\left(Y(\phi)_{it} \mid S_{it}, \mathbf{x}_{it}\right)$ we get

$$q(\phi)_{it} = \frac{Y(\phi)_{it}}{S_{it}} = e^{\mathbf{x}_{it}'\boldsymbol{\gamma}+\varepsilon_{it}}, \tag{9}$$

where ε_{it} is an error term. With this specification the poisson restriction $\mathrm{E}(Y_{it} \mid S_{it}, \mathbf{x}_{it}) = \mathrm{Var}(Y_{it} \mid S_{it}, \mathbf{x}_{it}) = \lambda_{it}$ is rejected, hence we use the negative binomial regression model, which allows for "overdispersion".[5]

The results are displayed in the last three columns of Table 1. In accordance with the theoretical predictions, EPL, union density, centralisation and inflation, all have a negative effect on the incidence of nominal wage changes below each floor, while coordination and unemployment have a positive effect. The effects of the institutional variables are significant apart from coordination in the model without dummies, EPL in the model with country dummies, and union density in the model with time dummies.

5 Concluding remarks

A number of recent papers have provided extensive evidence for the existence of considerable downward nominal wage rigidity (DNWR) for job stayers, in many different countries see e.g. Knoppik and Beissinger (2005) and Dickens et al. (2007). However, various mechanisms may transform DNWR at zero wage growth for individual workers to floors at positive or negative growth rates for aggregate wages. For example, aggregate wages fall when old, high-wage workers are replaced by younger workers with lower wages. The effect of the DNWR may then be a floor on nominal wage growth that is below zero, e.g. at minus 2 percent. On the other hand, downward wage rigidity may also involve growth in aggregate wages, to allow for changes in relative wages. Furthermore, when wages are rigid downwards, it may provide workers with the possibility of threatening to work less efficiently (work-to-rule), without the firm being able to retaliate, thus forcing firms to grant a nominal wage increase.

We explore the existence of floors on nominal wage growth on industry data for 19 OECD countries, for the period 1973–2006. For the 1970s and 1980s, we find evidence of floors on nominal wage growth in OECD countries at all rates from minus 2 to plus 6 percent. Thus, there were significantly less nominal wage changes below these growth rates than one would have expected if wage setting had been entirely flexible. While our data with few exceptions does not allow for conclusions about the existence of wage growth floors for individual countries, we do have indication of floors for the nominal wage growth up till 4 percent growth for all the four regions we consider, namely Anglo (native English-speaking countries), Southern European countries, Nordic countries, and Core European countries.

[5]Overdispersion means that the variance in the data is greater than the mean, in contrast to the Poisson assumption that the variance and the mean are equal. Using a goodness-of fit test from a Poisson regression of Y_{it}/S_{it}, we reject no overdispersion with $\chi^2(11, 721) = 12566.57$. Including a Gamma-distributed error term, ε_{it}, allows the variance-to-mean ratios of Y_{it} to be larger than unity.

The floors on nominal wage growth in the 1970s and 1980s, even if considerably below average inflation (in our sample an unweighted average of all countries of 10 percent in the 1970s and 8 percent in the 1980s), may have contributed to causing persistent inflation in this period. A recent literature (see e.g. Nelson, 2005 and Meltzer, 2005) have argued that the rise and persistence of high inflation in these years were mainly caused by several errors in the conduct of the monetary policy. Our results add to these explanations by showing that in the 1970s and 80s, an inflationary tendency was entrenched in the wage setting system in many OECD countries. Given the floors on nominal wage growth, a restrictive monetary policy to restrain wage and price growth would have led to further compression of the wage change distribution, inducing both greater wage pressure and compression of relative wages. The upshot would have been greater short run costs in the form of higher unemployment from anti-inflation policies. Thus, our results can help explaining why policymakers in most OECD countries failed to pursue a sufficiently tight monetary policy in the 1970s, and why the costs in terms of higher unemployment were so severe when policy finally was tightened in the 1980s and 1990s.

The existence of these floors to growth in nominal wages must be seen in light of the persistent high inflation rates in these decades. However, it is also clear that the existence of the floors was not only a matter of persistent high inflationary expectations. High inflation expectations would affect the location of the wage change distribution, as wage setters would set high nominal wage increases to reach their target real wages, but it should not affect the shape of the distribution. Thus, high inflationary expectations would not by itself compress the lower part of the wage change distribution, which is the effect we find in the 1970s and 1980s.

In the 1990s we also find evidence of a floor on nominal wage growth at zero percent, implying that 17 percent of the industry wage changes that should have been negative, are pushed above zero by binding DNWR. In the 2000s, the evidence is weaker, yet there is some indication of a floor on wage growth at the OECD level, and also some evidence for the Southern European countries. For the Nordic countries there is, however, more robust evidence of significant DNWR also for the 2000s. The evidence of DNWR in Southern European countries is especially interesting in light of the apparent high cost levels in these countries, combined with the fact that they are members of the EMU, and thus do not have the possibility of devaluing the currency. In Portugal and Italy, high nominal wage growth relative to the productivity growth have led to a steady loss of competitiveness, amplifying the difficult economic situation these countries are in (Blanchard, 2007). If nominal wages are rigid downwards in these countries, it may be difficult to escape from a position with weak international competitiveness.

The more limited and weaker evidence of DNWR in the 2000s may to some extent reflect institutional changes like lower union density in many countries. It may also reflect a stronger pressure on wages arising from increasing globalisation, or changes in wage setting systems, as more flexible pay systems, providing firms with more flexibility to reduce wages. However, our finding of less significant DNWR in the 2000s may to some extent also be due to our method being less able to detect DNWR in a low inflation era.

We also find that the extent of DNWR depends on institutional and economic variables. We find that wages are more rigid downwards when employment protection legislation is strict, union density is high, and wages are set a centralised level. Coordination of wage setting leads, however, to less DNWR.

Our finding of widespread DNWR in OECD countries over the recent decades raises the question of how this feature of the wage setting has affected other important variables like output, employment and unemployment. Our analysis yields country-year specific estimates of DNWR, albeit noisy, for 19 countries over more that 30 year, hence it provides a good starting point for future work. A considerable extension of the data set in terms of variables would be required, but it seems an interesting avenue for future research.

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A Data

We have obtained wage data for most countries and years from the ILO. The precise source is Table 5A (Wages by economic activity) and Table 5B (Wages in manufacturing), from yearly statistics under the domain Wages in the *Laborsta* database (`laborsta.ilo.org`). Wage changes are calculated for observations within groups of the same source, worker coverage, sex, type of data, industry classification, country and year. We use observations covering both men and women. If observations for both men and women are not available, we use observations covering only men or only women. The wage variable is labeled either "Earnings per hour" or "Wage rates per hour". When they serve as alternatives, "Earnings per hour" is used. The worker coverage is either "Salaried employees", "Employees" or "Wage earners". The latter is preferred over the others, "Employees" is preferred over "Salaried employees". If there are several series with different sources available we have chosen the series with most observations.

The industry classifications used are ISIC rev. 2 and ISIC rev. 3. The data classified by ISIC rev. 2 cover the groups: Mining and Quarrying (2), Manufacturing (3), Electricity, Gas and Water (4) and Construction (5). The data classified by ISIC rev. 3 covers Mining and Quarrying (C), Manufacturing (D), Electricity, Gas and Water Supply (E) and Construction (F). We use data on various levels of aggregation from the section levels (e.g., D Manufacturing) to group levels (e.g., DA 15 Manufacture of Food Products and Beverages), however, using the most disaggregate level available in order to maximize the number of observations. If, for example, wage data are available for D and DA 15, we use the latter only to avoid counting the same observations twice. The data chosen for Germany is the series labeled "Germany, Fed. Rep. of before 3.10.1990", thus the series relates to the territory of the Fed. Rep. of Germany before 3.10.1990.

Some country-year samples are missing from the ILO database, for which we use data from Eurostat. These country-years are Austria (1974–1999), Belgium (1995), Germany (1973) Spain (1996), France (1976, 1985, 1988, 1994–1996), Ireland (1985), Italy (1973–1985), Portugal (1994, 1995, 1998) and United Kingdom (1980, 1983). The precise source is Table *hmwhour* in the Harmonized Earnings Domain under the Population and Social Conditions theme in the NEWCRONOS database. *hmwhour* is labeled "Gross hourly earnings of manual workers in industry". Gross earnings cover remuneration in cash paid directly and regularly by the employer at the time of each wage payment, before tax deductions and social security contributions payable by wage earners and retained by the employer. Payments for leave, public holidays, and other paid individual absences, are included in principle, in so far as the corresponding days or hours are also taken into account to calculate earnings per unit of time. The weekly hours of work are those in a normal week's work (i.e., not including public holidays) during the reference period (October or last quarter). These hours are calculated on the basis of the number of hours paid, including overtime hours paid. Furthermore, we use data in national currency, and males and females are both included in the data. The data for Germany does not include GDR before 1990 or new Länder. The data are recorded by classification of economic activities (NACE Rev. 1). The sections represented are Mining and quarrying (C), Manufacturing (D), Electricity, gas and water supply (E), and Construction (F). The principles guiding which observation to choose when several are available are the same as described for the ILO data. Data for wages in manufacturing for Italy 2002–2006 are from Istat (*Istituto nazionale di statistica*). Data for Norway are from Statistics Norway. The distribution of the number of observations by years and countries are reported in Table A1. We have removed 3 extreme observations from the sample. The average number of observations per country-year sample is 22.6, with a standard error of 4.9. Table A2 shows the 35th percentile wage growth in each country-year sample.

Data for inflation and unemployment are from the OECD Economic Outlook database.

The primary sources for the employment protection legislation (EPL) index, which is displayed in Table A3, are OECD (2004) for the 1980–1999 period and Lazear (1990) for the years before 1980. We follow the same procedure as Blanchard and Wolfers (2000) to construct time-varying series, which is to use the OECD summary measure in the 'Late 1980s' for 1980–89 and the 'Late 1990s' for 1995–99. For 1990–94, we interpolate the series. For 1973–79, the percentage change in Lazear's index is used to back-cast the OECD measure. However, we are not able to reconstruct the Blanchard and Wolfers data exactly.

Data for union density before 1990 is from OECD (2004). Data for Greece for 1978 and 1979 are interpolated, while data before 1977 is extrapolated at the 1977 level. From 1990 onwards we have used data from Visser (2006). Data for centralisation and coordination are from the OECD (2004, Table 3.5) extrapolated with information from Du Caju et al. (2009).

Table A1: The number of industry observations by countries and years.

	Anglo					Core						Nordic				South				
	CA	IE	NZ	UK	US	AT	BE	FR	DEW	LU	NL	DK	FI	NO	SE	GR	IT	PT	ES	Total
1971	26			24	22		24		25	14	25			21		20				201
1972	26		30	23	22				25		25			21	30	20		24		246
1973	26		30	24	21		26	22	23	17	32	19	18	22	30	20	23	26		379
1974	26	24	30	24	22	16	26	22	27	17	32	19	18	23		20	24	22		392
1975	26	24	31	24	20	16	26	22	27	16	31	19	18	23	30	13	24	17		407
1976	26	23	30	24	20	16	26	22	27	17	31	19	18	23	28	20	24	24		418
1977	26	23	30	24	20	16	26	22	27	18	31	19	18	23	28	20	24	25		420
1978	26	24	30	24	20	16	26	22	27	18	31	19	18	23	26	20	24	28	10	432
1979	26	24	30	24	20	16	26	22	27	18	31	19	18	23	30	20	24	28	10	436
1980	26	24	30	22	20	16	26	22	27	18	31	19	18	23	30	20	24	28	10	434
1981	25	24	30	24		16	26	22	27	14	31	19	18	23	30	20	23	27	10	409
1982	22	24	28	24	21	16	26	20	27	20	31	19	18	23	31	20	24	29	10	433
1983		24	30	24	21	16	26	20	27	22	31	19	18	23	31	11	24	30	10	407
1984	31	23	31	27	21	16	26	20	27	21	25	19	18	23	31	20	24	28	10	441
1985	31	19	31	27	21	16	26	23	27	16	25	19	18	23	31	18	24	28	13	436
1986	31	23	30	30	21	16	26	20	27	17	28	19	19	23	30	20		28	13	421
1987	29	23	30	25	21	16	27	28	27	17	28	19	19	23	31	20		28	13	424
1988	31	23	31	25	18	16	27	23	27	16	27	19	19	23	31	20		27	12	415
1989	31	23		25	23	16	27	18	27	20	27	18	19	23	31	20		28	13	389
1990	31	23	31	25	23	16	27	18	27	11	29	19	19	23	30	20		19	28	419
1991	27	23	31	25	23	16	27	18	27	11	29	19	19	23		20		19	28	385
1992	29	23	31	25	23	16	27	18	27	12	27	19	19	23	16	20		20	27	402
1993	29	20	31	25	23	16	27	18	27	13	25	20	19	23	17	20		20	28	401
1994	23	20	31	24	23	16	27	15	27	12			19	23	17	20		23	28	348
1995	23	19	31	24	23	16	21	10	27	12	20		18	23	17	20		23	28	355
1996	26	19	31	25	23	14	24	12	25	18	21	26		23	17	20		21	24	369
1997	26	19	31	25	21	14	23	26	26	18	22	25		23	15	20		21	26	381
1998	26	19	31	26	21	14	23	26	26	18	22	26		23	17	20		29	26	393
1999	26	15	25	27	21	14		26	26	18	22	25		23	17			16	26	327
2000	26	15		27	21	25	26	26	24	18	22	26	11	23	17				26	333
2001	26	15	24	27	21	25	26	26	24	18	22	26	11	23	22			16	26	378
2002	26	15	24	27	18	25	26	25	24	18	22	26	11	23	22		22	16	26	396
2003	26	15	24	27	15	24	25	25	24	18	22	26		23	22		22		26	364
2004	26	15	24	26	15	24	25	24		18	22	26	11	23	22		22	17	26	366
2005	26	15	23	26	15	25	25	26		18	22	26		24	22		22	17	26	358
2006	26	15		25		25				18					22		22		26	179
Total	939	677	935	904	703	581	848	709	866	585	902	657	467	801	821	542	420	752	585	13,694

Table A2: The 35th percentile wage growth by countries and years. Percent.

	Anglo					Core						Nordic				South			
Year	CA	IE	NZ	UK	US	AT	BE	FR	DEW	LU	NL	DK	FI	NO	SE	GR	IT	PT	ES
1971	8.3			10.0	6.4		11.8		11.4	8.0	14.1			11.6		6.0			
1972	7.4		8.5	13.2	6.5				8.8		12.3			10.0	11.3	5.1		13.8	
1973	8.1		13.8	12.3	5.9		13.0	14.1	10.9	12.6	14.5	17.0	16.5	10.0	7.7	13.5	24.2	12.7	
1974	12.4	18.8	15.5	19.6	7.3	14.7	24.2	20.3	10.7	17.9	16.5	18.2	20.8	16.4		29.4	20.6	46.7	
1975	15.6	25.8	13.2	24.1	8.2	10.9	15.7	15.2	7.4	17.8	13.1	17.3	20.3	18.3	15.8	29.2	23.8	37.7	
1976	12.4	15.0	13.6	11.2	7.6	9.1	10.2	14.3	6.3	13.1	7.3	11.4	13.9	16.1	12.1	23.1	21.9	18.3	
1977	9.6	13.0	13.8	7.8	7.9	8.2	8.2	12.2	7.0	6.1	10.0	9.9	8.2	12.1	8.0	17.8	21.0	14.0	
1978	6.8	14.9	13.4	14.9	7.8	5.3	5.6	11.2	5.2	2.8	5.1	8.9	7.0	9.1	11.6	25.0	14.6	13.3	28.7
1979	8.7	16.9	14.5	16.0	8.0	4.9	6.6	11.4	5.3	5.0	4.1	10.2	10.8	4.8	8.3	20.9	16.7	18.2	23.6
1980	9.7	13.6	11.3	16.5	8.5	6.5	8.3	15.2	6.1	8.1	4.7	8.4	11.8	8.0	10.3	25.0	18.5	21.5	16.8
1981	12.0	18.8	18.0	8.6		6.4	11.2	14.1	5.5	5.6	5.2	9.2	12.2	10.5	8.7	23.5	24.0	19.2	18.0
1982	10.6	13.8	16.3	7.7	6.8	5.6	5.1	12.8	4.5	6.1	6.4	9.4	10.1	10.3	5.2	35.4	16.0	19.2	15.3
1983		8.5	3.4	8.7	4.5	4.0	4.9	12.4	3.3	7.0	1.5	6.8	9.7	8.4	5.9	16.6	14.9	17.7	14.8
1984	4.5	8.8	1.1	6.2	3.2	4.1	3.7	5.6	2.3	3.6	0.8	4.6	8.7	9.4	10.6	15.5	5.3	15.3	10.1
1985	3.0	6.9	6.2	6.8	3.2	5.4	4.0	5.6	3.0	3.3	1.7	4.3	7.5	8.7	7.8	16.1	10.1	20.4	8.0
1986	2.6	6.1	17.8	6.5	1.9	4.0	-0.0	2.8	3.2	1.3	1.1	3.3	5.7	8.7	7.0	11.5		18.7	8.1
1987	2.7	3.3	11.3	7.0	1.8	2.5	1.8	3.9	3.9	2.6	2.1	9.3	7.0	12.8	6.4	9.9		13.6	7.4
1988	3.1	4.7	8.2	6.4	2.7	3.3	1.7	1.4	3.8	3.2	1.4	6.1	7.6	5.5	7.5	16.8		11.9	7.4
1989	4.2	3.4		8.0	2.9	2.8	4.0	2.9	3.6	5.5	2.5	4.0	7.0	4.1	9.1	20.2		15.6	9.7
1990	3.9	5.0	4.6	9.1	3.2	6.1	4.7	4.3	4.9	3.9	3.4	3.8	8.9	5.8	9.4	19.0		13.5	9.1
1991	3.8	3.6	2.9	9.5	3.1	5.1	5.4	4.4	5.9	4.5	3.3	4.3	4.1	5.0		15.7		12.6	10.4
1992	2.8	3.7	1.6	6.1	2.3	5.3	4.1	3.6	5.3	7.7	5.4	3.2	1.7	2.4	7.1	13.0		12.4	6.5
1993	0.6	5.7	-0.1	4.2	2.1	3.2	3.7	1.9	4.9	4.8	3.4	1.5	1.5	2.6	-0.1	10.5		6.6	5.6
1994	0.6	1.0	0.1	0.8	2.4	3.7	3.3	-2.1	2.6	3.2			2.9	3.0	3.4	12.5		3.8	3.5
1995	1.4	1.9	2.7	3.0	2.0	3.6	-5.9	2.6	3.1	2.8	2.3		6.1	4.4	2.9	10.6		4.0	4.3
1996	1.6	1.5	2.9	2.9	2.7	3.6	2.3	3.2	1.9	-0.7	3.4	5.3		4.1	6.2	7.3		5.3	3.0
1997	0.4	2.2	3.5	2.0	2.6	1.6	1.9	1.3	1.1	3.2	2.7	2.0		4.4	3.0	8.3		6.2	3.7
1998	0.9	2.5	2.5	5.1	3.0	2.1	2.6	2.0	1.5	1.3	3.2	3.1		5.4	2.8	4.3		1.3	3.6
1999	-0.4	4.9	2.0	2.5	2.8	1.8		1.2	2.2	3.3	3.7	5.3		5.1	1.8			11.4	2.1
2000	1.0	5.0		3.0	3.5	1.9	2.9	4.4	2.0	3.4	2.9	1.3	4.7	4.7	3.6				2.3
2001	1.2	8.2	2.1	4.1	2.5	2.3	2.7	4.2	1.3	-0.3	5.3	4.2	3.3	5.7	2.4			6.6	2.9
2002	2.4	6.3	2.6	4.2	2.3	2.9	1.5	7.8	2.1	3.4	2.7	3.4	2.8	6.4	1.8		2.4	9.3	3.4
2003	0.9	4.5	-0.5	2.7	2.5	2.6	3.1	3.1	2.1	3.0	3.0	3.2		3.0	3.2		2.3		4.0
2004	0.4	2.9	2.5	2.3	2.5	1.7	2.6	2.6		3.8	1.4	0.3	2.7	2.4	2.9		1.7	2.4	3.0
2005	1.3	3.5	0.5	3.2	1.0	2.3	1.8	1.7		3.2	0.9	3.0		3.6	2.3		2.3	0.6	1.9
2006	0.3	3.1		2.7		2.5				-0.4					2.8		2.4		4.5

Table A3: Indices for employment protection legislation, EPL.

Year	*AT*	*BE*	*CA*	*DE*	*DK*	*ES*	*FI*	*FR*	*GR*	*IE*	*IT*	*NL*	*NO*	*NZ*	*PT*	*SW*	*UK*	*US*
1971	1.17	3.20	0.80	3.20	2.30	4.00	2.30	2.18	3.60	0.63	3.60	2.70	2.90	0.90	2.67	1.63	0.52	0.20
1972	1.25	3.20	0.80	3.20	2.30	4.00	2.30	2.31	3.60	0.70	3.60	2.70	2.90	0.90	2.92	2.10	0.54	0.20
1973	1.32	3.20	0.80	3.20	2.30	4.00	2.30	2.44	3.60	0.76	3.60	2.70	2.90	0.90	3.17	2.57	0.56	0.20
1974	1.39	3.20	0.80	3.20	2.30	4.00	2.30	2.57	3.60	0.83	3.60	2.70	2.90	0.90	3.43	3.03	0.58	0.20
1975	1.47	3.20	0.80	3.20	2.30	4.00	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	3.68	3.50	0.60	0.20
1976	1.61	3.20	0.80	3.20	2.30	3.96	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	3.76	3.50	0.60	0.20
1977	1.76	3.20	0.80	3.20	2.30	3.92	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	3.85	3.50	0.60	0.20
1978	1.91	3.20	0.80	3.20	2.30	3.88	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	3.93	3.50	0.60	0.20
1979	2.05	3.20	0.80	3.20	2.30	3.84	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	4.02	3.50	0.60	0.20
1980	2.20	3.20	0.80	3.20	2.30	3.80	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	4.10	3.50	0.60	0.20
1981	2.20	3.20	0.80	3.20	2.30	3.80	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	4.10	3.50	0.60	0.20
1982	2.20	3.20	0.80	3.20	2.30	3.80	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	4.10	3.50	0.60	0.20
1983	2.20	3.20	0.80	3.20	2.30	3.80	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	4.10	3.50	0.60	0.20
1984	2.20	3.20	0.80	3.20	2.30	3.80	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	4.10	3.50	0.60	0.20
1985	2.20	3.20	0.80	3.20	2.30	3.80	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	4.10	3.50	0.60	0.20
1986	2.20	3.20	0.80	3.20	2.30	3.80	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	4.10	3.50	0.60	0.20
1987	2.20	3.20	0.80	3.20	2.30	3.80	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	4.10	3.50	0.60	0.20
1988	2.20	3.20	0.80	3.20	2.30	3.80	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	4.10	3.50	0.60	0.20
1989	2.20	3.20	0.80	3.20	2.30	3.80	2.30	2.70	3.60	0.90	3.60	2.70	2.90	0.90	4.10	3.50	0.60	0.20
1990	2.20	3.03	0.80	3.08	2.15	3.65	2.27	2.75	3.58	0.90	3.45	2.60	2.87	0.90	4.03	3.28	0.60	0.20
1991	2.20	2.87	0.80	2.97	2.00	3.50	2.23	2.80	3.57	0.90	3.30	2.50	2.83	0.90	3.97	3.07	0.60	0.20
1992	2.20	2.70	0.80	2.85	1.85	3.35	2.20	2.85	3.55	0.90	3.15	2.40	2.80	0.90	3.90	2.85	0.60	0.20
1993	2.20	2.53	0.80	2.73	1.70	3.20	2.17	2.90	3.53	0.90	3.00	2.30	2.77	0.90	3.83	2.63	0.60	0.20
1994	2.20	2.37	0.80	2.62	1.55	3.05	2.13	2.95	3.52	0.90	2.85	2.20	2.73	0.90	3.77	2.42	0.60	0.20
1995	2.20	2.20	0.80	2.50	1.40	2.90	2.10	3.00	3.50	0.90	2.70	2.10	2.70	0.90	3.70	2.20	0.60	0.20
1996	2.20	2.20	0.80	2.50	1.40	2.90	2.10	3.00	3.50	0.90	2.70	2.10	2.70	0.90	3.70	2.20	0.60	0.20
1997	2.20	2.20	0.80	2.50	1.40	2.90	2.10	3.00	3.50	0.90	2.70	2.10	2.70	0.90	3.70	2.20	0.60	0.20
1998	2.20	2.20	0.80	2.50	1.40	2.90	2.10	3.00	3.50	0.90	2.70	2.10	2.70	0.90	3.70	2.20	0.60	0.20
1999	2.20	2.20	0.80	2.50	1.40	2.90	2.10	3.00	3.50	0.90	2.70	2.10	2.70	0.90	3.70	2.20	0.60	0.20
2000	2.13	2.13	0.80	2.42	1.40	2.95	2.07	3.00	3.33	0.95	2.50	2.10	2.67	1.05	3.65	2.20	0.63	0.20
2001	2.05	2.05	0.80	2.35	1.40	3.00	2.05	3.00	3.15	1.00	2.30	2.10	2.65	1.20	3.60	2.20	0.65	0.20
2002	1.98	1.98	0.80	2.28	1.40	3.05	2.03	3.00	2.97	1.05	2.10	2.10	2.63	1.35	3.55	2.20	0.68	0.20
2003	1.90	1.90	0.80	2.20	1.40	3.10	2.00	3.00	2.80	1.10	1.90	2.10	2.60	1.50	3.50	2.20	0.70	0.20
2004	1.90	1.90	0.80	2.20	1.40	3.10	2.00	3.00	2.80	1.10	1.90	2.10	2.60	1.50	3.50	2.20	0.70	0.20
2005	1.90	1.90	0.80	2.20	1.40	3.10	2.00	3.00	2.80	1.10	1.90	2.10	2.60	1.50	3.50	2.20	0.70	0.20
2006	1.90	1.90	0.80	2.20	1.40	3.10	2.00	3.00	2.80	1.10	1.90	2.10	2.60	1.50	3.50	2.20	0.70	0.20

Table A4: Trade union density, percent.

Year	*AT*	*BE*	*CA*	*DE*	*DK*	*ES*	*FI*	*FR*	*GR*	*IE*	*IT*	*LU*	*NL*	*NO*	*NZ*	*PT*	*SW*	*UK*	*US*
1971	61.9	43.4	33.0	32.1	62.2	12.9	56.2	21.6	35.8	53.2	39.7	45.8	36.2	57.0	55.2	60.8	70.0	45.3	26.9
1972	61.0	46.1	35.0	32.4	61.5	12.9	60.8	21.6	35.8	53.6	41.8	45.1	36.6	51.9	56.4	60.8	71.4	46.2	26.3
1973	60.8	47.6	34.6	32.4	62.2	12.9	61.4	22.1	35.8	53.3	43.3	45.0	36.2	53.2	57.5	60.8	72.5	45.5	23.5
1974	57.9	49.0	35.0	33.7	65.2	12.9	63.2	21.7	35.8	53.9	46.2	45.6	36.0	54.1	58.7	60.8	73.5	46.4	23.2
1975	59.0	51.8	36.3	34.6	68.9	12.9	65.3	22.2	35.8	55.3	48.0	45.7	37.8	53.8	59.8	60.8	74.5	48.3	21.6
1976	59.2	52.6	35.7	35.1	73.0	12.9	67.6	21.4	35.8	56.3	50.5	46.7	37.1	52.8	61.0	60.8	73.9	49.4	21.6
1977	58.6	53.5	36.5	35.2	74.1	12.9	66.4	21.4	35.8	57.0	49.8	47.7	37.2	53.6	63.7	60.8	76.0	51.1	23.2
1978	57.6	53.1	36.0	35.5	77.8	12.9	66.9	20.7	36.9	57.6	50.4	48.9	37.0	54.0	66.3	60.8	77.0	51.8	22.4
1979	56.7	53.8	35.1	35.3	77.1	12.9	68.1	19.2	37.9	57.5	49.7	49.4	36.6	55.5	69.0	60.2	77.3	51.6	23.4
1980	56.7	54.1	34.9	34.9	78.6	12.9	69.4	18.3	39.0	57.1	49.6	50.8	34.8	58.3	69.1	59.7	78.0	50.7	22.3
1981	56.4	53.4	35.3	35.1	79.9	7.4	68.3	17.8	38.8	56.6	48.0	52.2	33.5	57.9	65.7	61.8	78.3	50.5	21.0
1982	53.8	52.1	35.8	35.0	80.2	8.4	68.4	17.0	38.4	56.1	46.7	52.5	32.8	58.1	65.1	61.1	78.9	48.7	20.2
1983	53.6	51.9	36.6	35.0	80.8	8.9	68.8	16.0	38.6	57.2	45.5	53.0	31.3	58.1	64.5	57.8	79.6	48.0	19.5
1984	52.1	52.0	34.7	34.9	79.3	8.6	69.0	14.9	38.0	57.0	45.3	53.0	30.0	58.3	59.5	56.3	80.8	47.5	18.2
1985	51.6	52.4	32.6	34.7	78.2	8.9	69.1	13.6	37.5	54.2	42.5	52.3	28.7	57.5	56.0	54.6	81.3	46.2	17.4
1986	50.6	51.5	33.0	33.9	77.4	8.6	70.0	12.5	37.2	51.6	40.4	51.1	27.3	57.1	54.1	51.4	82.5	44.8	17.0
1987	49.6	51.6	32.9	33.3	75.0	9.1	70.7	11.9	36.3	50.2	40.0	49.8	24.9	55.7	52.8	47.7	82.4	44.5	16.5
1988	48.9	51.4	34.3	33.1	73.8	9.6	72.3	11.2	34.9	50.5	39.8	48.1	24.7	56.1	54.2	42.3	81.4	42.6	16.2
1989	48.0	52.4	33.0	32.4	75.6	10.0	73.0	10.7	33.7	51.8	39.4	46.1	25.1	58.0	55.1	37.6	80.7	40.6	15.9
1990	46.9	53.9	32.9	31.2	75.3	12.5	72.5	10.1	32.4	51.1	38.8	44.7	24.3	58.5	51.0	31.7	80.8	39.3	15.5
1991	45.5	54.3	35.3	36.0	75.8	14.7	75.4	9.9	32.4	50.2	38.7	42.6	24.1	58.1	44.4	31.5	80.6	38.5	15.5
1992	44.3	54.3	33.1	33.9	75.8	16.5	78.4	9.9	32.0	49.8	38.9	41.5	25.2	58.1	37.1	29.0	83.3	37.2	15.1
1993	43.2	55.0	32.8	31.8	77.3	18.0	80.7	9.6	31.1	47.7	39.2	40.7	25.9	58.0	34.5	28.6	83.9	36.1	15.1
1994	41.4	54.7	34.2	30.4	77.5	17.6	80.3	9.2	30.3	46.2	38.7	39.6	25.6	57.8	30.2	27.3	83.8	34.2	14.9
1995	41.1	55.7	33.8	29.2	77.0	16.3	80.4	9.0	29.6	45.8	38.1	38.6	25.7	57.3	27.6	25.4	83.1	32.6	14.3
1996	40.1	55.9	34.0	27.8	77.1	16.1	80.4	8.3	28.9	45.5	37.4	38.4	25.1	56.3	24.9	24.8	82.7	31.7	14.0
1997	38.9	56.0	28.8	27.0	75.3	15.7	79.5	8.2	28.6	43.5	36.2	38.0	25.1	55.5	23.6	24.3	82.2	30.6	13.6
1998	38.4	55.4	28.5	25.9	75.6	16.4	78.0	8.0	26.7	41.5	35.7	37.4	24.5	55.5	22.3	23.3	81.3	30.1	13.4
1999	37.4	55.1	27.9	25.6	74.1	16.2	76.3	8.1	26.1	40.6	36.1	35.7	24.6	54.5	21.9	23.5	80.6	29.8	13.4
2000	36.5	55.6	28.1	25.0	73.3	16.1	75.0	8.2	26.0	37.8	34.9	34.9	23.1	53.7	22.7	23.5	79.1	29.7	12.8
2001	35.7	55.8	28.2	23.5	72.5	16.1	74.5	8.1	25.4	36.6	34.8	33.6	22.5	52.8	22.6	23.4	78.0	29.3	12.8
2002	35.4	55.4	28.2	23.2	71.5	16.2	74.8	8.3	25.4	36.3	34.0	33.6	22.4	53.0	22.1	23.4	78.0	29.2	12.6
2003	35.4	55.4	28.4	22.6	70.4	16.3	74.1	8.3	25.4	35.3	33.7	33.6	22.3	53.3	22.1	23.4	78.0	29.3	12.4
2004	35.4	55.4	28.4	22.6	70.4	16.3	74.1	8.3	25.4	35.3	33.7	33.6	22.3	53.3	22.1	23.4	78.0	29.3	12.4
2005	35.4	55.4	28.4	22.6	70.4	16.3	74.1	8.3	25.4	35.3	33.7	33.6	22.3	53.3	22.1	23.4	78.0	29.3	12.4
2006	35.4	55.4	28.4	22.6	70.4	16.3	74.1	8.3	25.4	35.3	33.7	33.6	22.3	53.3	22.1	23.4	78.0	29.3	12.4

Table A5: Indices of centralisation.

Year	*AT*	*BE*	*CA*	*DE*	*DK*	*ES*	*FI*	*FR*	*IE*	*IT*	*NL*	*NO*	*NZ*	*PT*	*SW*	*UK*	*US*
1971	3.0	4.0	1.0	3.0	5.0	5.0	5.0	2.0	4.0	2.0	3.0	4.5	3.0	5.0	5.0	2.0	1.0
1972	3.0	4.0	1.0	3.0	5.0	5.0	5.0	2.0	4.0	2.0	3.0	4.5	3.0	5.0	5.0	2.0	1.0
1973	3.0	4.0	1.0	3.0	5.0	5.0	5.0	2.0	4.0	2.0	3.0	4.5	3.0	5.0	5.0	2.0	1.0
1974	3.0	4.0	1.0	3.0	5.0	5.0	5.0	2.0	4.0	2.0	3.0	4.5	3.0	5.0	5.0	2.0	1.0
1975	3.0	3.5	1.0	3.0	5.0	4.0	5.0	2.0	4.0	2.0	3.0	4.5	3.0	4.0	5.0	2.0	1.0
1976	3.0	3.5	1.0	3.0	5.0	4.0	5.0	2.0	4.0	2.0	3.0	4.5	3.0	4.0	5.0	2.0	1.0
1977	3.0	3.5	1.0	3.0	5.0	4.0	5.0	2.0	4.0	2.0	3.0	4.5	3.0	4.0	5.0	2.0	1.0
1978	3.0	3.5	1.0	3.0	5.0	4.0	5.0	2.0	4.0	2.0	3.0	4.5	3.0	4.0	5.0	2.0	1.0
1979	3.0	3.5	1.0	3.0	5.0	4.0	5.0	2.0	4.0	2.0	3.0	4.5	3.0	4.0	5.0	2.0	1.0
1980	3.0	3.0	1.0	3.0	3.0	4.0	4.0	2.0	1.0	3.5	3.0	3.5	3.0	3.0	4.5	1.0	1.0
1981	3.0	3.0	1.0	3.0	3.0	4.0	4.0	2.0	1.0	3.5	3.0	3.5	3.0	3.0	4.5	1.0	1.0
1982	3.0	3.0	1.0	3.0	3.0	4.0	4.0	2.0	1.0	3.5	3.0	3.5	3.0	3.0	4.5	1.0	1.0
1983	3.0	3.0	1.0	3.0	3.0	4.0	4.0	2.0	1.0	3.5	3.0	3.5	3.0	3.0	4.5	1.0	1.0
1984	3.0	3.0	1.0	3.0	3.0	4.0	4.0	2.0	1.0	3.5	3.0	3.5	3.0	3.0	4.5	1.0	1.0
1985	3.0	3.0	1.0	3.0	3.0	3.5	5.0	2.0	2.5	2.0	3.0	4.5	3.0	3.0	3.0	1.0	1.0
1986	3.0	3.0	1.0	3.0	3.0	3.5	5.0	2.0	2.5	2.0	3.0	4.5	3.0	3.0	3.0	1.0	1.0
1987	3.0	3.0	1.0	3.0	3.0	3.5	5.0	2.0	2.5	2.0	3.0	4.5	3.0	3.0	3.0	1.0	1.0
1988	3.0	3.0	1.0	3.0	3.0	3.5	5.0	2.0	2.5	2.0	3.0	4.5	3.0	3.0	3.0	1.0	1.0
1989	3.0	3.0	1.0	3.0	3.0	3.5	5.0	2.0	2.5	2.0	3.0	4.5	3.0	3.0	3.0	1.0	1.0
1990	3.0	3.0	1.0	3.0	3.0	3.0	5.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
1991	3.0	3.0	1.0	3.0	3.0	3.0	5.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
1992	3.0	3.0	1.0	3.0	3.0	3.0	5.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
1993	3.0	3.0	1.0	3.0	3.0	3.0	5.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
1994	3.0	3.0	1.0	3.0	3.0	3.0	5.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
1995	3.0	3.0	1.0	3.0	2.0	3.0	5.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
1996	3.0	3.0	1.0	3.0	2.0	3.0	5.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
1997	3.0	3.0	1.0	3.0	2.0	3.0	5.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
1998	3.0	3.0	1.0	3.0	2.0	3.0	5.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
1999	3.0	3.0	1.0	3.0	2.0	3.0	5.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
2000	3.0	3.0	1.0	3.0	2.0	3.0	4.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
2001	3.0	3.0	1.0	3.0	2.0	3.0	4.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
2002	3.0	3.0	1.0	3.0	2.0	3.0	4.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
2003	3.0	3.0	1.0	3.0	2.0	3.0	4.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
2004	3.0	3.0	1.0	3.0	2.0	3.0	4.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
2005	3.0	3.0	1.0	3.0	2.0	3.0	4.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0
2006	3.0	3.0	1.0	3.0	2.0	3.0	4.0	2.0	4.0	2.0	3.0	4.5	1.0	4.0	3.0	1.0	1.0

Table A6: Indices of coordination.

Year	*AT*	*BE*	*CA*	*DE*	*DK*	*ES*	*FI*	*FR*	*IE*	*IT*	*NL*	*NO*	*NZ*	*PT*	*SW*	*UK*	*US*
1971	5.0	4.0	1.0	4.0	5.0	5.0	5.0	2.0	4.0	2.0	3.0	4.5	4.0	5.0	4.0	3.0	1.0
1972	5.0	4.0	1.0	4.0	5.0	5.0	5.0	2.0	4.0	2.0	3.0	4.5	4.0	5.0	4.0	3.0	1.0
1973	5.0	4.0	1.0	4.0	5.0	5.0	5.0	2.0	4.0	2.0	3.0	4.5	4.0	5.0	4.0	3.0	1.0
1974	5.0	4.0	1.0	4.0	5.0	5.0	5.0	2.0	4.0	2.0	3.0	4.5	4.0	5.0	4.0	3.0	1.0
1975	5.0	3.5	3.0	4.0	5.0	4.0	5.0	2.0	4.0	2.0	4.0	4.5	4.0	4.0	4.0	4.0	1.0
1976	5.0	3.5	3.0	4.0	5.0	4.0	5.0	2.0	4.0	2.0	4.0	4.5	4.0	4.0	4.0	4.0	1.0
1977	5.0	3.5	3.0	4.0	5.0	4.0	5.0	2.0	4.0	2.0	4.0	4.5	4.0	4.0	4.0	4.0	1.0
1978	5.0	3.5	3.0	4.0	5.0	4.0	5.0	2.0	4.0	2.0	4.0	4.5	4.0	4.0	4.0	4.0	1.0
1979	5.0	3.5	3.0	4.0	5.0	4.0	5.0	2.0	4.0	2.0	4.0	4.5	4.0	4.0	4.0	4.0	1.0
1980	4.5	4.0	1.0	4.0	3.0	4.0	4.0	2.0	1.0	3.5	4.5	3.5	4.0	3.0	3.5	1.0	1.0
1981	4.5	4.0	1.0	4.0	3.0	4.0	4.0	2.0	1.0	3.5	4.5	3.5	4.0	3.0	3.5	1.0	1.0
1982	4.5	4.0	1.0	4.0	3.0	4.0	4.0	2.0	1.0	3.5	4.5	3.5	4.0	3.0	3.5	1.0	1.0
1983	4.5	4.0	1.0	4.0	3.0	4.0	4.0	2.0	1.0	3.5	4.5	3.5	4.0	3.0	3.5	1.0	1.0
1984	4.5	4.0	1.0	4.0	3.0	4.0	4.0	2.0	1.0	3.5	4.5	3.5	4.0	3.0	3.5	1.0	1.0
1985	4.0	4.0	1.0	4.0	4.0	3.5	5.0	2.0	2.5	2.0	4.0	4.5	4.0	3.0	3.0	1.0	1.0
1986	4.0	4.0	1.0	4.0	4.0	3.5	5.0	2.0	2.5	2.0	4.0	4.5	4.0	3.0	3.0	1.0	1.0
1987	4.0	4.0	1.0	4.0	4.0	3.5	5.0	2.0	2.5	2.0	4.0	4.5	4.0	3.0	3.0	1.0	1.0
1988	4.0	4.0	1.0	4.0	4.0	3.5	5.0	2.0	2.5	2.0	4.0	4.5	4.0	3.0	3.0	1.0	1.0
1989	4.0	4.0	1.0	4.0	4.0	3.5	5.0	2.0	2.5	2.0	4.0	4.5	4.0	3.0	3.0	1.0	1.0
1990	4.0	4.0	1.0	4.0	3.0	3.0	5.0	2.0	4.0	3.0	4.0	4.5	1.0	4.0	3.0	1.0	1.0
1991	4.0	4.0	1.0	4.0	3.0	3.0	5.0	2.0	4.0	3.0	4.0	4.5	1.0	4.0	3.0	1.0	1.0
1992	4.0	4.0	1.0	4.0	3.0	3.0	5.0	2.0	4.0	3.0	4.0	4.5	1.0	4.0	3.0	1.0	1.0
1993	4.0	4.0	1.0	4.0	3.0	3.0	5.0	2.0	4.0	3.0	4.0	4.5	1.0	4.0	3.0	1.0	1.0
1994	4.0	4.0	1.0	4.0	3.0	3.0	5.0	2.0	4.0	3.0	4.0	4.5	1.0	4.0	3.0	1.0	1.0
1995	4.0	4.5	1.0	4.0	4.0	3.0	5.0	2.0	4.0	4.0	4.0	4.5	1.0	4.0	3.0	1.0	1.0
1996	4.0	4.5	1.0	4.0	4.0	3.0	5.0	2.0	4.0	4.0	4.0	4.5	1.0	4.0	3.0	1.0	1.0
1997	4.0	4.5	1.0	4.0	4.0	3.0	5.0	2.0	4.0	4.0	4.0	4.5	1.0	4.0	3.0	1.0	1.0
1998	4.0	4.5	1.0	4.0	4.0	3.0	5.0	2.0	4.0	4.0	4.0	4.5	1.0	4.0	3.0	1.0	1.0
1999	4.0	4.5	1.0	4.0	4.0	3.0	5.0	2.0	4.0	4.0	4.0	4.5	1.0	4.0	3.0	1.0	1.0
2000	4.0	4.5	1.0	4.0	4.0	5.0	5.0	2.0	4.0	4.0	4.0	4.5	1.0	4.0	4.0	1.0	1.0
2001	4.0	4.5	1.0	4.0	4.0	5.0	5.0	2.0	4.0	4.0	4.0	4.5	1.0	4.0	4.0	1.0	1.0
2002	4.0	4.5	1.0	4.0	4.0	5.0	5.0	2.0	4.0	4.0	4.0	4.5	1.0	4.0	4.0	1.0	1.0
2003	4.0	4.5	1.0	4.0	4.0	5.0	5.0	2.0	4.0	4.0	4.0	4.5	1.0	4.0	4.0	1.0	1.0
2004	4.0	4.5	1.0	4.0	4.0	5.0	5.0	2.0	4.0	4.0	4.0	4.5	1.0	4.0	4.0	1.0	1.0
2005	4.0	4.5	1.0	4.0	4.0	5.0	5.0	2.0	4.0	4.0	4.0	4.5	1.0	4.0	4.0	1.0	1.0
2006	4.0	4.5	1.0	4.0	4.0	5.0	5.0	2.0	4.0	4.0	4.0	4.5	1.0	4.0	4.0	1.0	1.0

B The fraction of industry-years affected

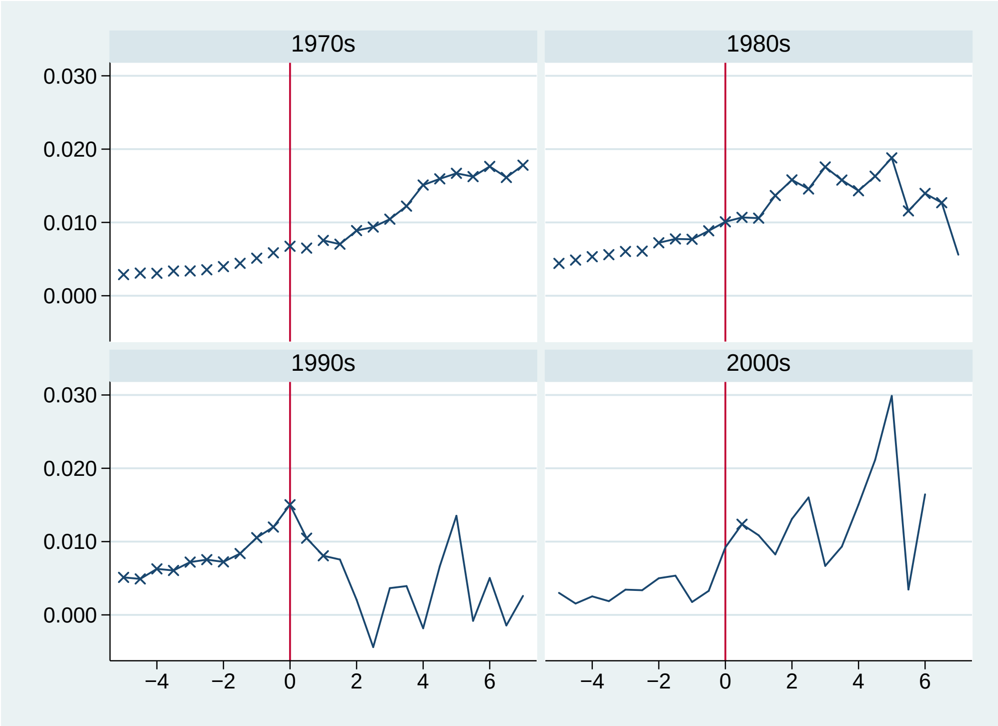

Figure B1: The fraction of industry-years affected $(q - \tilde{q})$ *by periods.*

C Country estimates

Table C1: Results from 5000 simulations on countries.

Country	S_i	T_i	q_i	$\tilde{q}_i$	FWCP$_i$
Italy	420	18	0.000	0.024	1.000***
Portugal	752	32	0.012	0.039	0.692***
Norway	801	35	0.004	0.012	0.687**
Greece	542	28	0.004	0.010	0.617
Austria	581	33	0.007	0.017	0.584**
Sweden	804	33	0.009	0.021	0.576***
Finland	467	27	0.011	0.021	0.496*
Luxembourg	531	35	0.028	0.054	0.476***
Ireland	677	33	0.038	0.060	0.360***
Netherlands	902	34	0.034	0.053	0.352***
UK	904	36	0.041	0.050	0.174
Germany	866	33	0.009	0.011	0.173
Denmark	657	34	0.043	0.049	0.135
New Zealand	880	34	0.057	0.065	0.129
US	703	34	0.016	0.018	0.126
Spain	585	29	0.044	0.050	0.105
Canada	913	35	0.090	0.098	0.085
Belgium	801	33	0.042	0.045	0.057
France	694	33	0.023	0.023	0.018

Notes: T_i is the number of years. The estimates are marked with * if $p < 0.1$, with ** if $p < 0.05$, and with *** if $p < 0.01$.

D Robustness

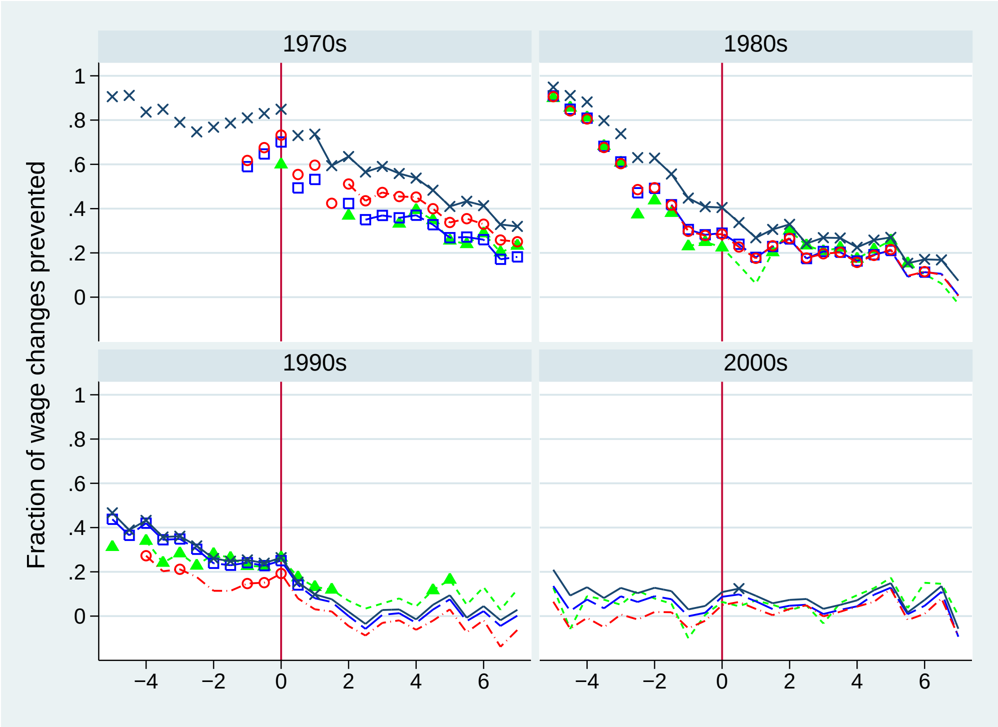

Figure D1: Estimates of the fraction of wage changes prevented at different floor levels by periods. Dark blue lines and x-markers represent estimates based on the default method presented in the paper; red lines and circle markers represent estimates based on country-specific notional distributions; lime green lines and triangle markers represent estimates based on symmetric notional distributions; and blue lines and square markers represent estimates based on period specific underlying distributions.

Figure D2: Fraction of wage changes prevented at different floor levels by regions.

Figure D3: Fraction of wage changes prevented at different floor levels by periods for the Anglo countries.

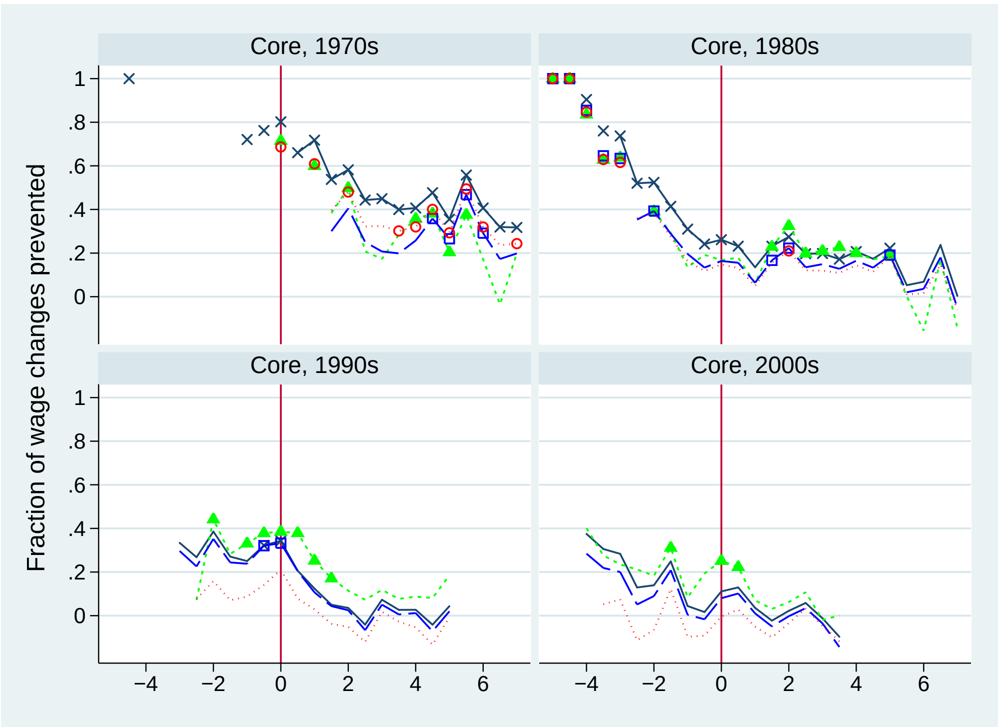

Figure D4: Fraction of wage changes prevented at different floor levels by periods for the Core region.

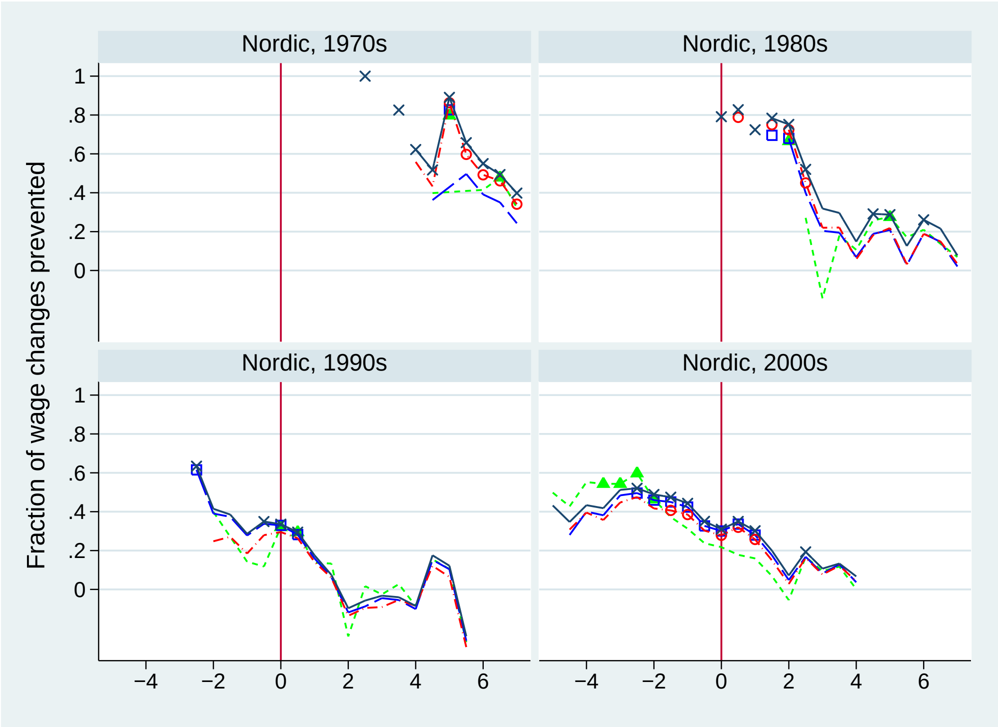

Figure D5: Fraction of wage changes prevented at different floor levels by periods for the Nordic region.

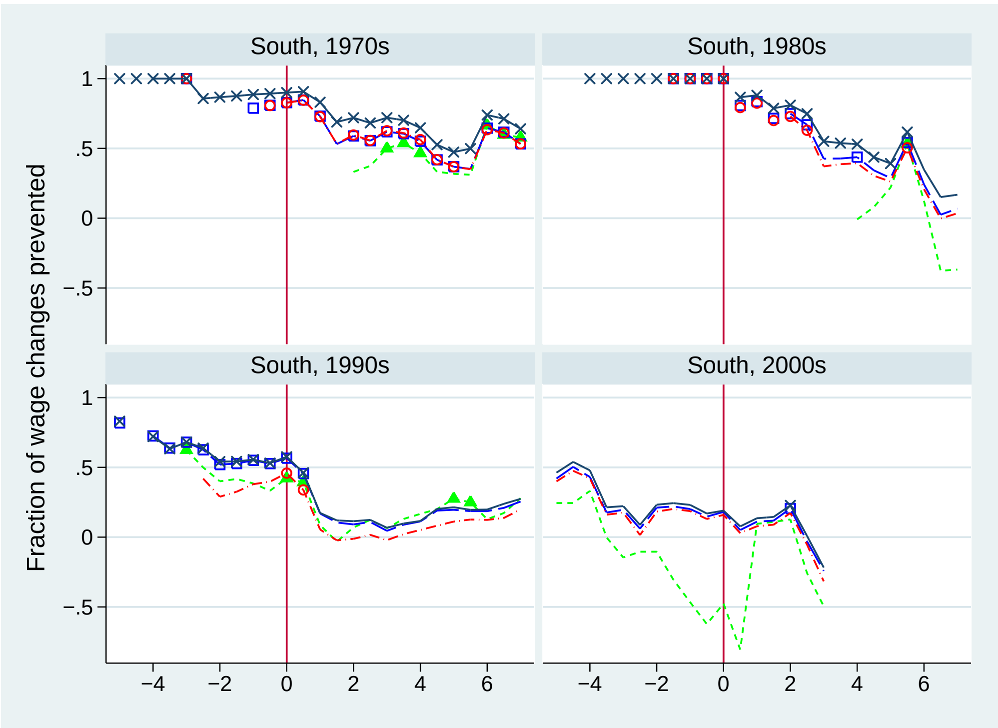

Figure D6: Fraction of wage changes prevented at different floor levels by periods for the South region.

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