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Downward Nominal Wage Rigidity in a Cross Section: An Analysis of Linked Employer-Employee Data for the Years 1995 to 2007

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Abstract

Applying unconditional quantile regression to a linked employer-employee dataset from Germany, I show that downward nominal wage rigidity (DNWR) affects workers not only at the lower tail of the wage change distribution but over the entire distribution. The effect of the inflation rate on the workers' wage changes differs between and within the percentiles of the wage change distribution. The effect is conditional on the workers' individual characteristics and on the firm characteristics, and the conditional effects also differ over the wage change distribution.

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1 Introduction

Concerns about negative employment effects of low inflation have given rise to many studies on the extent of downward nominal wage rigidity (DNWR). These concerns are based on Tobin's (1972) hypothesis that if nominal wages are downwardly rigid, then a certain amount of positive inflation could be necessary to ease the firms' real wage adjustments in response to idiosyncratic shocks. Looking at microeconometric evidence, Tobin's (1972) concern appears to be justified: the empirical evidence overwhelmingly points to a high degree of DNWR (see, e.g., the multicountry studies from Dickens et al., 2007; Knoppik and Beissinger, 2009; Behr and Pötter, 2010). However, the resulting macroeconomic effects on aggregate real wages and employment appear to be surprisingly weak. This contradiction in the empirical evidence leads Lebow et al. (1999) to speak of a "micro-macro puzzle." However, recent studies show that pronounced wage rigidity on the individual level can be consistent with weak macroeconomic effects (see, e.g., Elsby, 2009; Stüber and Beissinger, 2012). These studies show that in the presence of DNWR and low inflation, not only are wage cuts compressed but—due to the forward-looking behavior of firms—wages also increase. Because of the compression of the wage increases, the average real wage growth is hardly affected by DNWR. The results indicate that DNWR does not provide a strong argument against the low inflation targets of central banks.

However, even if the macroeconomic effects of DNWR are negligible, one should look closely at the workers who are affected by DNWR. If wage changes are unevenly distributed across workers, a microeconomic analysis could reveal effects of nominal wage rigidity where a macroeconomic analysis cannot. So far, several studies show that certain types of workers experience nominal wage freezes more often, while other types of workers experience nominal wage cuts (see, e.g., Kahn, 1997; Beissinger and Knoppik, 2001; Anspal and Järve, 2011) and that the firm characteristics play a crucial role in DNWR (see, e.g., Babecký et al., 2010). However, there is no empirical evidence showing whether workers in the upper part of the wage change distribution are affected differently by DNWR and whether this effect is conditional on the worker's characteristics, the firm characteristics and/or the position of the worker in the wage change distribution. It could be, for example, that certain types of workers are "discriminated" against due to DNWR—they could not only be affected by nominal wage cuts more frequently, but they could also experience a compression of wage increases more frequently. If DNWR affects workers differently over the wage change distribution, conditional on their individual characteristics and/or on the characteristics of their workplace, this result should be considered in any forthcoming theoretical and empirical research on the microeconomic consequences of DNWR.

For the empirical analysis, I apply unconditional quantile regressions on a linked employer-employee dataset to provide an in-depth empirical analysis on how DNWR affects different worker types conditional on their position in the wage change distribution. However, analyzing the extent of DNWR or the macroeconomic effects of DNWR is beyond the scope of this chapter.

The remainder of the paper is structured as follows. In the next section, I describe the research design and the data. In Section 3 I present and discuss the results, while Section 4 summarizes and concludes the paper.

2 Methodology, Data, and Data Selection

To analyze whether the wage changes over the wage change distribution are affected if DNWR binds, I follow the approach of Elsby (2009). He considers the percentiles of the real wage change distribution. In the absence of DNWR, a change in the inflation rate should leave the real wage change distribution unaltered. In contrast, if DNWR exists, a systematic relationship between the changes in the inflation rate and the changes in the shape of the real wage change distribution should be observed.

For the empirical testing, I follow Stüber and Beissinger (2012) and apply the unconditional quantile regression (UQR, or RIF-OLS) introduced by Firpo et al. (2009). I estimate the effect of inflation and of further controls on the percentiles of the recentered influence function of the individual log real wage change. Applying this regression, I estimate the impact of the inflation rate on the *unconditional* percentiles of the real wage change distribution.[1] A standard quantile regression (see Koenker and Bassett, 1978; Koenker, 2005) would only observe the effects of inflation on the *conditional* percentiles of the real wage change distribution. However, wage changes that correspond to a particular *conditional* percentile can be distributed over the entire observed (*unconditional*) wage change distribution. A brief introduction of the UQR is provided in Appendix B.

The empirical analysis is undertaken for Germany over the 1995 to 2007 period[2] using the linked employer-employee dataset (LIAB) from the Institute for Employment Research (IAB). The LIAB is created by matching the data from the IAB Establishment Panel and the data from the Employee History File (BeH), and it includes all workers who were employed in one of the firms included in the Establishment Panel as of July 1 for the data year. The Establishment Panel is an annual survey of establishments in Germany that represents all industries and establishment sizes nationwide. The BeH comprises the total population that is gainfully employed and covered by the social security system. Those not covered are self-employed persons, family workers assisting in the operation of a family business, civil servants (Beamte) and regular students. A general introduction to the IAB Establishment Panel is provided by Kölling (2000); more detailed information is provided by Fischer et al. (2009). A general introduction to the LIAB is provided by Alda et al. (2005).

Advantages of the LIAB are its huge sample size and its reliable earnings data. One disadvantage of the data is that it does not allow fringe benefits to be separated from "regular" earnings. In addition, the BeH contains no data on the hours worked except for information about part-time or full-time employment. Therefore, I calculate gross average daily earnings. To avoid any contamination with effects from working time, I only observe full-time blue-collar and white-collar workers, aged 16 to 65 years (subject to social security without particular tokens).[3] Unfortunately, the wage data are right-censored at the contribution assessment ceiling (Beitragsbemessungsgrenze). For workers whose wages are censored, the wage change cannot be computed. Therefore, I analyze only the non-censored wage spells.[4]

[1] In the framework of the UQR, the "unconditional percentiles" are the percentiles of the marginal distribution of the outcome variable.

[2] East Germany is included from 1996/97 onwards.

[3] The BeH contains eight classes of workers. I drop all classes except "white-collar workers," "unskilled workers" and "skilled workers." The two latter classes are combined to form the class "blue-collar workers."

[4] This leads to an underrepresentation of highly qualified (white collar) workers, making the results somewhat less generalizable. See Appendix A for more information on the contribution assessment ceiling and data selection.

Consistent with the literature, the analysis is confined to "job stayers." I define job stayers as workers who continually execute the same job at the same employer for at least two consecutive years.[5] Including job movers in the analysis could lead to a systematic relationship between inflation and the compression of the wage change distribution that is unconnected with DNWR. The reason for this relationship is that inflation often rises during economic upswings and, simultaneously, more voluntary job changes occur that go hand in hand with real wage increases (see, e.g., Cornelißen et al., 2007).

After the selection, the dataset contains more than 10.7 million wage changes from nearly 3.1 million workers who work in a total of 20,596 firms. The control variables that are used in the regressions are displayed in Tables 1 and 2.

As an individual control variables, I use, inter alia, the gender and the wage level of the worker. Controlling for gender is important for two reasons: first, it has been shown that the average nominal wage increase for women in Germany is higher and that female workers are less frequently affected by nominal wage cuts (see, e.g., Pfeiffer, 2003, Table 2, p. 624). Second, controlling for gender allows me to control for the fact that shifts from part-time to full-time employment (and vice versa) are more common for female workers (see, e.g., Schäfer and Vogel, 2005).[6] Kahn (1997) shows that minimum wage workers in the US are more often affected by zero nominal wage changes and less often affected by negative nominal pay changes than other workers. Therefore, I control for the wage level of the workers using ten dummy variables.

The use of the LIAB also allows me to control for institutional characteristics. Because the labor unions and other forms of worker participation still have a large influence on wage setting in Germany, they could influence the wage changes of workers. Therefore, I control for whether a work council is present in a firm, whether the firm pays wages according to an agreement at the industry or the firm level, and whether a firm pays wages above the standard rate.[7]

For the inflation rate, I use the log change in the consumer price index (CPI, see Table 6 in Appendix A). Following Elsby (2009) and Stüber and Beissinger (2012), productivity growth is measured by the observed average regional real wage change rate. Productivity is not directly measured because the real wages adjust to changes in productivity with a time lag.[8] The absolute change in the rate of inflation is included because Groshen and Schweitzer (1999) hypothesized that higher inflation volatility leads to greater dispersion

[5]The breakdown of occupations is very detailed, but still, not every job change leads to a change in the occupation classification. Therefore, some spells for persons who changed their job within a firm may not be excluded. The "same position" restriction has also been applied by Christofides and Stengos (2001) as well as by Stüber and Beissinger (2012).

[6]Shifts from part-time to full-time work and vice versa that occur during the course of the year do not lead to a new report for the employer. A new status is conveyed with the annual report at the end of a year—this status applies for the whole year. However, because I only observe wage changes for full-time workers, the observed wage change can only be overestimated—due to changes from part-time to full-time employment—but the wage change cannot be underestimated.

[7]In 1999, the question on union agreements was changed slightly. The category "firm-level collective agreement" was replaced by "firm-level collective agreement underwritten by a union." I did ignore this modification because Dustmann et al. (2007, p. 45) found that "[...] its impact is almost invisible on time series plots of the evolution of union recognition."

[8]Alternatively, one could model some type of error-correction mechanism for the discrepancy between real wage change and productivity growth. I avoid these complications by using the average regional real wage change rate as a proxy variable reflecting the impact of (regional) productivity growth on wages. It is a suitable proxy because, according to the theoretical predictions of Elsby (2009), DNWR should have no effect on the average wage change.

in relative wages regardless of the existence of DNWR. The current and lagged regional unemployment rates are included because DNWR can affect unemployment. The unemployment rates are used to control for changes in the wage change distribution due to workers "leaving" the distribution.

Table 1: Summary statistics for worker spells

	Mean	Std. Err.	Min.	Max.
Individual (micro) data				
Change in log real wage	0.01	0.05	-0.19	0.22
Change in log nominal wage	0.03	0.05	-0.18	0.24
Age	41.99	9.65	17	65
Female (yes = 1)	0.32	0.47	0	1
Non-German (yes = 1)	0.08	0.27	0	1
White-collar workers (yes = 1)	0.45	0.50	0	1
Tenure (days worked in firm)	4,275	2,610	730	11,869
Education:				
Lower secondary school and intermediate (secondary) school without vocational qualification	0.15	0.36	0	1
Lower secondary school and intermediate (secondary) school with vocational qualification	0.71	0.46	0	1
Upper secondary school examination without vocational qualification	0.01	0.08	0	1
Upper secondary school examination with vocational qualification	0.04	0.20	0	1
Post-secondary technical college degree	0.03	0.17	0	1
University degree	0.03	0.17	0	1
No formal education and no classification applicable	0.03	0.18	0	1
Establishment data				
Work council (yes = 1)	0.95	0.21	0	1
Wages paid above standard rate (yes=1)	0.48	0.50	0	1
Establishment size	4,239	8,321	1	51,155
Union variable:				
Collective agreement (agreements at industry level)	0.85	0.36	0	1
In-house rate (agreements at the firm level)	0.13	0.34	0	1
No collective agreement	0.02	0.15	0	1

Note: Pooled data from 13 years (1995/1996 to 2006/2007). Number of observations = 10,733,205. The dataset also contains dummies for 6 occupation fields and 10 dummies for wage levels.

Table 2: Summary statistics for regional (macro) variables

	Obs.	Mean	Std. Err.	Min.	Max.
Inflation (log change in consumer price index)	13	0.015	0.004	0.006	0.022
Absolute change in the rate of inflation	13	0.005	0.003	0.001	0.010
Regional productivity growth (average regional real wage growth)	197	0.012	0.012	-0.027	0.046
Regional unemployment rate	197	0.133	0.048	0.055	0.221
Regional lagged unemployment rate	197	0.133	0.047	0.055	0.221

Note: Pooled data from 13 years (1995/1996 to 2006/2007). The dataset also contains dummies for the 16 German federal states.

3 Empirical Implementation, Results, and Discussion

To analyze whether workers' wage changes are affected by changes in the inflation rate, conditional on their position in the wage change distribution and their individual and/or firm characteristics, I estimate a UQR that has several variables interacted with inflation. I regress the percentile-transformed individual log real wage change—the re-centered influence function $\left(\widehat{RIF}\right)$—of the individual log real wage change (Δw) against $\mathbf{X} = \left(\pi_t \quad \mathbf{a}'_{irt} \quad \mathbf{b}'_{irt} \quad \mathbf{c}'_{irt}\right)$.

π_t is the inflation rate of year t, and **a** and **b** are vectors containing further control variables on the individual level i or on the regional level r (see Tables 1 and 2). Vector **c** contains the same six control variables as vector **b**, but they are interacted with the inflation rate. The six variables contained in vectors **b** and **c** are dummies for white-collar worker, female, work council, wages paid above standard rate, and the two union variables (collective agreement and in-house rate).[9]

Because I want to focus on whether the effect of inflation on the real wage change varies for workers and whether the effect depends on the position of the worker in the wage change distribution, I only display the coefficients for the inflation rate, the coefficients of the variables contained in vector **b** and the corresponding coefficients of the interaction terms contained in vector **c** (see Table 3).[10]

The coefficients for the inflation rate (see Table 3) can be interpreted as the marginal effect of inflation on the real wage change for the reference worker: a male blue-collar worker who is employed by a firm without a work council that is not paying according to a collective agreement and that is not paying wages above a collective agreement.[11]

If a coefficient for the inflation rate is positive, a decrease of the inflation rate is associated with a decrease of the real wage change; a negative coefficient is associated with an increase of the real wage change. Depending on the position in the wage change distribution, this association has different effects. The distribution can be divided into three segments: the lower part of the distribution where the nominal wage cuts are observed (the $10th$ percentile), the range of the distribution where zero nominal wage changes are observed (the $20th$ and $30th$ percentile), and the upper part of the distribution where nominal wage increases are observed ($\geq 40th$ percentile).[12]

For the reference worker in the lower part of the distribution, a decrease in the inflation rate leads to more pronounced real wage cuts brought about by nominal wage cuts. This leads to a decompression of the distribution on the left hand side of the distribution. The compression on the left hand side of the wage change distribution occurs in the range where zero nominal wage changes are observed because DNWR leads to an increase of zero nominal wage changes. For the reference workers in the range of the distribution where zero nominal wage changes are observed, a decrease in the inflation rate is associated with an increase in the real wage change. It cannot be determined whether they experience a more pronounced real wage increase or a less pronounced real wage cut. For the reference workers in the upper part of the distribution, a decrease in the inflation rate will lead to a less pronounced real wage increase and hence to a compression of the distribution on the right hand side. This method of interpreting the coefficients for the inflation rate, and hence for the reference worker, also holds for the interpretation of the coefficient of the variables that are interacted with the inflation rate.

To observe how strongly the inflation rate affects the real wage change of workers, and to observe how this effect varies between workers, I calculate the marginal effect of inflation

[9] Appendix C shows that the LIAB appears to be suitable for the analysis. Furthermore, it shows that a decrease in the inflation rate leads to a compression of real wage increases—confirming the findings of Elsby (2009) and Stüber and Beissinger (2012).

[10] Looking at the coefficients of the variables that are not interacted with the inflation rate—presented in Table 3—one can see that not only individual characteristics but also institutional characteristics have an influence on the real wage change of workers: nearly all coefficients for the variables are highly significantly different from zero but small in magnitude.

[11] For this reference worker, the effect of the inflation rate perfectly fits the predictions of Elsby's (2009) model (see Appendix C).

[12] See Appendix C.

Table 3: The marginal effects of the inflation rate and selected variables on the percentiles of the real wage change

Percentiles	10	20	30	40	50	60	70	80	90
Inflation (π)	0.391***	-0.180***	-0.397***	0.154***	0.399***	0.493***	0.772***	1.275***	2.111***
	(0.065)	(0.045)	(0.027)	(0.025)	(0.028)	(0.022)	(0.030)	(0.045)	(0.057)
Productivity growth	1.142***	0.789***	0.613***	0.645***	0.822***	0.814***	0.874***	1.078***	1.425***
	(0.005)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.005)
White-collar worker	-0.006***	0.002***	0.005***	0.006***	0.005***	0.005***	0.003***	0.001***	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
White-collar worker * π	0.522***	0.050***	0.005***	-0.455***	-0.506***	-0.584***	-0.555***	-0.646***	-0.913***
	(0.016)	(0.012)	(0.008)	(0.006)	(0.006)	(0.008)	(0.011)	(0.015)	(0.023)
Female	0.010***	0.007***	0.006***	0.007***	0.008***	0.009***	0.009***	0.007***	0.008***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female * π	0.123***	0.126***	0.006	-0.137***	-0.228***	-0.293***	-0.265***	-0.051***	0.040**
	(0.021)	(0.011)	(0.007)	(0.006)	(0.007)	(0.008)	(0.009)	(0.013)	(0.019)
Work council	0.015***	0.011***	0.006***	0.014***	0.015***	0.015***	0.013***	0.009***	0.004***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Work council * π	-0.604***	-0.259***	-0.228***	-0.537***	-0.686***	-0.785***	-0.746***	-0.604***	-0.476***
	(0.042)	(0.028)	(0.021)	(0.017)	(0.016)	(0.019)	(0.022)	(0.026)	(0.034)
Collective agreement[1]	0.006***	0.005***	0.005***	0.007***	0.006***	0.004***	0.001***	-0.004***	-0.008***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Collective agreement * π	-0.038	-0.013	-0.053**	-0.274***	-0.239***	-0.195***	-0.120***	0.062	0.244***
	(0.050)	(0.034)	(0.024)	(0.021)	(0.022)	(0.021)	(0.030)	(0.040)	(0.057)
In-house agreement[1]	0.017***	0.006***	0.003***	0.003***	0.001**	-0.001***	-0.000	0.002**	0.002
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
In-house agreement * π	-1.337***	-0.429***	-0.129***	-0.123***	0.019	0.147***	0.080***	-0.057	0.003
	(0.058)	(0.041)	(0.026)	(0.021)	(0.023)	(0.022)	(0.031)	(0.042)	(0.066)
Wages above std. rates	-0.013***	-0.011***	-0.011***	-0.010***	-0.009***	-0.009***	-0.004***	0.004***	0.012***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Wages above std. rates * π	0.513***	0.537***	0.676***	0.720***	0.746***	0.793***	0.524***	0.084***	-0.441***
	(0.017)	(0.010)	(0.007)	(0.006)	(0.008)	(0.008)	(0.010)	(0.013)	(0.020)

[1] Reference category: no collective agreement

Notes: Unconditional quantile regression. Bootstrapped standard errors (50 replications) are in brackets. The further controls used are as follows: 16 regions, age, age^2, absolute change in inflation, current and lagged regional unemployment rate, 8 educational classes, worker with foreign nationality, 6 occupational fields, firm size, (firm size)^2, (firm size)^3, (firm size)^4, West Germany, tenure, tenure^2, 10 wage levels. Gray colored columns indicate the range of percentiles where zero nominal wage changes are observed in the data. *** p<0.001; ** p<0.05.

on the real wage change. The marginal effect is the sum of the coefficient of the inflation rate (η) and the 6 coefficients (λ_i) of the variables interacted with the inflation rate multiplied with the corresponding variable (b_i): $\eta + \sum_i \lambda_i b_i$.

Because two of the dummy variables interacted with the inflation rate are exclusive (in the sense that workers cannot get paid according to a collective agreement and an in-house agreement simultaneously), I can calculate the marginal effect of the inflation rate on real wage change for 48 worker types. To get a sense for how significantly the effects over the wage change distribution vary between worker types, I show some summary statistics in Table 4.

Table 4: Summary statistics for the marginal effects of the inflation rate on the percentiles of the real wage change for 48 different settings of individual and firm characteristics

Percentiles	10	20	30	40	50	60	70	80	90
Min.	-1.551	-0.869	-0.753	-1.249	-1.259	-1.364	-0.913	-0.083	0.281
Max.	1.548	0.533	0.290	0.874	1.165	1.432	1.376	1.421	2.395
Mean	0.209	-0.100	-0.228	-0.183	-0.010	0.042	0.238	0.668	1.298
Range	3.098	1.402	1.044	2.123	2.424	2.796	2.289	1.504	2.114

Notes: The marginal effect of the inflation rate on the real wage change calculated for all 48 possible worker types. Gray colored columns indicate the range of percentiles where zero nominal wage changes are observed in the data. Unweighted mean.

The summary statistics (see Table 4) show that the real wage changes of workers are not equally affected by inflation. The marginal effect varies within and between the different percentiles of the real wage change distribution. Over the entire real wage change distribution, there are some worker types whose real wage decreases with a decrease in the inflation rate, and vice versa. Other workers experience an increase in the real wage change with a decrease in the inflation rate, and vice versa. The range shows that the marginal effect of inflation on the wage change between the workers differs significantly for the $10th$ percentile of the real wage change distribution in particular—where the nominal wage cuts are observed. The ranges for the $20th$ and $30th$ percentiles—where zero nominal wage changes are observed—are small when compared to the ranges of the other percentiles.[13]

Table 5: Summary statistics for the coefficient of the variables interacted with inflation

	Min.	Max.	Mean
Individual characteristics			
White-collar worker	-0.913	0.522	-0.342
Female	-0.293	0.126	-0.075
Firm characteristics			
Work council	-0.785	-0.228	-0.547
Wages above std. rates	-0.441	0.793	0.461
Union variable (reference category: no collective agreement)			
Collective agreement (at the industry level)	-0.274	0.244	-0.069
In-house rate (collective agreement at the firm level)	-1.337	0.147	-0.203

Notes: Calculations based on the calculated coefficients for the 10th, 20th, ..., 90th percentile. Unweighted mean.

To observe which characteristics really influence the real wage change of workers when the inflation rate changes, I focus on the coefficients of the variables of vector **c**, which are interacted with the inflation rate. A look at Table 3 shows that the coefficients for these variables vary within and between the different percentiles of the real wage change distribution. To provide an overview, Table 5 shows some summary statistics for the coefficients of the variables. While interpreting the coefficients, one should always keep the general effect of the inflation rate on the real wage change—the marginal effect of

[13] While interpreting the summary statistics, one should keep in mind that the presented mean values are un-weighted—every worker type has the same weight regardless of how many workers it actually represents. Table 1, however, shows that, e.g., nearly 85 percent of the workers are employed by firms that pay according to a collective agreement.

inflation on the real wage change for the reference worker—in mind (see Table 3 and Figure 1). Because the marginal effects are linear, they add up. Hence, the marginal effect of inflation on the real wage change for a worker who is identical to the reference worker except that he is a white-collar worker is the sum of the marginal effect of the inflation rate and the marginal effect of the white-collar dummy interacted with inflation.

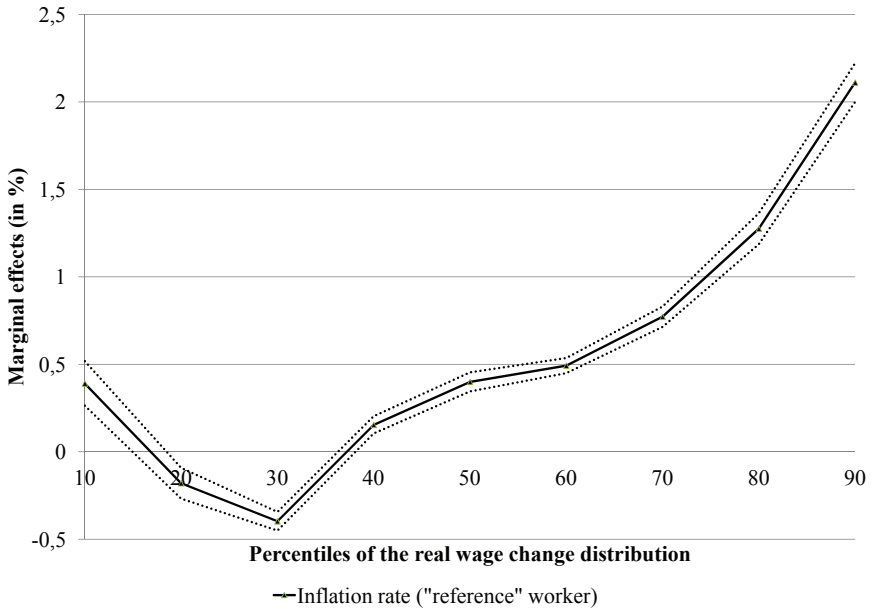

Figure 1: The marginal effects of inflation on the real wage change for the reference worker
Note: Reference worker: a male blue-collar worker who is employed by a firm without a work council that is not paying according to a collective agreement and that is not paying wages above a collective agreement. The dotted lines represent the 95% confidence interval.

First, I take a closer look at the coefficients of the individual characteristics interacted with the inflation rate. The effect of a change in the inflation rate on the real wage change conditional on the class of the worker—in terms of white-collar worker or blue-collar worker—is especially strong for the very low and the very high percentiles of the wage change distribution (see Table 3 and Figure 2). For the 10th percentile—where workers experience nominal wage cuts—the coefficient is strongly positive: if the inflation rate decreases, the white-collar workers experience higher real wage cuts than the blue-collar workers. For the $20th$ and $30th$ percentiles—the range where the zero nominal wage changes are observed—the effect of a change in inflation barely differs between the white-collar worker and the blue-collar worker. Above the $30th$ percentile of the real wage change distribution, the coefficients are negative: a decrease in the inflation rate is associated with higher wage increases for white-collar workers.
The effects of a change in the inflation rate on the real wage change conditional on gender is tiny when compared to the effects of a change in the inflation rate on the real wage change conditional on the class of the worker (see Table 3 and Figure 2). For the $10th$, $20th$ and $90th$ percentiles, the coefficients for the interaction term are positive: a decrease in the inflation rate is associated with lower real wage changes. For the women in the $10th$ percentile and in the $20th$ percentile of the real wage change distribution, this real wage cut goes hand in hand with a nominal wage cut. Hence, women more often experience wage cuts. This finding is consistent with Anspal and Järve's (2011) findings for Estonia: using Kahn's (1997) histogram-location approach, they find that women resist pay cuts

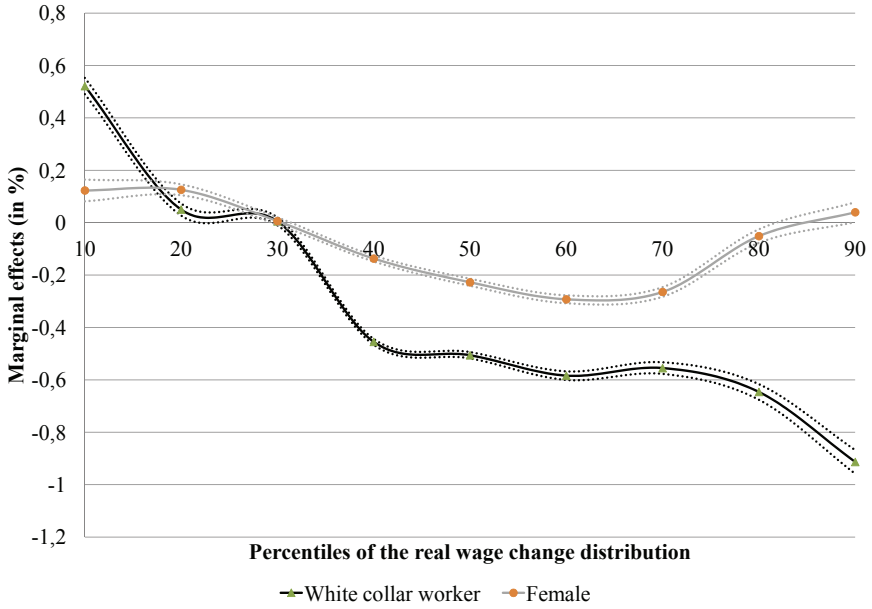

Figure 2: The marginal effect of inflation on the real wage change for white-collar workers and female workers

Note: Dotted lines represent the 95% confidence interval.

less than men. For the $40th$ to the $80th$ percentile, the coefficients are negative: a decrease in the inflation rate is associated with higher real wage changes.

Institutional characteristics also have an influence on the real wage change of workers when the inflation rate changes (see Table 3 and Figures 3 and 4). This influence is particularly strong for the existence a work council and whether a firm pays wages above standard rates. For the workers of firms that pay wages above the standard rates, all of the coefficients of the interaction term are positive except for the $90th$ percentile. However, for the workers of firms with a work council, all of the coefficients of the interaction term are negative. Therefore, a decrease in the inflation rate is associated with a lower wage change for the workers who are paid above the standard rate, while the workers at firms with a work council experience an inverse effect: a decrease in the inflation rate is associated with higher wage changes.

Surprisingly, labor unions do not appear to have a strong influence on how a change in the inflation rate influences the real wage change—the base category for both variables is "no collective agreement." For workers who are paid according to a collective agreement at the industry level, the coefficients for the $30th$ to the $70th$ percentile of the interaction term are significantly negative, while only the coefficient for the $90th$ percentile is significantly positive. For the workers who are paid according to an in-house rate (collective agreement at the firm level), the coefficients of the interaction term are significantly negative for the $10th$ to the $40th$ percentile and significantly positive for the $60th$ to the $70th$ percentile. Aside from the fact that the coefficients for the labor unions are not statistically significant for quite a few of the percentiles, the coefficients that are significantly different from zero are fairly small when compared to the coefficients of the other institutional characteristics. The only exception is the coefficient for the $10th$ percentile for workers of firms that pay according to an in-house rate.

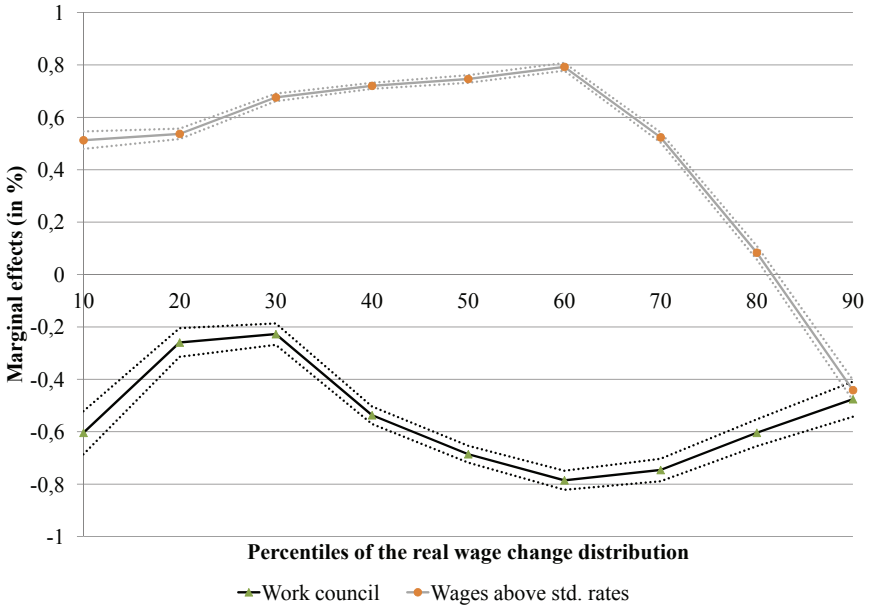

Figure 3: The marginal effect of inflation on the real wage change for workers at firms with a work council and workers at firms that pay wages above the standard rates

Note: Dotted lines represent the 95% confidence interval.

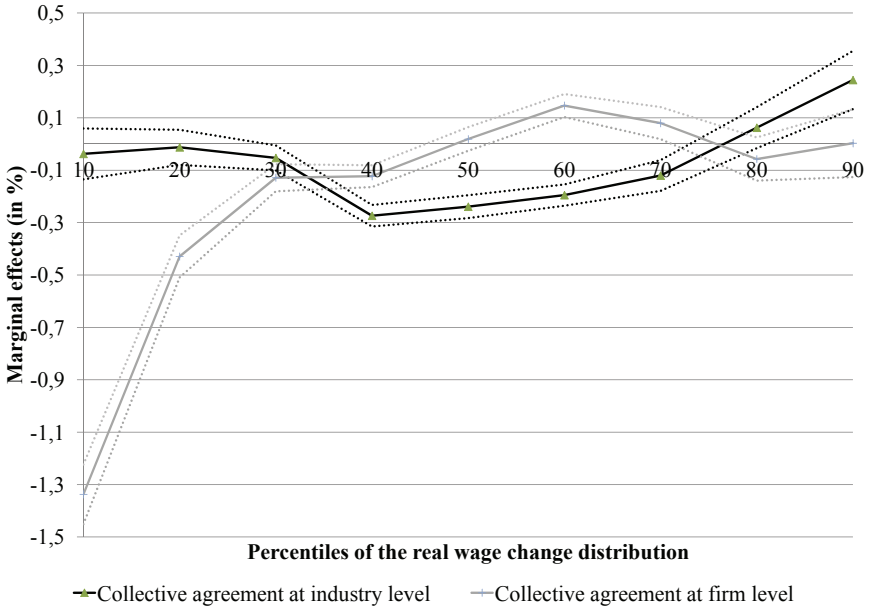

Figure 4: The marginal effect of inflation on the real wage change for workers of firms that pay according to a collective agreement (at the industry level) or that pay according to an in-house rate (collective agreement at the firm level)

Note: Dotted lines represent the 95% confidence interval.

4 Conclusion

Applying UQR, I estimated the impact of inflation on the unconditional percentiles of the real wage change distribution. The empirical analysis has been undertaken for Germany over the 1995 to 2007 period using the LIAB of the IAB. The analysis has been confined to "job stayers," i.e., full-time workers who continually exercise the same job at the same employer for at least two consecutive years. After data selection, nearly 11 million earnings changes are analyzed.

Using interacting dummies for the individual and the firm characteristics with the inflation rate, I show that the effect of the inflation rate on the workers' real wage changes differs not only *between* but also *within* the percentiles of the wage change distribution. The effect is conditional on the workers' position in the wage change distribution, and it is conditional on the workers' individual characteristics and on the firm characteristics; the conditional effects also differ over the wage change distribution. In particular, the class of the workers (in terms of white- and blue-collar workers), whether an employee pays wages above the standard rates, and/or whether a work council exists in the firm have a strong influence on how a change in the inflation rate affects the real wage change of the worker.

The results show that some workers are somehow "discriminated" against by DNWR: previous results are confirmed, e.g., that women more often experience nominal wage cuts (see, e.g., Anspal and Järve, 2011), and new insights are gained, e.g., that blue-collar workers in particular are affected by the compression of wage increases.

Given the results of this paper, forthcoming research on the microeconomic consequences of DNWR should consider that DNWR affects not only the lower tail of the wage change distribution but also the upper part of the wage change distribution (as shown by, e.g, Elsby, 2009; Stüber and Beissinger, 2012). Furthermore, future research should consider that the effect of inflation on the workers' real wage change is conditional on the individual characteristics and the firm characteristics and that these effects differ over the wage change distribution. Considering these insights in further research will provide a better picture of the microeconomic effects of DNWR.

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A Data Description and Data Selection

The contribution assessment ceiling is annually adjusted to the changes in earnings. Some employees—miners, mine employees, sailors and railroad employees—are insured in the "knappschaftliche" pension insurance. The contribution assessment ceiling of this pension insurance is always higher than that for the compulsory pension insurance scheme. Since 1999, the BeH no longer indicates through which pension insurance a person is insured. For this reason, I use only the contribution assessment ceiling of the compulsory pension insurance scheme (see Table 6).
Because the monthly wage is also censored, it is possible that the yearly wages are below the contribution assessment ceiling even if the wages for several months are censored. This causes some noise for the wages that are just below the contribution assessment ceiling. Therefore, the wage spells that are above 0.96 times the contribution assessment ceiling of the compulsory pension insurance scheme are dropped. The lower limit of earnings is given by the earnings limit for the "marginal" part-time workers/fringe workers (Geringfügigkeitsgrenze; see Table 6). These workers are not included in the BeH.

Table 6: Contribution assessment ceiling for Western Germany, lower earnings limit, and inflation

Year	Contribution assessment ceiling for Western Germany (€ per year)[a]		Lower earnings limit (§8, Social Code IV)	Change of the German consumer price index to the previous year in %
	Compulsory pension insurance scheme	"Knappschaftliche" pension insurance		
1995	47,856.92	58,900.82	3,558.60	1.63
1996	49,084.02	60,127.93	3,619.92	1.38
1997	50,311.12	61,968.58	3,742.68	1.93
1998	51,538.22	63,195.68	3,804.00	1.00
1999	52,151.77	63,809.23	3,865.32	0.55
2000	52,765.32	65,036.33	3,865.32	1.42
2001	53,378.87	65,649.88	3,865.32	1.94
2002	54,000.00	66,600.00	3,900.00	1.48
2003	61,200.00	75,000.00	3,900.00	1.04
2004	61,800.00	76,200.00	4,800.00	1.65
2005	62,400.00	76,800.00	4,800.00	1.52
2006	63,000.00	77,400.00	4,800.00	1.60
2007	63,000.00	77,400.00	4,800.00	2.26

[a] Values from 1975 until 2001 converted from DM into Euro. Source: Deutsche Rentenversicherung Knappschaft-Bahn-See; Hauptverwaltung Bochum.

B Unconditional Quantile Regression

Applying an unconditional quantile regression (UQR) allows us to estimate the impact of the inflation rate on the "unconditional percentiles" of the real wage change distribution. In the framework of the UQR, the "unconditional percentiles" are the percentiles of the marginal distribution of the outcome variable. To estimate the average marginal effect $E\left[d\Pr\left[Y > P_\tau \mid \mathbf{X}\right]/d\mathbf{X}\right]$ Firpo et al. (2009) propose, inter alia, a recentered influence function OLS (RIF-OLS) regression.[14] This regression provides consistent estimates if $\Pr\left[Y > P_\tau \mid \mathbf{X} = x\right]$ is linear in x. In case of quantiles, the conditional expectation of the recentered influence function $E\left[RIF\left(Y; P_\tau, F_Y\right) \mid \mathbf{X}\right]$ can be viewed as an unconditional quantile regression.
The RIF-OLS consists of regressing the (recentered) influence function RIF of the outcome variable Y for the τth percentile P_τ on the explanatory variables $\mathbf{X}$ by OLS. The

[14] For a brief introduction see also Fortin et al. (2011).

RIF is computed by estimating the sample percentile P_τ and the density of the outcome variable $\hat{f}_Y(\cdot)$, using kernel (or other) methods: $\widehat{RIF}\left(Y;\hat{P}_\tau\right) = \hat{c}_{1,\tau}\mathbf{I}\left(Y > \hat{P}_\tau\right) + \hat{c}_{2,\tau}$, where $\mathbf{I}(\cdot)$ is an indicator function, $\hat{c}_{1,\tau} = 1/f_{Y(P_\tau)}$, $f_{Y(P_\tau)}$ is the density of Y evaluated at P_τ and $\hat{c}_{2,\tau} = P_\tau - c_{1,\tau}(1-\tau)$. I follow Firpo et al. (2009) and use a kernel density estimator $\hat{f}_Y\left(\hat{P}_\tau\right) = \frac{1}{Nb}\sum_{i=1}^{N}\kappa_Y\left(\left(Y_i - \hat{P}_\tau\right)/b\right)$, where $\kappa_Y(\cdot)$ is a kernel function, and $b > 0$ denotes the scalar bandwidth.[15]

C Model Predictions and the Suitability of the Dataset

The LIAB covers a much shorter time period than the BeH dataset used by Stüber and Beissinger (2012), and the inflation rate in this shorter time period is less volatile.
To ensure that the LIAB is suitable for the analysis, I run a UQR that is comparable to the UQR of Stüber and Beissinger (2012): I run the UQR from Section 3 without the variables interacted with the inflation rate.
If the wage cuts and the wage increases are compressed due to DNWR, one should observe—according to Elsby's (2009) model—positive coefficients for the inflation rate for the percentiles of the real wage change distribution below and above minus the inflation rate. For the percentiles of the real wage change distribution that correspond to minus the inflation rate, one should observe negative coefficients for the inflation rate (see Table 7).

Table 7: Predicted effects of the rate of inflation and of productivity growth on the unconditional percentiles of the log real wage change distribution according to Elsby's (2009) model

τth percentile of the log real wage change distribution (P_τ)	Coefficient on	
	inflation rate	productivity growth
$P_\tau <$ minus inflation rate	> 0	> 1
$P_\tau \approx$ minus inflation rate	< 0	attenuates towards zero (< 1)
$P_\tau >$ minus inflation rate	> 0	> 1

In the LIAB, the zero nominal wage changes ($P_\tau \approx$ minus inflation rate) appear in the range equal to and above the $13th$ percentile and equal to and below the $31st$ percentile of the wage change distribution. The mean of these observed percentiles is the $24th$ percentile. With this information, I am able to check whether the coefficients for the inflation rate and the productivity growth that were obtained applying the UQR (see Table 8) fit the predictions of Elsby's (2009) model (see Table 7).
As predicted for the percentiles below minus the inflation rate—the $10th$ percentile—I find a coefficient for the inflation rate that is positive and a coefficient for productivity growth that is larger than one. For the percentiles equal to minus the inflation rate—the $20th$ and $30th$ percentiles—I find coefficients for the inflation rate that are below zero and coefficients for productivity growth that are below one. Similar to the results of Stüber and Beissinger (2012), I find further positive coefficients only for the very high percentiles—the $80th$ and $90th$—of the real wage change distribution. As predicted for those percentiles, the coefficients for the productivity growth are larger than unity. The results clearly show that in the presence of DNWR, wage increases are compressed-

[15] The influence function $IF(Y;\nu,F_Y)$ of a distributional statistic $\nu(F_Y)$ represents the influence of an individual observation on that distributional statistic. Adding back the statistic $\nu(F_Y)$ to the IF yields what Firpo et al. (2009) call the recentered influence function (RIF). Therefore, for the τth percentile, the $RIF(Y;P_\tau,F_Y) = P_\tau + IF(Y;P_\tau,F_Y) = P_\tau + (\tau - \mathbf{I}(Y > P_\tau))/f(P_\tau)$.

confirming the finding of Stüber and Beissinger (2012) that in Germany, a decrease in the inflation rate leads to a compression of wage increases. Because I find that the inflation rate has similar effects on the real wage change using the LIAB, as Stüber and Beissinger (2012) did for Germany using the BeH data for the years 1975 to 2007, I am confident that the LIAB is suitable for the analysis despite the shorter time period covered by the dataset.

Table 8: The marginal effects of the inflation rate and productivity growth on the percentiles of the real wage change distribution without interaction terms

	Consumer price index		Average regional real wage growth (as a proxy for productivity growth)	
	Coef.	Std.Err.	Coef.	Std.Err.
p10	0.159***	(0.009)	1.158***†	(0.005)
p20	-0.160***	(0.006)	0.799***†	(0.003)
p30	-0.473***	(0.004)	0.623***†	(0.002)
p40	-0.511***	(0.004)	0.654***†	(0.002)
p50	-0.402***	(0.004)	0.831***†	(0.002)
p60	-0.386***	(0.005)	0.823***†	(0.002)
p70	-0.119***	(0.005)	0.881***†	(0.002)
p80	0.480***	(0.008)	1.082***†	(0.004)
p90	1.259***	(0.012)	1.425***†	(0.007)

Notes: Unconditional quantile regression. Bootstrapped standard errors (50 replications). Further controls are used as follows: 16 regions, age, age^2, absolute change in inflation, current and lagged regional unemployment rate, 8 educational classes, workers with foreign nationality, 6 occupational fields, establishment size, (establishment size)^2, (establishment size)^3, (establishment size)^4, West Germany, tenure, tenure^2, 10 wage levels, white-collar worker, female, work council, collective agreement, in-house rate, wages paid above standard rate. *** p<0.001. †: the coefficient for productivity growth is significantly different from unity at the 5% level. The gray colored rows indicate the range of percentiles where zero nominal wage changes are observed in the data.