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Wage Adjustment and Employment in Europe

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GEP

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Abstract

We explore the impact of wage adjustment on employment with a focus on the role of downward nominal wage rigidities. We use a harmonised survey dataset, which covers 25 European countries in the period 2010-2013. The main advantages of the data are firm-level information on the change in economic conditions and collective pay agreements. Our findings confirm the presence of wage rigidities in Europe: first, collective pay agreements reduce the probability of downward wage adjustment; second, the rise in the probability of downward base wage responses to a decrease in demand is significantly smaller than the rise in the probability of an upward wage response to an increase in demand. Estimation results point to a negative effect of downward wage rigidities on employment at the firm level.

Non-technical summary

This paper empirically explores the behaviour of wages and the impact of wage adjustment on employment in Europe during the years 2010 to 2013, with a focus on the role of nominal rigidities. The analysis is based on new harmonised firm-level survey data from the Wage Dynamics Network – a European System of Central Banks research network. One major advantage of the WDN data when exploring wage and employment adjustments is firm-level information on the change in economic conditions during the 2010-to-2013 period.

Our analysis differs from previous studies in the way we identify downward nominal wage rigidity. We estimate an ordered probit model of wage adjustments and find evidence in favour of the presence of wage rigidities in Europe. First, collective pay agreements increase the probability of a base wage raise and lower the probability of unchanged wages or a decrease in wages. This suggests that the wage bargaining process impacts the degree of downward nominal wage rigidity. This result also implies significantly more downward nominal wage rigidities for countries with much higher shares of employees covered by collective pay agreements. Second, the rise in the probability of a downward base wage response to a decrease in demand is significantly smaller than the rise in the probability of upward wage responses to an increase in demand. Furthermore, a strong and moderate fall in demand significantly increases the probability that base wages will remain unchanged. This is further evidence of downward nominal wage rigidity, as the distribution of changes in wages starts to bunch around unchanged base wages when demand falls. By contrast, when there is a moderate or strong increase in demand, there is a lower probability of base wages staying unchanged.

We further explore the influence of wage reactions to a fall in demand on employment. To take the endogeneity of wages in the employment equation into account, we use the share of workers covered by a collective pay agreement as an instrumental variable for wage adjustments. Estimation results point to a negative effect of downward wage rigidities on employment at the firm level, when these rigidities are induced by collective pay agreements. We find that wage adjustments have a significant effect on employment within the firm. The probability that employment falls or remains unchanged is significantly lower when wages decrease compared to the reference category of unchanged base wages. The probability of an increase in employment is accordingly raised. If wages increase, the probability of a decrease in employment is higher than under unchanged wages.

Wages and employment depend on similar economic circumstances. A decrease in the availability of supplies from the firm's usual suppliers, in the customers' ability to pay and meet contractual terms, or in the access to external financing affects wages and employment negatively. Moreover, firms that use flexible wage components are less likely to reduce wag-

es and employment. This suggests that firms adjust bonuses prior to adjusting base wages and employment. We find evidence that employment protection increases workers' bargaining power as the probability of a base wage rise is higher in firms that report firing costs as relevant obstacles to hiring.

An obvious limitation of the data is that it only includes firms that survived during 2010 and 2013. Further, direct conclusions from our firm-level analysis (which treats the development of demand as exogenous) to the macro level cannot be made, as wage adjustments and the incidence of unemployment have an impact on aggregate demand.

1   Introduction

During the economic and financial crisis, unemployment increased markedly in Europe, particularly for some countries. Furthermore, it has remained at an elevated level for a number of years. The severe labour market conditions have been to some extent attributed to the limited response of nominal wages and to downward wage rigidity (Schmitt-Grohé and Uribe, 2013). This paper empirically explores the behaviour of wages and the impact of wage adjustment on employment, with a focus on the role of nominal rigidities. Based on harmonised firm-level survey data from the latest wave of the Wage Dynamics Network (WDN) – a European System of Central Banks (ESCB) research network – this paper analyses wage setting behaviour as well as the employment decisions of firms in European countries during the years 2010 to 2013. Firm-level responses show their perceptions of the nature and extent of shocks, which—combined with data on wage adjustment— provides a tool to measure wage rigidities. In particular, we investigate the key determinants of wage behaviour as well as the impact of wage adjustment and demand conditions on employment at the firm level.

Rigidities could stem from several factors and the empirical literature focuses mostly on the role of institutions in wage rigidities. Holden and Wulfsberg (2008) and Anderton and Bonthuis (2015) find that downward wage rigidities reflect institutional factors such as a high degree of union coverage and employment protection, while Anderton et al. (2016) show that these institutional variables reduce the response of wages to unemployment.[7] Downward wage rigidities can also be the result of employers fearing that wage cuts would reduce their employees' motivation which would lead to a fall in workers' productivity as well as increasing the quits of the most productive workers (Stiglitz, 1974, Solow, 1979, Akerlof 1982, and Du Caju *et al.*, 2015, who use data from the first wave of the WDN).

The incidence of wage freezes is often taken as an indicator of rigidities assuming that all wage freezes would be wage cuts in the absence of downward nominal wage rigidity. Results of papers based on the previous two waves of the WDN survey of European firms, suggest that wage cuts occur very rarely, even during periods of deep economic contraction and an environment of low inflation. For example, Fabiani *et al.* (2015) show that, out of all the firms surveyed, only 2.6% cut base wages in the period of continuing economic growth from 2002-2006, while 9.5% of firms froze wages. During the first phase of the crisis in 2009 the incidence of wage cuts increased only mildly (to 3.2%), while the share of firms that froze wages increased markedly (to 34.5%), indicating the presence of a significant degree of

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[7] By contrast, Knoppick and Beissinger (2009) cannot relate downward nominal wage rigidity in European countries to institutional variables.

downward nominal wage rigidity in the European Union.[8] A measure of the degree of wage rigidity is proposed by Dickens et al. (2007) who use the ratio of wage freezes to the sum of freezes and wage cuts. However, we find that these measures have some drawbacks. For example, firms that respond to a fall in demand by freezing wages could be more flexible than firms that increase wages. Even in the presence of wage flexibility, wage freezes can be optimal and may occur due to specific economic circumstances. Furthermore, firms that neither cut nor freeze wages are not included in the measure. We therefore take advantage of information on the changes in demand perceived by the firms contained in the WDN survey. We estimate an ordered probit model of wage adjustments to changes in the level of demand making use of all categories of base wage development.[9] We find that wages do not react symmetrically to upward and downward movements in demand. In other words, asymmetries in the marginal effects of demand provide evidence of downward nominal wage rigidity. Furthermore, collective pay agreements reduce the probability of downward wage adjustment. Given the wide range of collective bargaining coverage across countries, this result also implies significantly more downward nominal wage rigidities for countries with larger shares of employees covered by collective pay agreements.

Nominal rigidities are particularly important in a period of low inflation. The literature provides arguments for an amplifying effect of wage rigidities on unemployment during recessions as well as a mitigating effect.[10] Using a small open economy model, Galì and Monacelli (2016) show recently that increasing wage flexibility could have a negative impact on welfare in a currency union and only small employment effects. Moreover, results from empirical studies are mixed on the impact of wage rigidities on employment. Babecký *et al.* (2012) highlight the substitutability between base wage flexibility and alternative labour cost adjustments: firms facing base wage rigidities, defined as firms freezing wages, are more likely to use alternative margins. Using microdata on Portugal, Dias *et al.* (2013) find that firms with more flexible base wages, which they define as firms that freeze wages, are less likely to reduce employment. This is strengthened by the availability of alternative labour-cost adjustment mechanisms. Carneiro *et al.* (2009) show empirically that wages offered to new entrants react more strongly to labour market conditions than wages of workers already on the job. Martins *et al.* (2010) confirm that wages offered to new hires react strongly to the unemployment rate. Consequently, rigidities induce more inflows on the labour market to adjust wages to the economic situation. By contrast, Card and Hyslop (1997) do not find any significant impact of wage flexibility on employment. Altonji and Devereux (2000) derive a measure of wage rigidi-

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[8] This result is in line with some other papers analysing the incidence of wage cuts during recessions. For example, Agell and Lundborg (2003) analysing the Swedish firm survey data conclude that virtually no wage cuts occurred during the recession in the 1990s (only 2 out of the 153 surveyed firms cut wages).

[9] Namely: strong decrease, moderate decrease, no change, moderate increase and strong increase.

[10] For a mitigating effect see Calmfors and Johansson (2006), and Shimer (2012). By contrast, according to another strand of the literature, wages could be considered too flexible if wage cuts during recessions led to a further fall in aggregate demand and employment (Keynes, 1936, Howitt, 1986, Amendola et al., 2004).

ty using the deviation of a notional wage change under flexible wages from the actual wage change. They do not find solid results for the impact of nominal wage rigidity on layoffs in the US. In contrast, using a similar measure of rigidity, Barwell and Schweitzer (2007) find for the UK that downward rigidities increase the probability of layoffs and Devicienti *et al.* (2007) find for Italy that rigidities lead to higher turnover at the firm level. We contribute to the literature by estimation of an IV ordered probit model of employment and wage adjustments which confirm the presence of downward wage rigidities. Estimation results show that a wage reduction significantly lowers the probability of a decrease in employment at the firm level when demand falls.

The paper is organized as follows. In Section 2, we illustrate a possible relationship between wages and employment using a simplified theoretical model framework. Section 3 describes the estimation sample. In Section 4, we estimate an ordered probit model of wage adjustments and show that there is evidence of downward nominal wage rigidity in Europe. In Section 5, we estimate the impact of downward nominal wage rigidity on employment using an IV ordered probit model. Section 6 concludes.

2 A simplified relationship between wages and employment

A simplified relationship between wage adjustments and employment can be derived from a Cobb-Douglas production function $Y = AK^{\alpha}L^{1-\alpha}$ with capital K and labour L. In a profit maximizing firm, real wages equal the marginal product of labour

$$w_{real} = (1 - \alpha)AK^{\alpha}L^{-\alpha}. \tag{2.1}$$

The real wage equals the ratio of the nominal wage w and the price index P. Substituting $w_{real} = \frac{w}{P}$ and the production function, equation (2.1) becomes

$$w = (1 - \alpha)\frac{PY}{L}.$$

Let us assume that the firm's output is determined by demand for its products and that the firm can adjust wages and employment such that the above equation holds. Employment then evolves according to

$$\Delta \ln L = \Delta \ln Y + \Delta \ln P - \Delta \ln w.$$

If wages are completely rigid and prices remain unchanged, a fall in log output is translated entirely into a fall in log employment:

$$\Delta \ln L = \Delta \ln Y.$$

A wage reduction could therefore mitigate the fall in employment induced by a negative demand shock. If log wages decrease to the same extent as log output, employment remains

unchanged. If the firm prefers to keep employment (and hours per worker) constant and if the level of demand for its products falls, adjustments have to take place completely by the reduction of the capital input which would reduce wages according to equation (2.1). Furthermore, for being an optimal adjustment to the firm, the real interest rate would need to increase. In this simple model, employment adjustments therefore depend on the reaction of wages and the interest rate to the development of demand. The latter is beyond the scope of this paper.

3   Description of the estimation sample

The analysis is based on the third wave of the WDN as the only data source. The firm survey was conducted simultaneously in 25 European Union countries[11] during June to September 2014. It was carried out by the national central banks. All countries used as the basis for the survey a harmonised questionnaire developed in the context of the ESCB Wage Dynamics Network, a research network analysing wage and labour cost dynamics. The full sample, excluding the public sector, contains the 17,530 responses of the firms located in survey countries for which there are no missing observations for the variables of our main firm-level estimation (Section 5).[12] The harmonised questionnaire includes questions referring to general firm characteristics, perceived shocks during the 2010-to-2013 period and their price and wage setting strategies.

Table 1 contains summary statistics with regards to sector composition, firm characteristics, payroll composition, the nature of shocks and labour cost adjustments. Three main sectors are represented in the sample: More than one third of the firms belong to the manufacturing sector; 29% to business sector; 22% to the trade sector. The other sectors represent 14% of the sample. Permanent workers constitute 90% of the total workforce and 60% of workers have tenure of more than five years. Low-skilled workers represent 41% of the workforce. A first set of questions concerns changes in the economic environment. Firms were asked how their activity had been affected between 2010 and 2013 by a change in the level of demand for its products/services, difficulties in access to external financing, lower ability to pay of customers and lower availability of supplies. The multiple choices were "strong decrease", "moderate decrease", "unchanged", "moderate increase" and "strong increase".

 A further set of questions concerns labour cost adjustments. We focus on the adjustment of employment and base wages. The "employment" variable is based on payroll composition (permanent, temporary or agency workers) and the change in the firm's number of employees. On average, firms report that more than half of their employees are covered by a collective pay agreement. In most firms, the share of bonuses on the total wage bill was positive in

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[11] The countries of the EU except Denmark, Finland and Sweden.
[12] Some questions were not in the Irish questionnaire. Consequently, Ireland is not in the sample.

2013. A reduction of base wages (or piece work rates) was rare; most firms reported that base wages had moderately increased during the period. The fraction of firms that had frozen wages at least once between 2010 and 2013 is more than twice as high as the fraction of firms that had cut wages at least once.

The demand development between 2010 and 2013 was heterogeneous. While 44% of firms experienced a decrease in demand, 32% indicated that demand increased. The fraction of firms reducing employment or wages is significantly higher if the firm experiences a fall in demand. However, employment was reduced in 43% of the firms which experienced negative demand developments, while only 14% of these ''negative demand'' firms reduced base wages. We take the relatively small percentage of wage decreases as an indication of downward nominal wage rigidity.

Firms often use employment and wage adjustments in combination to reduce labour costs. In the presence of a negative demand shock, the percentage of firms with a strong decrease in wages increases from only 1% of firms with a strong increase in employment to 13% of firms that indicate a strong decrease in employment. Further, only 9% of firms that report a strong increase in wages experience a strong decrease in employment against 46% of firms that reduce wages strongly (shaded areas in Table 2). The percentage of firms with wages (employment) falling into one category is the highest when employment (the wage) falls into the same category (diagonals in Table 2).

In our analysis below, collective bargaining agreements play a key role in the results, therefore we analyse the data more thoroughly for this variable also at the country level. First, the share of workers covered by a collective pay agreement in the euro area countries (average 74%) is much higher than for the non-euro countries (29%).[13] Several countries are significantly above the euro area average, such as: Belgium (95%); Spain (97%); France (94%); Italy (99%); the Netherlands (90%); Austria (75%); Slovenia (80%), while Portugal and Greece also have high shares of between 60-70%. With the exception of the Netherlands, these high shares are driven by collective bargaining agreements outside the firm (i.e., national or sectoral, rather than more decentralised firm-level agreements). By contrast, there are a number of euro area countries with collective bargaining coverage substantially below the euro average, including several countries where the share of workers covered by collective bargaining agreements is below 25%, namely: Estonia (8%); Latvia (22%); and Lithuania (16%). For the non-euro area EU countries, the UK and Poland have relatively low proportions of workers covered by collective pay agreements (i.e., around 20%), while Romania (72%) and Croatia (47%) have relatively high bargaining coverage.

Table 1: Firm characteristics and shocks (whole sample excluding public sector)

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[13] Reported shares of workers covered by collective pay agreement are employment weighted averages of the full estimation sample.

		Full sample	*Neg. D shock*
Firm characteristics		*17,530*	*7,706*
Sector	Manufacturing	35%	32%
	Electricity, gas, water	1%	1%
	Construction	10%	11%
	Trade	22%	24%
	Business services	29%	29%
	Financial intermediation	2%	2%
	Arts	1%	1%
Ownership at the end of 2013	Mainly domestic	81%	84%
	Mainly foreign	19%	16%
Size	less than 19 employees	30%	36%
	20-49 employees	23%	24%
	50-199 employees	25%	23%
	200 employees and +	22%	17%
Payroll composition at the end of 2013	Lower skilled	41%	42%
	Higher skilled	59%	58%
	Job tenure > 5 years	60%	65%
	Permanent contracts	90%	91%
	Temporary contracts	9%	9%
	Agency	1%	0.3%
Changes in the economic environment during 2010-2013			
Level of demand			
Strong decrease		14%	32%
Moderate decrease		30%	68%
Unchanged		24%	-
Moderate increase		27%	-
Strong increase		5%	-
Lower access to external financing		25%	40%
Customers' ability to pay decreased		44%	66%
Availability of supply decreased		16%	26%
(Very) relevant: Credit not available or conditions too onerous to			
finance working capital		35%	44%
finance new investment		34%	42%
refinance debt		28%	36%
Costs and adjustments			
Employmentª during 2010-2013			
Strong decrease		6%	11%
Moderate decrease		20%	32%
Unchanged		42%	41%
Moderate increase		27%	15%
Strong increase		4%	2%
Base wages during 2010-2013			
Strong decrease		2%	3%
Moderate decrease		6%	11%
Unchanged		31%	37%
Moderate increase		57%	45%
Strong increase		4%	4%
Labour cost share in total costs in 2013		37%	38%
Performance related share (bonuses) in 2013		8%	8%
Share of firms paying bonuses in 2013		67%	61%
Wages were frozen in at least one year between 2010 and 2013		20%	26%
Wages were cut in at least one year between 2010 and 2013		7%	10%
Firing costs are a (very) relevant obstacle in hiring workers with a permanent, open-ended contract		46%	55%
Wage setting in 2013			
Share of workers covered by any collective pay agreement		54%	61%
Firm level (coll. agreement)		29%	29%
Outside firm level (coll. agreement)		37%	45%

ª own definition based on payroll composition weighted average of permanent/ tempo-
rary or fixed-term employees/ agency workers and others

Table 2: Employment and wage adjustments when the level of demand goes down

	Base wages or piece work rates					
Employment	Strong decrease	Moderate decrease	Unchanged	Moderate increase	Strong increase	Total
Strong decrease	102	133	297	256	25	813
Moderate decrease	77	400	926	999	65	2,467
Unchanged	35	242	1,343	1,408	117	3,145
Moderate increase	5	51	301	753	47	1,157
Strong increase	1	2	17	72	32	124
Total	220	828	2,884	3,488	286	7,706

	Base wages or piece work rates given employment development:					
	Strong decrease	Moderate decrease	Unchanged	Moderate increase	Strong increase	Total
Strong decrease	**13%**	16%	37%	31%	3%	100%
Moderate decrease	3%	**16%**	38%	40%	3%	100%
Unchanged	1%	8%	**43%**	45%	4%	100%
Moderate increase	0%	4%	26%	**65%**	4%	100%
Strong increase	1%	2%	14%	58%	**26%**	100%
Total	3%	11%	37%	45%	4%	100%

Employment given wage development:	Strong decrease	Moderate decrease	Unchanged	Moderate increase	Strong increase	Total
Strong decrease	**46%**	16%	10%	7%	9%	11%
Moderate decrease	35%	**48%**	32%	29%	23%	32%
Unchanged	16%	29%	**47%**	40%	41%	41%
Moderate increase	2%	6%	10%	**22%**	16%	15%
Strong increase	0%	0%	1%	2%	**11%**	2%
Total	100%	100%	100%	100%	100%	100%

4 Evidence of downward nominal wage rigidity

We explore the empirical wage response to changes in the level of demand by estimation of the following ordered probit model of wage adjustments:

$$W_i^* = \gamma Z_i + X_i' \beta_1 + \varepsilon_{i1}, \qquad (4.1)$$

where W_i^* is a latent variable. Further $W_i = k$ if $d_{k-1} < W_i^* \le d_k$, with $k = 1, \dots 5$; d_k are estimated threshold parameters, with $d_0 = -\infty$ and $d_5 = \infty$. There are five different outcomes of W_i: strong decrease, moderate decrease, unchanged, moderate increase and strong increase. We use nominal base wages here. Data are qualitative, which does not enable us to compute real wages. The price indices are captured by the sector and country dummies.

Wage adjustments depend on the wage bargaining process.[14] Therefore, the share of workers covered by a collective pay agreement, denoted by Z_i, is included in the wage equation. The vector of covariates X_i comprises among other things the development of demand (all five categories). Estimation results (Table 3) show that the share of workers covered by any collective pay agreement is significant at the 1% level. It increases the probability of a base wage raise and lowers the probability of unchanged wages or a decrease in wages. This provides evidence in support of an influence of the wage bargaining process on the degree of downward nominal wage rigidity. Given the wide range of collective bargaining coverage

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[14] For a theoretical analysis of the influence of the bargaining process on wage flexibility see Hall and Milgrom (2008).

across countries shown in Section 3, this result also implies significantly more downward nominal wage rigidities for countries with much higher shares of employees covered by collective pay agreements. The results also contain evidence in favour of asymmetric demand elasticities for wages and thereby indicate downward nominal wage rigidity:[15] the rise in the probability of a downward base wage response to a decrease in demand is significantly smaller than the rise in the probability of upward wage responses to an increase in demand.[16] Furthermore, a strong and moderate fall in demand significantly increases the probability that base wages will remain unchanged, whereas one might expect these decreases in demand to actually reduce wages. Hence, this is further evidence of downward nominal wage rigidity, as the distribution of changes in wages starts to bunch around unchanged base wages when demand falls. By contrast, when there is a moderate or strong increase in demand there is a lower probability of base wages staying unchanged. The results are robust to the inclusion of further covariates which capture changes in the economic environment.[17]

Table 3: Ordered Probit Estimation of Wage Responses to a change in the level of demand

	Marginal effects on the probability of observing the outcome				
	(1)	(2)	(3)	(4)	(5)
	base wages	base wages	base wages	base wages	base wages
VARIABLES	strong decrease	moderate decrease	unchanged	moderate increase	strong increase
collective pay agreement[a]	-0.004***	-0.012***	-0.028***	0.033***	0.012***
	(0.001)	(0.002)	(0.005)	(0.006)	(0.002)
demand					
strong decrease	0.016***	0.042***	0.081***	-0.117***	-0.022***
	(0.002)	(0.004)	(0.006)	(0.010)	(0.002)
moderate decrease	0.006***	0.016***	0.037***	-0.048***	-0.011***
	(0.001)	(0.002)	(0.005)	(0.007)	(0.002)
unchanged (reference)					
moderate increase	-0.006***	-0.023***	-0.073***	0.071***	0.031***
	(0.001)	(0.002)	(0.006)	(0.006)	(0.002)
strong increase	-0.009***	-0.035***	-0.130***	0.107***	0.068***
	(0.001)	(0.002)	(0.010)	(0.006)	(0.007)
Observations	17,530				
p-value	0.000				
Pseudo R-squared	0.110				

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
[a] share of workers covered
Note: Firm size, sector and country dummies included. Marginal effect for indicator variables is the discrete change from the base level.

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[15] These asymmetric demand elasticities remain de facto unchanged regardless of including the collective pay agreement variable in the equation. The fear of employers that wage cuts would reduce their employees' motivation is one possible explanation for this finding.
[16] We conducted z-tests to compare the marginal effects.
[17] Furthermore, we obtain similar results for the subsample of firms with unchanged prices in domestic and foreign markets.

5   Wage adjustments and employment

In the following, we explore the impact of wage responses to a negative demand shock on the development of employment. The ordered probit model of employment adjustments is given by

$$L_i^* = \alpha W_i + X_i' \beta_2 + \varepsilon_{i2}, \tag{5.1}$$

where L_i^* is a latent variable. Further $L_i = k$, $c_{k-1} < L_i^* \leq c_k$, whereby c_k are estimated threshold parameters with $c_0 = -\infty$ and $c_5 = \infty$. We are especially interested in the parameter α which captures the effect of wage adjustments on employment. In contrast to the theoretical model presented in Section 2, prices are not explicitly included. The price index is assumed country and sector-specific and is captured by the corresponding dummies.

Firms can adjust both employment and wages in response to changing economic conditions. To take the possible endogeneity of wages in the employment equation into account, we use an instrumental variable approach with employment equation (5.1) and wage equation (4.1). The error terms are jointly normally distributed:

$$\begin{pmatrix} \varepsilon_{i1} \\ \varepsilon_{i2} \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right].$$

With wages being endogenous in the employment equation, the error terms are correlated ($\rho \neq 0$). The share of workers covered by a collective pay agreement, Z_i, serves as an instrumental variable for wage adjustments. We presume that collective bargaining has no direct effect on employment adjustment in Europe as it seldom covers severance pay and notice periods different from legislation (Venn, 2009). The view that bargaining is over wages and employers take the wage as given when "choosing the employment levels" is a "standard (and realistic) characterization of collective bargaining" according to Boeri and van Ours (2013, p. 71). Moreover, the empirical literature arrives at very heterogeneous results[18] suggesting a non-positive impact of unionisation on employment.

5.1   Wage rigidities and employment adjustments following a demand shock

Estimation results are presented in Table 4. As we consider only firms that experienced a fall in demand, the ordinal demand variable is replaced by dummy equal to one if the negative demand shock was strong and equal to zero if demand decreased only moderately. The Appendix contains estimation results for the total sample with all five demand categories.

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[18] See for example DiNardo and Lee (2004) and Sojourner et al. (2012) for recent studies.

Evidence of downward nominal wage rigidity is also present in the IV ordered probit estimation (Table 4, top panel wage equations) with collective bargaining agreements reducing the probability of downward wage adjustment. The significant correlation of the error terms (see ρ, bottom of Table 4) confirms that wages are endogenous in the employment equation and that the IV approach is adequate. Wage adjustments have a significant effect on employment within the firm (Table 4, bottom panel employment equations). The probability that employment falls or remains unchanged is significantly lower when wages decrease compared to the reference category of unchanged base wages. The probability of an increase in employment is accordingly raised. If wages increase, the probability of a decrease in employment is higher than under unchanged wages.

Table 4: IV Ordered Probit Estimation

	Marginal effects on the probability of observing the outcome				
Wage equation	(1)	(2)	(3)	(4)	(5)
	base wages	base wages	base wages	base wages	base wages
VARIABLES	strong decrease	moderate decrease	unchanged	moderate increase	strong increase
collective pay agreement[a]	-0.008***	-0.018***	-0.022***	0.038***	0.010***
	(0.002)	(0.004)	(0.005)	(0.008)	(0.002)
strong demand shock	0.010***	0.023***	0.027***	-0.048***	-0.012***
	(0.002)	(0.004)	(0.004)	(0.008)	(0.002)
foreignown	-0.003	-0.007	-0.009	0.015	0.004
	(0.002)	(0.005)	(0.006)	(0.010)	(0.003)
Negative shocks:					
finance	0.007***	0.015***	0.019***	-0.032***	-0.008***
	(0.002)	(0.004)	(0.005)	(0.009)	(0.002)
customers	0.003**	0.007**	0.009*	-0.015**	-0.004*
	(0.002)	(0.004)	(0.005)	(0.008)	(0.002)
supplies	0.002	0.005	0.007	-0.011	-0.003
	(0.002)	(0.004)	(0.005)	(0.009)	(0.002)
bonuses	-0.007***	-0.017***	-0.020***	0.035***	0.009***
	(0.002)	(0.004)	(0.005)	(0.008)	(0.002)
labour cost share	-0.006	-0.013	-0.016	0.027	0.007
	(0.004)	(0.009)	(0.011)	(0.018)	(0.005)
firingcosts	-0.007***	-0.015***	-0.018***	0.032***	0.008***
	(0.002)	(0.004)	(0.004)	(0.007)	(0.002)
Credit constraints:					
financedebt	0.006**	0.015**	0.018***	-0.031**	-0.008***
	(0.003)	(0.006)	(0.007)	(0.012)	(0.003)
financeinvest	-0.001	-0.002	-0.003	0.005	0.001
	(0.002)	(0.005)	(0.007)	(0.011)	(0.003)
financeworkingcapital	0.001	0.002	0.003	-0.005	-0.001
	(0.003)	(0.006)	(0.007)	(0.012)	(0.003)
Employment equation	(1)	(2)	(3)	(4)	(5)
	employment	employment	employment	employment	employment
VARIABLES	strong decrease	moderate decrease	unchanged	moderate increase	strong increase
base wages:					
strong decrease	-0.085***	-0.125***	-0.074**	0.096***	0.187**
	(0.015)	(0.016)	(0.035)	(0.017)	(0.081)
moderate decrease	-0.065***	-0.085***	-0.033**	0.076***	0.107***
	(0.011)	(0.009)	(0.016)	(0.007)	(0.039)
unchanged (reference)					
moderate increase	0.173***	0.083***	-0.061***	-0.124***	-0.071***
	(0.035)	(0.004)	(0.003)	(0.011)	(0.022)
strong increase	0.538***	0.010	-0.236***	-0.218***	-0.094***
	(0.084)	(0.039)	(0.011)	(0.014)	(0.025)
strong demand shock	0.124***	0.050***	-0.045***	-0.081***	-0.048***
	(0.008)	(0.012)	(0.010)	(0.010)	(0.008)
foreignown	-0.002	-0.001	0.001	0.002	0.001
	(0.009)	(0.004)	(0.002)	(0.006)	(0.004)
Negative shocks:					

finance	0.026***	0.013***	-0.008***	-0.019***	-0.012***
	(0.007)	(0.004)	(0.003)	(0.005)	(0.004)
customers	0.004	0.002	-0.001	-0.003	-0.002
	(0.006)	(0.003)	(0.002)	(0.004)	(0.003)
supplies	0.015**	0.007*	-0.005*	-0.011**	-0.007**
	(0.007)	(0.004)	(0.003)	(0.005)	(0.004)
bonuses	-0.031***	-0.014***	0.009***	0.021***	0.014***
	(0.007)	(0.004)	(0.003)	(0.005)	(0.004)
labour cost share	0.024	0.012	-0.007	-0.017	-0.012
	(0.015)	(0.008)	(0.005)	(0.011)	(0.007)
firingcosts	-0.008	-0.004	0.002	0.006	0.004
	(0.007)	(0.003)	(0.002)	(0.004)	(0.003)
Credit constraints:					
financedebt	0.037***	0.017***	-0.011***	-0.026***	-0.017***
	(0.010)	(0.005)	(0.004)	(0.007)	(0.005)
financeinvest	-0.018**	-0.009*	0.005*	0.013*	0.009*
	(0.009)	(0.005)	(0.003)	(0.007)	(0.005)
financeworkingcapital	0.002	0.001	-0.001	-0.001	-0.001
	(0.010)	(0.005)	(0.003)	(0.007)	(0.005)
Observations	7,706				
p-value	0.000				
ρ	0.751***				

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
[a] share of workers covered

Note: Firm size, sector and country dummies included. The IV ordered probit model was estimated using the Stata command cmp written by Roodman (2011). Marginal effect for indicator variables is the discrete change from the base level.

5.2   Further determinants of wage and employment adjustments

Wages and employment depend on similar economic circumstances. Both are more likely to decrease if the fall in demand is strong. With regards to wages, also the probability of unchanged wages is increased.

A decrease in the availability of supplies from the firm's usual suppliers, a fall in the customers' ability to pay and meet contractual terms and lower access to external financing raises the probability of lower employment and wages. As in the case of a negative demand shock, also the probability of unchanged wages is increased. The supply shock is not statistically significant for wages and the customers shock is not significant for employment.

We capture flexible wage components by a dummy variable equal to one if the firm uses bonuses. We find that firms which use flexible wage components increase base wages more often and have a lower likelihood to reduce employment. This suggests that firms adjust bonuses prior to adjusting base wages and employment.

The probability of a base wage rise is higher in firms that report firing costs as relevant obstacles in hiring. The firing cost variable captures the strictness of employment protection. Its positive impact on wages works through the strengthening of workers' bargaining power. We do not find a significant effect of firing costs on employment.

If credit is not available to refinance debt or conditions are too onerous, the probability of wage reductions and unchanged wages is higher. Furthermore, the probability of employment reduction is increased. Relevant credit constraints regarding financing of investment

have a positive effect on employment. That effect might arise when investments lead to a substitution of capital for labour.

5.3 Robustness

The results are still valid if we estimate the IV ordered probit model separately for euro-area and non-euro-area countries and also if we include less covariates (Table 6 in Appendix). Results are also robust to the inclusion of the percentage of higher skilled workers and of workers with more than five years of tenure. Our preferred specification does not contain these two variables as we only have information on tenure and skills in 2013 which gives rise to further endogeneity issues. The percentage of workers with tenure below three years in 2013 can increase through hiring of workers between 2010 and 2013. This yields a negative relationship between tenure and employment. In another specification, we include the persistence of the strong demand shock[19] and also find evidence of downward nominal wage rigidity and a positive effect of wage reductions on employment in the presence of a fall in demand.

Two-stage OLS yields similar results as the ordered probit specification (Table 7 and Table 8 in Appendix). The instrument is significant at the 1% level and we conclude from the test statistics that our instrument is valid. The null of base wages being exogenous is rejected.

6 Concluding remarks

One major advantage of the WDN data when exploring wage and employment adjustments is firm-level information on the change in economic conditions during the 2010-to-2013 period. We explore the marginal effects of a change in demand on the probabilities of observing specific wage reactions and find evidence of downward nominal wage rigidity in Europe for the years between 2010 and 2013. Our findings show wage rigidities via two channels: first, collective pay agreements reduce the probability of downward wage adjustment. Given the wide range of collective bargaining coverage across countries, this result also implies significantly more downward nominal wage rigidities for countries with larger shares of employees covered by collective pay agreements; second, asymmetric demand elasticities for wages indicate that the rise in the probability of downward base wage responses to a decrease in demand is significantly smaller than the rise in the probability of an upward wage response to an increase in demand.

The paper further analyses the influence of wage reactions to a fall in demand on employment. Estimation results point to a negative effect of downward wage rigidities on employment at the firm level when these rigidities are induced by collective pay agreements. This

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[19] This yields nine categories of demand development, as the strong positive or negative shock is further subdivided into a "transitory", "only partly persistent", and "long-lasting" positive or negative shock.

does not imply that wage rigidities which aim to reduce the possible negative effects of wage cuts on employees' motivation have the same effect. Our results suggest that exit clauses from collective pay agreements in case of demand shocks/recessions could mitigate negative employment effects at the firm level.

An obvious limitation of the data is that it only includes firms that survived during 2010 and 2013. We therefore cannot explore how wage rigidities had an impact on business failures. Further, direct conclusions from our firm-level analysis (which treats the development of demand as exogenous) to the macro level cannot be made, as wage adjustments and the incidence of unemployment have an impact on aggregate demand.

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Appendix

Asymmetric wage responses: IV Ordered Probit

There is also evidence in favour of asymmetric demand elasticities for wages in the IV ordered probit model.

Table 5: IV Ordered Probit Estimation with all five demand categories

		Marginal effects on the probability of observing the outcome			
Wage equation	(1)	(2)	(3)	(4)	(5)
	base wages	base wages	base wages	base wages	base wages
VARIABLES	strong decrease	moderate decrease	unchanged	moderate increase	strong increase
collective pay agreement[a]	-0.006***	-0.015***	-0.035***	0.041***	0.015***
	(0.001)	(0.002)	(0.004)	(0.005)	(0.002)
demand					
strong decrease	0.013***	0.035***	0.068***	-0.097***	-0.019***
	(0.002)	(0.004)	(0.007)	(0.010)	(0.002)
moderate decrease	0.005***	0.013***	0.031***	-0.039***	-0.009***
	(0.001)	(0.002)	(0.006)	(0.007)	(0.002)
unchanged (reference)					
moderate increase	-0.007***	-0.023***	-0.071***	0.071***	0.030***
	(0.001)	(0.002)	(0.006)	(0.006)	(0.002)
strong increase	-0.010***	-0.036***	-0.126***	0.107***	0.064***
	(0.001)	(0.002)	(0.010)	(0.007)	(0.007)
foreignown	-0.003***	-0.008***	-0.020***	0.023***	0.009***
	(0.001)	(0.002)	(0.005)	(0.005)	(0.002)
Negative shocks:					
finance	0.004***	0.011***	0.025***	-0.030***	-0.010***
	(0.001)	(0.002)	(0.005)	(0.007)	(0.002)
customers	0.000	0.001	0.003	-0.003	-0.001
	(0.001)	(0.002)	(0.004)	(0.005)	(0.002)
supplies	0.002	0.004	0.009	-0.011	-0.004*
	(0.001)	(0.003)	(0.006)	(0.007)	(0.002)
bonuses	-0.003***	-0.009***	-0.021***	0.025***	0.008***
	(0.001)	(0.002)	(0.004)	(0.005)	(0.002)
labour cost share	-0.004***	-0.012***	-0.028***	0.033***	0.012***
	(0.001)	(0.004)	(0.009)	(0.011)	(0.004)
firingcosts	-0.004***	-0.010***	-0.024***	0.028***	0.010***
	(0.001)	(0.002)	(0.004)	(0.005)	(0.002)
Credit constraints:					
financedebt	0.002*	0.005*	0.012*	-0.014*	-0.005*
	(0.001)	(0.003)	(0.006)	(0.008)	(0.003)
financeinvest	-0.001	-0.002	-0.006	0.007	0.002
	(0.001)	(0.003)	(0.006)	(0.007)	(0.003)
financeworkingcapital	0.002*	0.005*	0.012*	-0.014*	-0.005*
	(0.001)	(0.003)	(0.007)	(0.008)	(0.003)
Employment equation	(1)	(2)	(3)	(4)	(5)
	employment	employment	employment	employment	employment
VARIABLES	strong decrease	moderate decrease	unchanged	moderate increase	strong increase
base wages:					
strong decrease	-0.024***	-0.048***	-0.043**	0.047***	0.067**
	(0.007)	(0.015)	(0.020)	(0.010)	(0.032)
moderate decrease	-0.021***	-0.042***	-0.037***	0.043***	0.058***
	(0.004)	(0.007)	(0.010)	(0.004)	(0.017)
unchanged (reference)					
moderate increase	0.065***	0.080***	0.020***	-0.099***	-0.067***
	(0.011)	(0.007)	(0.003)	(0.009)	(0.012)
strong increase	0.223***	0.155***	-0.050***	-0.223***	-0.105***
	(0.044)	(0.005)	(0.015)	(0.019)	(0.016)
demand:					
strong decrease	0.176***	0.142***	-0.080***	-0.189***	-0.049***
	(0.010)	(0.012)	(0.007)	(0.008)	(0.005)
moderate decrease	0.050***	0.067***	-0.004***	-0.084***	-0.029***
	(0.004)	(0.006)	(0.001)	(0.007)	(0.003)
unchanged (reference)					
moderate increase	-0.036***	-0.081***	-0.053***	0.101***	0.069***
	(0.004)	(0.005)	(0.004)	(0.007)	(0.005)

	(1)	(2)	(3)	(4)	(5)
strong increase	-0.053***	-0.149***	-0.175***	0.157***	0.220***
	(0.006)	(0.005)	(0.013)	(0.013)	(0.015)
foreignown	-0.006**	-0.007**	-0.001*	0.009**	0.005*
	(0.003)	(0.004)	(0.001)	(0.005)	(0.003)
Negative shocks:					
finance	0.014***	0.017***	0.002***	-0.022***	-0.012***
	(0.003)	(0.004)	(0.000)	(0.005)	(0.003)
customers	0.001	0.001	0.000	-0.002	-0.001
	(0.003)	(0.003)	(0.000)	(0.004)	(0.002)
supplies	0.012***	0.014***	0.002***	-0.017***	-0.009***
	(0.004)	(0.004)	(0.000)	(0.005)	(0.003)
bonuses	-0.016***	-0.019***	-0.003***	0.025***	0.013***
	(0.003)	(0.003)	(0.000)	(0.004)	(0.002)
labour cost share	0.002	0.002	0.000	-0.003	-0.001
	(0.006)	(0.007)	(0.001)	(0.009)	(0.005)
firingcosts	-0.000	-0.001	-0.000	0.001	0.000
	(0.002)	(0.003)	(0.000)	(0.004)	(0.002)
Credit constraints:					
financedebt	0.015***	0.018***	0.002***	-0.023***	-0.012***
	(0.004)	(0.005)	(0.000)	(0.006)	(0.003)
financeinvest	-0.012***	-0.015***	-0.003***	0.019***	0.011***
	(0.004)	(0.005)	(0.001)	(0.006)	(0.004)
financeworkingcapital	0.005	0.006	0.001	-0.008	-0.004
	(0.004)	(0.005)	(0.001)	(0.006)	(0.004)
Observations	17,530				
p-value	0.000				
ρ	0.610***				

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

[a] share of workers covered

Note: Firm size, sector and country dummies included. The IV ordered probit model was estimated using the Stata command cmp (Roodman, 2011). Marginal effect for indicator variables is the discrete change from the base level.

Robustness of the IV Ordered Probit estimation

Table 6: Less covariates; only firms with negative demand shock

	Marginal effects on the probability of observing the outcome				
Wage equation	(1)	(2)	(3)	(4)	(5)
	base wages	base wages	base wages	base wages	base wages
VARIABLES	strong decrease	moderate decrease	unchanged	moderate increase	strong increase
collective pay agreement[a]	-0.008***	-0.018***	-0.022***	0.037***	0.010***
	(0.002)	(0.004)	(0.005)	(0.008)	(0.002)
strong demand shock	0.013***	0.029***	0.033***	-0.061***	-0.015***
	(0.002)	(0.004)	(0.004)	(0.008)	(0.002)
Employment equation	(1)	(2)	(3)	(4)	(5)
	employment	employment	employment	employment	employment
VARIABLES	strong decrease	moderate decrease	unchanged	moderate increase	strong increase
base wages:					
strong decrease	-0.086***	-0.125***	-0.078**	0.091***	0.199***
	(0.014)	(0.014)	(0.031)	(0.018)	(0.074)
moderate decrease	-0.067***	-0.085***	-0.036**	0.074***	0.114***
	(0.011)	(0.007)	(0.015)	(0.007)	(0.036)
unchanged (reference)					
moderate increase	0.182***	0.082***	-0.061***	-0.126***	-0.076***
	(0.032)	(0.004)	(0.003)	(0.009)	(0.020)
strong increase	0.566***	-0.003	-0.240***	-0.222***	-0.100***
	(0.071)	(0.034)	(0.009)	(0.012)	(0.024)
strong demand shock	0.135***	0.050***	-0.046***	-0.085***	-0.054***
	(0.008)	(0.011)	(0.010)	(0.010)	(0.008)
Observations	7,706				
p-value	0.000				
ρ	0.767***				

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

[a] share of workers covered

Note: Firm size, sector and country dummies included. The IV ordered probit model was estimated using the Stata command cmp (Roodman, 2011). Marginal effect for indicator variables is the discrete change from the base level.

In the Two-Stage OLS estimation (Table 7 and Table 8), we treat the ordinal employment variable and the ordinal wage variable (both taking five values) as if they were continuous. Base wages are instrumented by the share of workers covered by any collective pay agreement.

Table 7: Two-Stage OLS; only firms with negative demand shock

VARIABLES	(1) First Step base wages	(2) Second Step employment
base wages		-0.752*
		(0.420)
collective pay agreement[a]	0.095***	
	(0.026)	
strong demand shock	-0.128***	-0.547***
	(0.020)	(0.061)
foreignown	0.043*	0.022
	(0.024)	(0.043)
Negative shocks:		
finance	-0.084***	-0.132***
	(0.021)	(0.048)
customers	-0.044**	-0.026
	(0.019)	(0.035)
supplies	-0.035	-0.075**
	(0.022)	(0.037)
bonuses	0.093***	0.151***
	(0.020)	(0.050)
labour cost share	0.033	-0.159**
	(0.045)	(0.071)
firingcosts	0.070***	0.031
	(0.018)	(0.042)
Credit constraints:		
financedebt	-0.076***	-0.173***
	(0.029)	(0.056)
financeinvest	0.011	0.082*
	(0.028)	(0.044)
financeworkingcapital	-0.016	-0.011
	(0.030)	(0.048)
Constant	3.986***	6.075***
	(0.071)	(1.704)
Observations	7,706	
R-squared of first step	0.211	
p-value	0.002	
Kleib.-Paap rk Wald F stat.	13.798	
Underid. test chi-sq	0.000	
Weak-instr.-robust inf.	0.018	
Endogeneity test	0.001	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
[a] share of workers covered
Firm size, sector and country dummies included. We used the Stata command ivreg2 to perform the 2-Step OLS estimation and its test statistics.

VARIABLES	(1) First Step base wages	(2) Second Step employment
base wages		-1.195***
		(0.358)
collective pay agreement[a]	0.078***	
	(0.014)	
demand:		
strong decrease	-0.228***	-1.017***
	(0.021)	(0.090)
moderate decrease	-0.093***	-0.400***
	(0.014)	(0.043)
unchanged (reference)		
moderate increase	0.158***	0.512***
	(0.013)	(0.061)
strong increase	0.268***	1.054***
	(0.022)	(0.106)
foreignown	0.055***	0.082**
	(0.013)	(0.032)
Negative shocks:		
finance	-0.080***	-0.169***
	(0.015)	(0.041)
customers	-0.014	-0.023
	(0.012)	(0.023)
supplies	-0.041**	-0.116***
	(0.017)	(0.034)
bonuses	0.061***	0.158***
	(0.012)	(0.032)
labour cost share	0.050*	0.001
	(0.026)	(0.053)
firingcosts	0.062***	0.048
	(0.011)	(0.032)
Credit constraints:		
financedebt	-0.042**	-0.135***
	(0.018)	(0.038)
financeinvest	0.019	0.101***
	(0.018)	(0.036)
financeworkingcapital	-0.033*	-0.063
	(0.018)	(0.039)
Constant	3.932***	7.989***
	(0.038)	(1.431)
Observations	17,530	
R-squared of first step	0.223	
p-value	0.002	
Kleib.-Paap rk Wald F stat.	30.126	
Underid. test chi-sq	0.000	
Weak-instr.-robust inf.	0.000	
Endogeneity test	0.000	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
[a] share of workers covered
Firm size, sector and country dummies included. We used the Stata command ivreg2 to perform the 2-Step OLS estimation and its test statistics.