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# Downward Nominal and Real Wage Rigidity

## Survey Evidence from European Firms

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## Abstract

It has been well established that the wages of individual workers react little, especially downwards, to shocks that hit their employer. This paper presents new evidence from a unique survey of firms across Europe on the prevalence of downward wage rigidity in both real and nominal terms. The authors analyse which firm-level and institutional factors are associated with wage rigidity. The results indicate that it is related to workforce composition at the establishment level in a manner that is consistent with related theoretical models (e.g. efficiency wage theory, insider-outsider theory). The analysis also finds that wage rigidity depends on the labour market institutional environment. Collective bargaining coverage is positively related with downward real wage rigidity, measured on the basis of wage indexation. Downward nominal wage rigidity is positively associated with the extent of permanent contracts and this effect is stronger in countries with stricter employment protection regulations.


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This paper—a product of the Office of the Regional Chief Economist, Latin America and the Caribbean Region—is part of a larger effort in the department to understand the functions of labor markets in a comparative perspective. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at jmessina@worldbank.org.

# Downward Nominal and Real Wage Rigidity: Survey Evidence from European Firms

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**Non-technical summary**

Based on a unique firm-level survey carried out between late 2007 and early 2008 within the framework of the Wage Dynamics Network, we analyse the flexibility of wages across 14 countries of the European Union (EU). Our objective is to examine the extent and determinants of downward nominal and real wage rigidity.

Downward nominal wage rigidity (DNWR) is defined on the basis of the frequency of nominal wage freezes. Firms freezing nominal base wages at any point during the five-year period prior to the survey are considered to be subject to nominal wage rigidity. Downward real wage rigidity (DRWR) is defined on the basis of wage indexation. Firms that have an automatic link between nominal base wages and past or expected inflation are regarded as subject to downward real wage rigidity. Our survey-based measures of downward nominal and real wage rigidity are closely related to the alternative measures derived by earlier studies on the basis of the wage change distributions.

We find that the incidence of both types of wage rigidity is quite substantial in Europe – approximately 10% of firms experienced wage freezes and 17% of firms applied wage indexation mechanisms. Thus, indexation (DRWR) is much more prevalent in the EU countries than wage freezes (DNWR). This is consistent with other evidence on wage rigidity in most continental European countries, as opposed to the US and the UK. Overall, we find that the non-euro area member states of the EU are more likely to experience wage freezes compared to the euro area member states, whereas indexation mechanisms are more widely used in the euro area countries included in our sample.

Next, we analyse how DNWR and DRWR are related to a number of firm-level and institutional characteristics of labour markets in the countries covered by our sample. We employ the multinomial logit estimation method, which makes it possible to assess these relationships simultaneously for both types of rigidities. Our estimations indicate that country-specific factors appear to be significant determinants of downward wage rigidities and that institutional differences between countries are an important factor behind this finding. For example, high collective bargaining coverage is positively related with real wage rigidity, while the estimated relationship with nominal wage rigidity is insignificant. A possible interpretation of this finding is that unions have the capacity to provide their members with information about inflation expectations and explain the importance of maintaining the real income level to workers. Thus, union coverage reduces the prevalence of money illusion.

Analysis of the union contracts negotiated at different levels (firm-level versus higher-level bargaining contracts) implies that firm-level contracts are a more likely source of real wage rigidity in centralised wage-setting environments. However, there is a substantial degree of heterogeneity across countries regarding the impact of different types of union contracts. Another institutional aspect that influences wage rigidity is related to how difficult it is for employers to lay off workers. We find that nominal wage rigidity is positively associated with the extent of permanent contracts. In addition, permanent contracts have a stronger effect on wage rigidity in countries with stricter labour regulations.

Workforce composition also appears to play a significant role in the determination of wage rigidities. Both types of rigidity are positively correlated with the share of high-skilled white collars; downward nominal wage rigidity is positively related with employees' tenure in the firms under study. Both of these significant relationships are consistent with the implications of related theoretical models. In addition, we find that firms employing labour-intensive technologies are more likely to have rigid wages.

Finally, there seems to be a positive relationship between product market competition and downward nominal wage rigidity, although the results are dependent on the way competition is measured. A possible cause of this empirical result is that in highly competitive industries rents should be low, and therefore so should wages. This leaves smaller margins to reduce wages, because firms paying low wages that are closer to a collectively agreed or legislative minimum level have less flexibility than firms having a so-called wage cushion between the minimum and the actual wage bill.

## 1. Introduction

The success of central banks in achieving price stability during the last two decades has renewed the academic interest in the cost of low inflation. Following Tobin (1972), if workers resist nominal wage cuts a rate of inflation that is too low might result in higher unemployment, since increases in the price level facilitate relative wage adjustments. A sizeable literature identifies substantial resistance to nominal wage cuts in the US.[1] The European evidence, led by the International Wage Flexibility Project (Dickens et al., 2007) suggests lower levels of downward nominal wage rigidity (DNWR) than those observed in the US, but higher resistance to real wage cuts, a feature labelled downward real wage rigidity (DRWR). While the behavioural determinants of DNWR have been extensively studied in the literature[2] little is known about DRWR. Similarly, there is little evidence regarding the characteristics of firms that are typically associated with each type of rigidity.

The aim of the current article is to analyse the incidence and causes of downward nominal and real wage rigidity. For this purpose, we use a novel major firm-level survey that contains detailed qualitative information for 15 EU countries. The survey was carried out within the framework of the Wage Dynamics Network (WDN), a research network sponsored by a consortium of central banks of the EU and coordinated by the European Central Bank. The sampling and stratification (discussed in the next section) was designed to be representative at the country level, and the questionnaire was harmonised across countries. This is the first firm-level survey with a harmonised design covering a large number of countries including detailed information on the extent of wage rigidities.

Using an extensive micro-level survey has several advantages for our purposes. Most importantly, it allows us to examine the relevance of firm characteristics in the determination of rigidities, exploiting information that is usually unobservable in administrative and household data previously used in the literature. Moreover, the coverage of a large number of sectors and countries enables us to assess the importance of product and labour market characteristics in the determination of nominal versus real rigidities. Previous research, based on aggregate or sectoral data, has demonstrated that the institutional environment, e.g. the characteristics and coverage of collective bargaining or the extent of employment protection, is significantly correlated with wage rigidity (Dickens et al., 2007; Holden and Wulfsberg, 2007 and 2008). We benefit from the detailed firm-level information available to us to extend

[1] See among others Blinder and Choi (1990), Kahn (1997), Card and Hyslop (1997), Altonji and Devereux (1999) and Lebow et al. (2003).
[2] See e.g. Blinder and Choi (1990), Bewley (1994), Agell and Lundborg (1995, 2003) and Campbell and Kamlani (1997).

this analysis in examining the specific features of the institutional environment in which the firm operates, e.g. the extent of product market competition and characteristics of wage bargaining.

The measures of wage rigidity used in the current study are closely related to alternative indicators derived on the basis of the wage change distribution observed at the individual level (see e.g. Dickens et al., 2007). We define downward nominal wage rigidity (DNWR) on the basis of nominal wage freezes. Firms freezing nominal wages at any point during the five-year period prior to the survey are considered to be subject to nominal wage rigidity. Our measure of downward real wage rigidity is defined on the basis of wage indexation. We consider as subject to downward real wage rigidity (DRWR) those firms that have an automatic link between wages and past or expected inflation. Note that this is a narrower concept of real wage rigidity in comparison to the earlier research that derives wage rigidity measures on the basis of wage change distributions. Dickens et al. (2008) have shown that in many cases real wages are rigid but the focal point is different from expected or realised inflation. This pattern in the wage change distribution is consistent with wage indexation if firms have imperfect foresight. However, it can also result from a part of firms following the inflation rate in their wage-setting decisions, but not having a formal rule that links nominal wage changes to inflation. In spite of the noted differences, we will show in Section 2 that our measures of wage rigidity are highly correlated with the measures derived by earlier studies.

We employ multinomial logit regressions to analyse how DNWR and DRWR relate to a number of firm-level and institutional characteristics of labour markets in the countries covered by our sample. Employing this methodology makes it possible to assess these relationships simultaneously for both types of rigidities. Although a given firm can in principle be subject to both types of downward rigidity, in practice this cannot be observed, i.e. we cannot simultaneously observe that a firm freezes real wages and in addition avoids nominal wage cuts. This implies that cross-sectional sector- and country-level measures of nominal and real wage rigidity are negatively correlated. Given this interdependence and the fact that both types of rigidities are influenced by a set of variables that overlaps to a large extent, the estimated coefficients can be biased if these relationships are assessed separately for DNWR and DRWR. Using the multinomial logit regression method enables us to overcome this problem.

We find that the incidence of both types of wage rigidity is quite substantial in Europe – approximately 10% of firms experienced wage freezes and 17% of firms applied wage indexation mechanisms. The incidence of wage freezes implies that downward nominal wage

rigidity is more common in non-euro area economies, whereas indexation mechanisms are more widely used in the euro-area countries included in our sample. Our regression results indicate that collective bargaining coverage is positively related with real wage rigidity, while the estimated relationship with nominal wage rigidity is insignificant. A possible interpretation of this finding is that unions have the capacity to provide their members with information about inflation expectations and explain the importance of maintaining the real income level to workers (Dickens et al., 2007). Thus, union coverage reduces the prevalence of money illusion. DNWR instead is higher in countries where firing is costly due to employment protection legislation provisions and within firms with a higher share of workers holding open-ended contracts. This is consistent with Holden (2002), who shows that when renegotiation of contracts requires mutual consent, employment protection provisions increase the bargaining power of insiders, who have then a strategic advantage in imposing nominal wage increases even when firms want to cut wages.

Our regression results also show that wages of high-skilled white-collar workers are more rigid than those of blue-collar and low-skilled white-collar workers. This holds for both downward nominal and real rigidity and is in line with the predictions of standard labour market theories. Firms may be reluctant to cut wages of workers whose effort is less easily monitored or those with high replacement costs to avoid them reducing their effort or leaving the firm. These characteristics are typical for high-skilled white-collar workers. Our finding of higher real and nominal wage rigidity for this occupational group is consistent with Campbell's (1997) results. Using macroeconomic data for the US, he finds that wages of more skilled workers, and in particular white-collar workers, are less responsive to fluctuations in unemployment. It is also consistent with the findings by Franz and Pfeiffer (2006), who examine the determinants of wage rigidity in Germany. The implications of other firm characteristics, including size and tenure structure, and the importance of product market competition, are also discussed in the text.

The rest of the paper is organised as follows. Section 2 describes the main characteristics of the survey and definitions of wage rigidities. Section 3 presents some theoretical predictions regarding the impact of firm characteristics and institutions on rigidity, and discusses previous findings in the empirical literature. Section 4 concentrates on the survey evidence regarding wage freezes and indexation practices. Section 5 examines how nominal and real wage rigidities are related to various firm-level characteristics and institutional measures. Section 6 concludes and draws policy implications.

## 2. Survey design and definitions of wage rigidities

### *2.1. Survey design*

The analysis in the current paper is based on a survey of firms conducted between the second half of 2007 and the first quarter of 2008 in 15 European Union countries: Austria, Belgium, the Czech Republic, Estonia, France, Greece, Hungary, Ireland, Italy, the Netherlands, Lithuania, Poland, Portugal, Slovenia and Spain.[3] The survey was carried out by the National Central Banks and all countries used as the basis for the survey a harmonised questionnaire developed in the context of the Eurosystem Wage Dynamics Network, a research network analysing wage and labour cost dynamics. The harmonised questionnaire contained a core set of questions referring to the firms' wage-setting strategies, which was included in all countries' questionnaires. The harmonised questionnaire was further adapted by some countries to account for specific country characteristics and differences in institutional framework. As a result, some countries opted for shorter versions of this questionnaire, while others extended it in several dimensions.

Appendix 1 gives an overview of the main characteristics of the national surveys. The sample frame in each country was based on firms with at least 5 employees. The sectors covered are manufacturing, energy, construction, market services, non-market services, trade and financial intermediation; there are, however, some differences in the sectoral coverage of individual countries. The sample covers around 15,300 firms representing around 47.5 million employees. A description of the distribution of the sample by country, sector and size is provided in Appendix 2. In order to make the results representative of the total population the cross-country statistics presented in the following sections use employment-adjusted weights. For each firm/observation these weights indicate the number of employees each observation represents in the population. They can be calculated as the population employment divided by the number of firms (in each stratum) in the realised sample.[4] Appendix 3 gives a detailed description of the construction of the employment-based weights.[5]

[3] The survey was conducted either by traditional mail, phone and face-to-face interviews or through the internet. Germany also conducted the survey, but with a different questionnaire (Radowski and Bonin, 2009). Hence, it is not included in the sample.

[4] For most of the cases the stratification is based on sector and firm size; some countries also used region as an additional stratum.

[5] The employment-adjusted weights account for the unequal probabilities of receiving and responding to the questionnaire across strata as well as for the average firm size (measured on the basis of number of employees) in the population in each stratum.

### *2.2. Definitions of downward nominal and real wage rigidity*

In the literature, wage rigidities are consensually referred to as (obstacles to) the speed or the amount with which wages adjust to changes in warranted real wages – real wage rigidity – and to changes in prices – nominal wage rigidity (see e.g. Blanchard, 2006). In this paper, rigidity refers to obstacles to wage adjustment, rather than to infrequent adjustment or stickiness of wages. Most often, the obstacles to wage flexibility prevent nominal or real wages from being adjusted downwards. We asked firms about wage freezes and indexation mechanisms, which we relate to downward nominal and real wage rigidity respectively, as argued below.

The measures of downward nominal and real wage rigidity used in the current study are closely related to the indicators which are derived on the basis of individual wage change distributions observed in household survey and administrative data (see e.g. Dickens et al., 2007). Our survey asked if firms have ever cut or frozen wages during the past five years. Firms were instructed to answer the wage-setting questions with reference to their main occupational group, defined earlier in the survey. Following the information on wage freezes, we regard firms that froze wages at any point as showing evidence of downward nominal wage rigidity.

We also asked firms if they had a policy that linked wage changes to inflation. Firms that replied yes to this question were further asked if the link with inflation was automatic or discretionary and whether the link was with past or expected inflation. Using information from these questions, we consider as subject to downward real wage rigidity those firms that have an automatic link between wages and past or expected inflation, i.e. who apply automatic wage indexation. The idea here is that workers not just resist nominal wage cuts but rather defend their real wages. They can do this through focusing collective bargaining on some measure of inflation, a practice that can be institutionalised by indexation mechanisms that link wages automatically to inflation.

Strictly speaking, our survey-based measures of real wage rigidity and nominal wage rigidity do not capture only downward wage rigidity. Due to various reasons mainly related to 'menu costs', a wage freeze can indicate upward as well as downward wage rigidity. For example, Elsby (2009) develops a model where he demonstrates that if firms are not able to cut nominal wages then they react to this constraint by compressing wage increases, i.e. downward rigidity imposes also upward rigidity in nominal wages. However, Dickens et al. (2007) show on the basis of 31 different datasets from 16 countries that a large spike at zero in the wage change

distribution is usually accompanied by a low incidence of wage changes below this point, while there is little or no evidence of a similar lack of mass at small wage increases. This clearly suggests that most of the observed nominal wage freezes reflect downward rigidity. We should note that the prevalence of wage cuts in the survey that the current study is based on is also extremely rare. Only 2.3% of sampled firms cut base wages of at least some employees during the five-year period prior to the survey, while 9.6% of firms froze base wages.[6]

In theory, wage indexation could also impose upward rigidity in addition to downward rigidity. Indeed, if firms are equally likely to be hit by positive and negative economic shocks then the rigidity imposed by wage indexation might be symmetric. However, indexation mechanisms are generally disconnected from the wage-bargaining calendar and present an asymmetric structure. As an example, in a country like Belgium, where wage indexation is most prevalent, real wage increases due to tenure or performance are negotiated and implemented. Independently from this, wages are automatically indexed either at fixed points in time or with fixed amounts of 2%.[7] In Spain, the common indexation clauses are independent of other wage increases and only apply upward. We conjecture from this that our indexation-based measure of real wage rigidity more probably reflects downward rather than upward rigidity.

To validate the use of the survey-based measures of downward nominal and real wage rigidity presented here, we compared our measures with the ones obtained by earlier studies in this area. It appears that the indicators defined in the current study are highly correlated with measures of downward nominal and real wage rigidity that are derived from household surveys and administrative data on individuals on the basis of the observed wage change distributions. The correlation between the country indicators in Dickens et al. (2007) and the country averages of our indicators is 0.68 for nominal and 0.61 for real wage rigidity.[8] Messina et al. (2009) report measures of DNWR and DRWR for 13 sectors in 3 of our countries: Belgium, Spain and Portugal. We have tabulated our measures of rigidity for those sectors and computed the correlations with the average rigidity in each sector and country during the 2000s from Messina et al. (2009). The correlation of sector averages is 0.82 for downward nominal and 0.86 for downward real wage rigidity. The high correlations in the case of downward real wage rigidity either indicate that this type of wage rigidity is to a large

[6] The employment-weighted average share of workers who experienced wage cuts was 0.8%.
[7] Recently however, all-in clauses have been included in a limited number of agreements, making real wage increases conditional on the difference between expected inflation and ex post indexation.
[8] Evaluated for six countries: Austria, Belgium, France, Greece, Italy and Portugal.

extent caused by wage indexation, or that other forces behind the resistance of real wages to adjust downwards are highly correlated with the indexation phenomenon studied here.

## 3. Discussion of related theories and previous empirical findings

Several prominent labour market theories (e.g. efficiency wage, insider-outsider and contract theories) imply predictions regarding the degree of rigidity for different categories of workers and firms. In the following, we discuss the implications of various theoretical models for the likely incidence of rigidities across firms depending on the occupational structure, workforce tenure, the type of work contract typically used (permanent vs temporary) and production technology.

According to the efficiency wage theory, workers' productivity (effort) depends positively on their wage, and hence firms might refrain from cutting wages because it could reduce profits. There are several possible explanations why productivity might depend on wages. In the shirking model of Shapiro and Stiglitz (1984), a cut in earnings lowers the cost of job loss, thereby inducing more workers to shirk. In the gift-exchange model (Akerlof, 1982) and the fair wage-effort hypothesis (Akerlof and Yellen, 1990), a fall in earnings leads to lower gratitude and loyalty to the firm, again reducing effort. Because the effort of high-skilled workers is difficult to monitor and more valuable (in terms of value added), especially for high-skilled white-collar jobs, firms may be more reluctant to cut their wages, which leads to the prediction that their wages are more rigid.

The relative wage level influences not only productivity but also the propensity of employees to quit. Wage cuts might increase the turnover of employees and have a negative impact on profitability. In the turnover model of Stiglitz (1974), firms that cut wages will experience more job quits and incur higher costs of hiring and training new workers. Since the training and hiring costs are typically higher for white-collar workers than for blue-collar workers, the turnover model predicts higher wage rigidity for the former. The turnover model also predicts that firms with high turnover costs invest in creation of long-term bonds with their employees (e.g. in the form of the implicit contracts of Lazear, 1979). If successful, such firms would exhibit higher average tenure. Hence, we expect to find a higher degree of rigidity among firms with higher average workforce tenure, all else equal. Similarly, when applying the adverse selection model of Weiss (1980) to quits, the most productive workers are most likely to quit their job after a wage cut. As white-collar workers are more difficult and costly to replace due to their specialised skills, firms are less willing to cut their wages, leading to higher wage rigidity.

According to the insider-outsider theory (Lindbeck and Snower, 1988), firms do not dismiss their current workers and replace them by job-seekers at lower wages because insiders can harass or refuse to cooperate with newly hired entrants. This implies that workers with higher tenure and/or permanent work contracts have more power in the wage-setting process than recently hired and/or temporary employees, which leads to higher wage rigidity for tenured employees and workers with permanent contracts. The productivity of white-collar workers is typically more directly linked to their integration into the work process (e.g. because blue-collar workers at an assembly line do not need much cooperation with other workers while teamwork is common for white-collar workers). As a result, the model predicts that white-collar workers exhibit a higher degree of wage rigidity than blue-collar workers.

In summary, all the theories discussed above predict higher wage rigidity for high-skilled and/or white-collar workers. Most reviewed models (various models related to the efficiency wage theory, the firm-specific human capital model, the insider-outsider theory and the contract theory) predict that workers with higher tenure and permanent workers have more rigid wages. The impact of the workforce composition on DNWR and DRWR has been empirically investigated for the US by Campbell (1997) and for Belgium by Du Caju et al. (2009). Both studies report lower wage rigidity for blue-collar workers as opposed to white-collar workers. Du Caju et al. (2007) find higher rigidity in firms with low quit rates in Belgium, which implies a positive relationship between tenure and wage rigidity.

Another firm characteristic that is likely to affect wage rigidity is production technology. We expect workers in firms operating with labour-intensive technologies to have more leeway in wage negotiations. So, on the basis of the reasons analogous to the ones implied by the insider-outsider theory, we can expect that the more labour-intensive is the technology the more rigid are wages. On the other hand, the reciprocity theory developed inter alia by Rabin (1993) would imply the opposite. According to the reciprocity theory, workers are very sensitive to wage cuts, because these are considered to be “unfriendly acts” or “punishments”. As Howitt (2002) argues, one of the consequences of the reciprocity theory can be that wage cuts are less likely to occur if labour costs make up a smaller share of firms’ total costs, the reason being that the direct increase in profit from the reduction in unit labour costs will be smaller relative to the damage that a disgruntled workforce can inflict on the firm’s profit.

One of the institutional features that is likely to play a crucial role regarding wage rigidity is the (de)centralisation of wage setting and coverage of union contracts. Various theoretical models predict that the bargaining power of labour unions is positively related with wage

rigidity. For example, models developed by Dunlop (1944), Shishter (1943) and Oswald (1986) assume that the unions try to maximise the total wage payments of their members, not taking into account the negative effect that excessive wage increases can have on employment. As a result, wages are downward rigid. The structure of wage setting is also likely to play an important role. One might expect unions negotiating at the firm level to be more flexible at the time of accepting wage cuts in exchange for the maintenance of employment when business conditions turn bad. In the theoretical model of Holden (2002), employment protection legislation (EPL) increases wage rigidity. Holden discusses that in the case of collectively negotiated wage agreements, wage cuts need the mutual consent of employers and employees. Such cuts are less easily obtained if the threat of lay-off is more difficult to implement for the firm, e.g. because of strong EPL.

In the empirical literature on wage rigidity, the above-described labour market institutions have been cited as the cause of differences in downward wage rigidity across countries. The studies by Dickens et al. (2007) and Holden and Wulfsberg (2007, 2008) find that higher wage rigidity is associated with higher union density. The former study finds a significant positive correlation between union density and real wage rigidity, whereas the latter studies imply that a positive relationship exists for both types of wage rigidity. Du Caju et al. (2009) in the case of Belgium and Messina et al. (2009) using individual data for four European countries also find that bargaining coverage is positively associated with real wage rigidity, but the latter finds no effect on DNWR. There is also some controversy in the literature regarding the role of EPL. On the one hand, Dickens et al. (2007) find that EPL indices are not significantly correlated with the country-level incidence of wage rigidity. On the other, Holden and Wulfsberg (2007, 2008) indicate a positive relationship between EPL and wage rigidity.

## 4. Typology of firms subject to wage rigidities and institutional characteristics of the sampled countries

### *4.1. The incidence of downward nominal and real wage rigidity in the sampled countries*

The survey used in the current article allows us to examine the extent of wage freezes in 15 European Union member states. The data on wage indexation is available for 14 countries.[9] Table 1 shows that indexation is much more prevalent in our data (17% of firms are affected) than wage freezes (only 10% of firms are affected), which is consistent with other evidence

[9] The national questionnaire for the Netherlands did not include the section related to wage indexation.

on wage rigidity in most continental European countries, as opposed to the US and the UK (see e.g. Dickens et al., 2008).

There are sizeable differences between the EU countries as regards the occurrence of wage freezes and the application of automatic indexation mechanisms. Wage freezes appear more common than average in the Czech Republic, Estonia and the Netherlands. They are considerably less common than average in Spain, Italy and Slovenia. Next, indexation mechanisms are especially prevalent in Belgium and Spain, whereas less than 5% of firms use indexation in Italy and Estonia. Overall, we find that the non-euro member states of the EU are more likely to experience wage freezes compared to the euro area member states, but that the reverse is true for indexation mechanisms. Note that almost all firms in Belgium apply automatic indexation mechanisms. This is caused by an institutionalised wage indexation process which covers all firms falling under the jurisdiction of a so-called "joint committee", i.e. a sector-level bargaining unit where wage negotiations take place. In our sample, 98% of Belgian firms belong to one of the more than 100 joint committees.

**Table 1: Incidence of wage freezes and indexation mechanisms in sampled countries**

| Country | Wage freezes (downward nominal wage rigidity) | Indexation (downward real wage rigidity) |
|---|---|---|
| Austria | 0.133 | 0.098 |
| Belgium | 0.118 | 0.982 |
| Czech Republic | 0.265 | 0.117 |
| Estonia | 0.217 | 0.044 |
| Spain | 0.024 | 0.548 |
| France | 0.071 | 0.096 |
| Greece | 0.125 | 0.200 |
| Hungary | 0.059 | 0.112 |
| Ireland | 0.087 | 0.095 |
| Italy | 0.039 | 0.017 |
| Lithuania | 0.199 | 0.108 |
| Netherlands | 0.232 | N/A |
| Poland | 0.100 | 0.069 |
| Portugal | 0.150 | 0.090 |
| Slovenia | 0.029 | 0.235 |
| Total | 0.096 | 0.167 |
| Euro area | 0.082 | 0.201 |
| Non-euro area | 0.134 | 0.085 |

Note: Proportion of firms having frozen wages over the past five years and applying an automatic indexation mechanism. Figures are employment-weighted and re-scaled to exclude non-responses.

### *4.2. Labour market institutions in the sampled countries*

The sample statistics presented in Table 1 indicate that there exist substantial differences in the incidence of wage rigidity across the sampled countries. A natural candidate for such cross-country variation in wage rigidity is the differences in the national labour market institutions. We explore the impact of the institutional environment in the regression analysis that is carried out in the subsequent section of this paper, focusing on two aspects: collective bargaining and employment protection legislation. In the following, we will give an overview of the differences in these institutional measures across countries.

Our survey included three questions related to the collective bargaining of wages. Managers were asked if a collective wage agreement is applicable and if so, whether it is a firm-level agreement or a binding agreement that was negotiated at a level outside the firm (e.g. national, sector level, etc). In addition, the survey obtained data on the proportion of workers in the firms that is covered by any kind (inside or outside) of collective wage agreement. Table 2 summarises this information across countries, and complements it with aggregate data obtained from other sources, collected by Du Caju et al. (2008). Where comparisons are possible, this information is consistent at the aggregate level with existing institutional sources, such as an overview by the OECD (2004). We should note, however, that the measures of collective bargaining coverage presented in Table 2 refer to private sector enterprises only, whereas the measures from the above-mentioned sources are representative of the whole populations of workers in different countries.[10]

Although union membership rates have been declining in Europe, collective bargaining coverage is still high in general. The percentage of firms that apply some kind of collective wage agreement is very high in the euro area countries under consideration, compared to non-euro area countries. Differences between euro area and non-euro area countries are also noticeable when one looks separately at collective agreements signed at different levels. Collective agreements signed outside the firm are the most common practice in the euro area countries, while firm-level agreements are more frequent in the non-euro area countries. In terms of the percentage of workers that are covered by some form of collective wage agreement, coverage is very high in the euro area countries. By contrast, non-euro area countries have low levels of coverage.

In addition to cross-country measures of bargaining coverage, Table 2 gives an overview of strictness of employment protection legislation (EPL). The measures of EPL for all countries

[10] Appendix 1 gives an overview of the main characteristics of the national surveys.

in our sample are based on two sources. EPL indices for EU-15 member states are based on OECD Employment Outlook (2004) and analogous indices for the new member states are based on Tonin (2005), which replicates the OECD methodology and covers all new member states that are present in our survey.

**Table 2: Collective bargaining coverage and strictness of employment protection**

| Country | Share of employees covered by collective bargaining agreements | Share of firms having collective bargaining agreement | Share of firms having firm-level bargaining agreement | Share of firms having higher-level bargaining agreement | EPL index |
|---|---|---|---|---|---|
| Austria | 0.946 (H) | 0.978 | 0.233 (N) | 0.962 | 2.15 |
| Belgium | 0.893 (H) | 0.994 | 0.353 (N) | 0.979 | 2.50 |
| Czech Republic | 0.502 (M) | 0.540 | 0.514 (D) | 0.175 | 2.02 |
| Estonia | 0.087 (L) | 0.121 | 0.104 (D) | 0.034 | 2.33 |
| Spain | 0.968 (H) | 1.000 | 0.169 (N) | 0.831 | 3.07 |
| France | 0.671 (M) | 0.999 | 0.587 (D) | 0.988 | 2.89 |
| Greece | 0.910 (H) | 0.934 | 0.208 (N) | 0.859 | 2.90 |
| Hungary | 0.184 (L) | 0.190 | 0.190 (D) | 0.000 | 1.65 |
| Ireland | 0.422 (L) | 0.724 | 0.313 (N) | 0.683 | 1.32 |
| Italy | 0.970 (H) | 0.996 | 0.429 (N) | 0.996 | 2.44 |
| Lithuania | 0.156 (VL) | 0.242 | 0.237 (D) | 0.008 | 2.81 |
| Netherlands | 0.676 (H) | 0.755 | 0.301 (N) | 0.454 | 2.27 |
| Poland | 0.193 (VL) | 0.229 | 0.214 (D) | 0.047 | 2.22 |
| Portugal | 0.555 (VL) | 0.621 | 0.099 (N) | 0.589 | 3.49 |
| Slovenia | N/A (H) | 1.000 | 0.257 (N) | 0.743 | 2.63 |
| Total | 0.678 . | 0.764 | 0.330 . | 0.655 | 2.50 |
| Euro area | 0.845 . | 0.942 | 0.356 . | 0.873 | 2.63 |
| Non-euro area | 0.241 . | 0.277 | 0.263 . | 0.060 | 2.15 |

Note: Figures are employment-weighted and re-scaled to exclude non-responses. Total and euro area country aggregates exclude Germany. Country-level institutional information from Du Caju et al. (2008) between brackets: union coverage: VL = very low (0 to 25% of workers are covered by collective agreements), L = low (26 to 50%), M = moderate (51 to 75%), H = high (76 to 100%); firm-level agreements: D = company level is dominant in the country, N = company level is not dominant in the country.

### *4.3. Typology of firms according to wage rigidity*

We start by noting that our definitions of downward nominal and real wage rigidity are, in principle, mutually exclusive, i.e. a firm cannot be subject to both types of rigidity simultaneously. Nevertheless, a small proportion of the sampled firms gave positive answers to both nominal and real wage rigidity-related questions. We have 146 such firms in our dataset (about 1% of the sample). This overlap is either attributable to measurement error or caused by the different reference periods in the survey questions regarding the two types of

rigidities.[11] Given that it will be convenient in the subsequent analysis to use multinomial logit techniques, we opted to leave these firms out of the sample.

Hence, we have three types of firms in the dataset: (1) firms that have frozen wages are considered to be subject to downward nominal wage rigidity (DNWR firms); (2) firms that apply an automatic wage indexation mechanism are considered to be subject to downward real wage rigidity (DRWR firms); (3) firms that don't show signs of nominal wage rigidity or real wage rigidity according to our indicators are considered to be flexible wage firms (FW firms). Table 3 presents mean values for a range of variables contained in the survey and used later in the regression analysis (more precisely defined in Appendix 6) and tests the significance of differences in means for these variables across the three firm types.

The differences in firm characteristics across firms belonging to each of the three groups outlined above are quite noticeable. While the share of workers covered by union contracts peaks at 80% for firms subject to DRWR, it is only 52% in firms exhibiting flexible wages, the differences being statistically significant. Interestingly, the share of union coverage in firms subject to DNWR is even lower, at 46%. This large difference in unionisation between DRWR firms and FW firms does not seem to be related to a differential incidence of firm-level bargaining, but rather to the much more important role of outside bargaining in firms featuring DRWR, covering 65% of workers vs. 40% of the workers in FW firms. These differences are probably very highly correlated to the differences across countries also reported in the Table, inasmuch as high-coverage countries such as Belgium and Spain clearly present a higher level of DRWR firms.

Some firm characteristics also seem to be related to the incidence of different types of wage rigidities. While the share of high-skilled white collars and the share of labour costs in total costs appear more important among DNWR firms, the unconditional means suggest a negative effect on DRWR. Note, however, that some of these unconditional means might change once we control for other factors. Importantly, cross-country differences in the extent of the different types of rigidity appear very relevant in our tabulations. Some of these cross-country differences are likely to reflect institutional features of each country under consideration. In addition, they might also be related to the specificities of the samples in each country. In the next section we will review how important firm characteristics are, once specific country effects have been controlled for.

[11] Companies were asked whether they have frozen wages during the last five years and whether they are currently indexing wages. Survey questions related to the definitions of nominal wage rigidity and real wage rigidity are presented in Appendix 5

**Table 3: Sample statistics, by type of wage rigidity**

| Variable | Mean DNWR (9.6% of firms) | Mean DRWR (16.7% of firms) | Mean FW (73.7% of firms) | t-stat DNWR/ FW | t-stat DRWR/ FW | Obs (total) |
|---|---|---|---|---|---|---|
| Low-skilled blue-collar (%) | 0.355 | 0.433 | 0.399 | -3.929 | 4.826 | 13408 |
| High-skilled blue-collar (%) | 0.276 | 0.212 | 0.249 | 2.918 | -6.424 | 13408 |
| Low-skilled white-collar (%) | 0.137 | 0.185 | 0.151 | -1.968 | 8.271 | 13408 |
| High-skilled white-collar (%) | 0.231 | 0.170 | 0.201 | 3.699 | -6.623 | 13408 |
| Covered workers (%) | 0.457 | 0.797 | 0.520 | -3.648 | 25.937 | 11696 |
| Only firm-level agreement | 0.097 | 0.096 | 0.075 | 2.527 | 3.835 | 13426 |
| Only outside agreement | 0.333 | 0.649 | 0.392 | -3.623 | 25.857 | 13426 |
| Firm-level and outside agreements | 0.138 | 0.148 | 0.175 | -2.959 | -3.511 | 13426 |
| No union contract | 0.432 | 0.107 | 0.358 | 4.580 | -27.816 | 13426 |
| Permanent workers (%) | 0.911 | 0.908 | 0.899 | 1.793 | 2.213 | 13449 |
| Tenure up to 1 year (%) | 0.135 | 0.147 | 0.155 | -2.900 | -1.195 | 7608 |
| Tenure 1–5 years (%) | 0.366 | 0.353 | 0.375 | -0.976 | -2.303 | 7605 |
| Tenure over 5 years (%) | 0.494 | 0.497 | 0.467 | 2.318 | 2.595 | 7605 |
| Labour cost (%) | 0.349 | 0.330 | 0.333 | 2.325 | -0.672 | 12243 |
| Sector = Manufacturing | 0.426 | 0.414 | 0.412 | 0.861 | 0.224 | 13551 |
| Sector = Energy | 0.005 | 0.023 | 0.010 | -1.634 | 5.291 | 13551 |
| Sector = Construction | 0.068 | 0.087 | 0.068 | 0.052 | 3.558 | 13551 |
| Sector = Trade | 0.184 | 0.209 | 0.203 | -1.394 | 0.796 | 13551 |
| Sector = Market services | 0.274 | 0.247 | 0.273 | 0.095 | -2.863 | 13551 |
| Sector = Financial interm. | 0.015 | 0.016 | 0.019 | -0.938 | -1.156 | 13551 |
| Sector = Non-market services | 0.027 | 0.004 | 0.015 | 2.940 | -5.070 | 13551 |
| Country = Austria | 0.043 | 0.019 | 0.045 | -0.218 | -6.612 | 13614 |
| Country = Belgium | 0.001 | 0.401 | 0.002 | -0.706 | 77.695 | 13614 |
| Country = Czech Rep. | 0.094 | 0.011 | 0.027 | 11.382 | -5.084 | 13614 |
| Country = Estonia | 0.067 | 0.004 | 0.026 | 7.219 | -7.738 | 13614 |
| Country = Spain | 0.019 | 0.299 | 0.087 | -7.563 | 30.917 | 13614 |
| Country = France | 0.144 | 0.045 | 0.156 | -0.974 | -16.531 | 13614 |
| Country = Greece | 0.038 | 0.021 | 0.027 | 2.105 | -1.722 | 13614 |
| Country = Hungary | 0.123 | 0.070 | 0.175 | -4.185 | -14.752 | 13614 |
| Country = Ireland | 0.072 | 0.024 | 0.087 | -1.628 | -12.248 | 13614 |
| Country = Italy | 0.036 | 0.005 | 0.094 | -6.144 | -17.298 | 13614 |
| Country = Lithuania | 0.057 | 0.008 | 0.027 | 5.396 | -6.435 | 13614 |
| Country = Poland | 0.081 | 0.017 | 0.080 | 0.159 | -12.645 | 13614 |
| Country = Portugal | 0.205 | 0.033 | 0.115 | 8.310 | -13.848 | 13614 |
| Country = Slovenia | 0.019 | 0.043 | 0.053 | -4.721 | -2.349 | 13614 |
| Size = 5–19 | 0.210 | 0.320 | 0.230 | -1.387 | 10.327 | 13612 |
| Size = 20–49 | 0.217 | 0.235 | 0.229 | -0.832 | 0.708 | 13612 |
| Size = 50–199 | 0.365 | 0.252 | 0.318 | 3.058 | -7.081 | 13612 |
| Size = 200+ | 0.207 | 0.193 | 0.224 | -1.198 | -3.720 | 13612 |
| Price comp = very likely | 0.192 | 0.175 | 0.174 | 1.369 | 0.141 | 11412 |
| Price comp = likely | 0.459 | 0.379 | 0.456 | 0.167 | -6.469 | 11412 |
| Price comp = not likely | 0.286 | 0.319 | 0.306 | -1.275 | 1.124 | 11412 |
| Price comp = not at all | 0.064 | 0.127 | 0.064 | -0.072 | 9.888 | 11412 |
| Perceived comp = severe | 0.459 | 0.397 | 0.402 | 3.243 | -0.306 | 8803 |
| Perceived comp = strong | 0.438 | 0.490 | 0.488 | -2.813 | 0.134 | 8803 |
| Perceived comp = weak | 0.078 | 0.088 | 0.078 | 0.037 | 1.027 | 8803 |
| Perceived comp = none | 0.025 | 0.025 | 0.032 | -1.141 | -1.115 | 8803 |

## 5. Empirical investigation of the factors related to nominal and real wage rigidity

### *5.1. Estimation of the multinomial logit model*

This section presents the results of the regression analysis on the relationships between real and nominal wage rigidity vs various firm-level and institutional characteristics. We start by examining firm-level characteristics, and move next to study the impact of labour market institutions. As our firms fall into one of three categories – those subject to downward nominal wage rigidity, those subject to downward real wage rigidity and those with flexible wages – we use multinomial logit estimation methods. All the regression specifications presented below include fixed effects based on firm size, country and sector. The inclusion of the fixed effects enables us to control in a cross-sectional context for the variation in relevant omitted variables that can influence the likelihood of a firm being subject to nominal or real wage rigidity. They will account for differences in the survey design across countries, differences in the business cycle during the time the interviews took place, etc.[12]

The multinomial logit model is valid if the independence of irrelevant alternatives (IIA) assumption holds. The IIA assumption means that adding or excluding categories for the dependent variable does not affect the odds among the remaining outcomes. We use two tests of the IIA assumption, as described by Hausman and McFadden (1984) and Small and Hsiao (1985). In the baseline regression, both tests support the IIA assumption. This also holds for almost all the other regression specifications. There is no regression specification for which this assumption is unambiguously rejected. We conclude on the basis of the IIA tests that multinomial logit is a valid estimation method given the structure of the data in the current study. Note that two countries covered by the original WDN survey – Germany and the Netherlands – are left out of the regression analysis, because their national surveys do not include the questions related to wage indexation.

### *5.2. Estimation results – firm characteristics*

We begin by examining the effects of a range of firm characteristics on nominal and real wage rigidity. The results of the multinomial logit estimation are shown in Table 4. The first

[12] The period covered by the survey relates mainly to the growing phase of the business cycle. Therefore, firms' answers are likely to be biased towards reporting fewer wage freezes and wage cuts as compared to the situation of economic downturn, which gives us potentially less variation in the data. The extent to which the cyclical position affects the interaction between wage rigidities and such factors as firm characteristics, competition and labour market institutions is a-priori unclear and represents an interesting field of future research. Examination of firms' reactions to the current economic and financial crisis is the subject of a follow-up survey and is beyond the scope of the present study.

column in Table 4 reports the odds ratio for downward nominal wage rigidity vs flexible wages and the second column the corresponding odds ratio for downward real wage rigidity vs flexible wages. Heteroscedasticity-robust p-values are given in the parentheses.

**Table 4: Downward nominal and real wage rigidity: Multinomial logit regression**

| | Downward nominal wage rigidity/ Flexible wage | Downward real wage rigidity/ Flexible wage |
|---|---|---|
| Low-skilled blue-collar (%) | 0.553*** | 1.038 |
| | (0.000) | (0.809) |
| High-skilled blue-collar (%) | 0.739* | 0.682** |
| | (0.063) | (0.026) |
| Low-skilled white-collar (%) | 0.730 | 0.684* |
| | (0.150) | (0.066) |
| Labour cost (%) | 1.479** | 1.351* |
| | (0.033) | (0.063) |
| Permanent workers (%) | 1.487* | 1.187 |
| | (0.073) | (0.301) |
| Size = 20–49 | 1.149 | 1.102 |
| | (0.222) | (0.278) |
| Size = 50–199 | 1.225* | 0.995 |
| | (0.065) | (0.949) |
| Size = 200+ | 1.051 | 1.060 |
| | (0.695) | (0.505) |
| Sector = Energy | 0.676 | 1.816*** |
| | (0.418) | (0.001) |
| Sector = Construction | 0.765* | 1.067 |
| | (0.076) | (0.649) |
| Sector = Trade | 0.826* | 0.960 |
| | (0.087) | (0.624) |
| Sector = Market services | 0.884 | 0.963 |
| | (0.209) | (0.619) |
| Sector = Financial interm. | 0.805 | 1.395 |
| | (0.470) | (0.158) |
| Sector = Non-market serv. | 1.004 | 0.792 |
| | (0.987) | (0.521) |
| Observations | 11981 | |
| Pseudo R2 | 0.3020 | |

Notes: The table presents the estimated odds ratios for nominal wage rigidity vs flexible wage and real wage rigidity vs flexible wage. The regression includes country fixed effects (not shown). Robust P-values in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

The regression results indicate that workforce composition is related to wage rigidity in a manner that is predicted by the theoretical models discussed in Section 3. We find that firms employing a larger proportion of high-skilled white-collar workers (the reference category)

are more likely to be subject to downward wage rigidity, both in real and nominal terms. The shares of high-skilled blue-collar workers and low-skilled white-collar workers are negatively related with the likelihood that a firm is subject to downward real wage rigidity. Firms employing more blue-collar workers have a lower tendency to be subject to downward nominal wage rigidity, this effect being more significant for low-skilled blue-collar workers. The odds ratio for the share of labour cost in total cost is significantly larger than those for both types of wage rigidity. This shows that production technology influences wage rigidity: firms employing labour-intensive technologies are more likely to have rigid wages. For the reasons outlined in Section 3, this finding is in accordance with the insider-outsider theory but opposes the implications of the reciprocity theory.

The regression results imply that a larger share of permanent workers is associated with greater nominal wage rigidity, although this effect is only marginally significant at the 10% level. We can expect that permanent workers are subject to more rigid wage setting for several reasons. First, their firing costs are in general higher than those of temporary workers, and as we will show below, stricter employment protection legislation (EPL) is positively related to nominal wage rigidity. Second, collective bargaining contracts are more likely to apply to them, which in turn has implications for wage rigidity, as shown later. In addition, greater wage flexibility of temporary workers is consistent with some of the efficiency wage theories and the insider-outsider model discussed in Section 3.

The regression presented in Table 4 also incorporates controls for the firm size, sector and country dummies. Wage rigidity is not significantly related to firm size. The estimated odds ratios for the sector dummies indicate that firms in the construction and trade sectors are less likely to be subject to nominal wage rigidity, whereas the propensity of being subject to real wage rigidity is higher in the energy sector. However, most of the sectoral fixed effects are insignificant, whereas country effects appear significant and quite sizeable for almost all countries.[13]

Table 5 presents the estimated odds ratios for two additional regression specifications.[14] The first specification includes two dummy variables related with worker tenure in a firm.[15] We included the two tenure categories measuring the shares of workers who have 1–5 years of tenure and above 5 years of tenure. The excluded category was the share of workers with less

[13] The estimated odds ratios for the country fixed effects are available from the authors upon request.
[14] The variables included in the additional regression specifications were not included in the baseline regression because their inclusion reduces the sample size, and this reduction possibly occurs in a non-random manner.
[15] This variable is not available for France, Italy and Spain.

than one year of tenure. The estimated odds ratios imply that the larger is the average tenure in a firm, the more likely it is that this firm is subject to nominal wage rigidity. This result is also in accordance with the implications of the theoretical models on wage rigidity that were reviewed in section 3.[16]

**Table 5: Downward nominal and real wage rigidity – additional firm characteristics**

| | Tenure structure | | Bonus payment | |
|---|---|---|---|---|
| | DNWR/FW | DRWR/FW | DNWR/FW | DRWR/FW |
| Tenure 1–5 years (%) | 2.593*** | 0.822 | | |
| | (0.003) | (0.508) | | |
| Tenure above 5 years (%) | 2.719*** | 1.032 | | |
| | (0.000) | (0.899) | | |
| Bonus | | | 1.015 | 1.098 |
| | | | (0.883) | (0.196) |
| Observations | 6449 | | 10298 | |

Notes: The table presents the estimated odds ratios for nominal wage rigidity vs flexible wage and real wage rigidity vs flexible wage. Worker skill groups, % permanent workers, % labour cost, dummy variables for different types of union contracts and sector, size and country fixed effects are added in all specifications. Robust P-values in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 5 also presents the estimated odds ratio for the dummy variable indicating the payment of performance-related bonuses in addition to the base wage. The estimated odds ratios for nominal and real wage rigidity vs flexible wage category were both insignificantly different from one. This result prevailed when we used the share of bonuses in total pay instead of the above-described dummy variable. This is a surprising finding at least when it comes to DNWR, where we would expect firms having more flexible wage components to be able to afford higher rigidity in base wages at a little cost. It is at odds with evidence for 4 European countries reported by Messina et al. (2009), who find lower wage rigidity in those sectors with a higher share of bonuses and other flexible wage components in total compensation. One possible explanation is that some of our survey respondents confused base wages with total wages at the time of assessing wage freezes and wage cuts, hence answering for the total degree of wage rigidity among the main occupation group employed by the firm.

[16] The complete regression results for the regressions investigating the effects of tenure, bonuses and competition are presented in Appendix 8.

### *5.3. Estimation results – competition*

In addition to the above-described firm characteristics, we also explored the effect of the extent of competition in the product market environment in which the firm operates. The effects of competition on wage rigidities are ambiguous. Firms subject to stronger competitive pressure may need more flexible wage-setting practices, which would imply a negative relationship between competition and wage rigidity. On the other hand, in sectors with severe competition rents should be low, and therefore so should wages. In such sectors, unions try to set common wage standards to avoid severe product market competition causing a race to the bottom of wages. As Cardoso and Portugal (2005) argue, in the absence of the wage cushion typical of non-competitive environments, wages are more likely to be rigid, since the leeway firms have for cutting wages in face of a negative shock is reduced. This would imply a positive association between competition and wage rigidity.

**Table 6: Downward nominal and real wage rigidity – competition**

| | Perceived competition | | Price competition | |
|---|---|---|---|---|
| | DNWR/FW | DRWR/FW | DNWR/FW | DRWR/FW |
| Perceived comp = strong | 0.674*** | 1.128 | | |
| | (0.000) | (0.161) | | |
| Perceived comp = weak | 0.770* | 1.255 | | |
| | (0.079) | (0.128) | | |
| Perceived comp = none | 0.696 | 0.662 | | |
| | (0.154) | (0.150) | | |
| Price comp = likely | | | 0.920 | 0.887 |
| | | | (0.423) | (0.161) |
| Price comp = not likely | | | 0.881 | 0.851* |
| | | | (0.261) | (0.089) |
| Price comp = not at all | | | 1.019 | 1.039 |
| | | | (0.915) | (0.782) |
| Observations | 7549 | | 9969 | |

Notes: The table presents the estimated odds ratios for nominal wage rigidity vs flexible wage and real wage rigidity vs flexible wage. Worker skill groups, % permanent workers, % labour cost, dummy variables for different types of union contracts and sector, size and country fixed effects are added in all specifications. Robust P-values in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

The survey included two questions on the firms' competitive environment. The price competition variable relates to a question on the likelihood of the firm changing its price in response to a price change by its main competitor; the answers were given on a four-point scale, from very likely to not at all. A second question on perceived competition was also

included; the firm was asked to directly rate the intensity of competition it faced in its main market. The answer was again requested on a four-point scale, ranging from severe competition to no competition.[17]

The related regression results are presented in Table 6. The estimations yield different results, depending on which competition measure we use. Two out of three of the estimated odds ratios for the dummy variables measuring different levels of perceived competition are significantly lower than one in the case of nominal wage rigidity. This implies that firms who face severe competition (the excluded category) are more likely to be subject to rigidity in nominal terms than firms facing lower competition levels. Thus, there seems to be a positive (although not monotonous) relationship between product market competition and nominal wage rigidity. However, this empirical finding depends on the way competition is measured – a similar significant relationship is not present if we use the price-reduction-based competition measure instead of perceived competition.[18]

If more competition is associated with higher wage rigidity due to the absence of a wage cushion to lower wages during a downturn, we should find stronger effects for competition in countries where it is more likely that severe competition is associated with lower wage levels, and where competition forces a larger proportion of workers to earn wages that are close to the statutory minimum level. This is more likely to be the case in the non-euro area countries included in our sample, since these countries tend to specialise in labour-intensive technologies and have a higher tendency to be involved in industries where competition is price-driven as opposed to quality-driven. We test this possibility by running separate regressions for the euro area and non-euro area countries. The regression results are presented in Table 7. The estimated odds ratios indicate that competition indeed has a much stronger (and monotonous) positive relationship with nominal wage rigidity in non-euro area countries, although similarly to the pooled regression results this significant relationship is present only for the measure that is based on perceived competition.

[17] Note that the use of the second measure (perceived competition) results in a significant reduction of the sample size, since the related question was not included in the national surveys of Austria, Belgium, Spain and Italy.

[18] Note that the significance of the estimated effects can also depend on the sample coverage, since the measure of perceived competition is available for only 10 countries out of 14. We tested for this possibility by estimating the regression including the price-reduction-based competition measure for the same set of 10 countries (i.e. excluding Austria, Belgium, Spain and Italy). The estimated effect was still insignificant, which implies that the results depend on the way competition is measured and not on different sample coverage.

**Table 7: The effect of competition on wage rigidity: Euro area vs non-euro area**

| | Euro area | | Non-euro area | | Euro area | | Non-euro area | |
|---|---|---|---|---|---|---|---|---|
| | DNWR/ FW | DRWR/ FW | DNWR/ FW | DRWR/ FW | DNWR/ FW | DRWR/ FW | DNWR/ FW | DRWR/ FW |
| Perceived comp = strong | 0.763** | 1.033 | 0.581*** | 1.290* | | | | |
| | (0.018) | (0.762) | (0.000) | (0.080) | | | | |
| Perceived comp = weak | 0.926 | 1.158 | 0.616** | 1.388 | | | | |
| | (0.715) | (0.463) | (0.023) | (0.156) | | | | |
| Perceived comp = none | 1.155 | 0.780 | 0.260** | 0.627 | | | | |
| | (0.636) | (0.514) | (0.014) | (0.277) | | | | |
| Price comp = likely | | | | | 0.956 | 0.889 | 0.867 | 0.915 |
| | | | | | (0.744) | (0.225) | (0.372) | (0.657) |
| Price comp = not likely | | | | | 0.825 | 0.803** | 0.951 | 1.059 |
| | | | | | (0.203) | (0.041) | (0.770) | (0.784) |
| Price comp = not at all | | | | | 1.172 | 1.032 | 0.791 | 1.087 |
| | | | | | (0.465) | (0.840) | (0.449) | (0.796) |
| Observations | 4319 | | 3230 | | 6982 | | 2987 | |

Notes: The table presents the estimated odds ratios for nominal wage rigidity vs flexible wage and real wage rigidity vs flexible wage. Worker skill groups, % permanent workers, % labour cost, dummy variables for different types of union contracts and sector, size and country fixed effects are added in all specifications. Robust P-values in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The full regression estimations are presented in Appendix 9.

### *5.4. Estimation results – labour market institutions*

In the above-described regressions, almost all the dummy variables for countries have highly significant estimates for the odds ratios of both types of rigidity vs flexible wage setting. As country effects appear to have an important impact on wage rigidity, national labour market institutions are a natural suspect as the cause of the differences between countries. Previous research in this area has demonstrated that indicators of the institutional environment, such as collective bargaining coverage and employment protection, are significantly correlated with real wage rigidity and nominal wage rigidity. We extend this analysis to more countries, exploiting the substantial cross-country variation in the institutionalisation of the wage-setting process between the euro area and non-euro area economies. In all our specifications we look

at firm rather than country or sectoral-level indicators of institutions, in an attempt to obtain more robust estimates of the institutional determinants of rigidity. Hence, all the regression specifications analysing institutional effects include country fixed effects, which control for unobservable country characteristics.

First, we analyse the effect of collective bargaining coverage. The WDN survey contains firm-level information on the share of employees covered by collective bargaining. The regression estimates for this variable are presented in Table 8. The estimations indicate that bargaining coverage is positively associated with real wage rigidity and insignificantly related with nominal wage rigidity. This finding is in accordance with the results of earlier empirical studies, which were based on country-level measures of rigidity (Holden and Wulfsberg, 2007; Dickens et al., 2007).

**Table 8: Downward nominal and real wage rigidity – collective bargaining coverage**

| | Collective bargaining coverage | |
|---|---|---|
| | DNWR/FW | DRWR/FW |
| Covered workers (%) | 1.010 | 1.273** |
| | (0.922) | (0.030) |
| Observations | 10309 | |

Notes: The table presents the estimated odds ratios for nominal wage rigidity vs flexible wage and real wage rigidity vs flexible wage. Worker skill groups, % permanent workers, % labour cost, and sector, size and country fixed effects are added in both specifications. Robust P-values in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The full regression estimation is presented in Appendix 10.

In addition to bargaining coverage, we explore the effect of employment protection legislation on wage rigidity. For this purpose, we employ the EPL index, which measures the overall strictness of individual dismissals (OECD, 2004; Tonin, 2005). The values of the EPL index across the sampled countries are presented in Table 2. We cannot enter the EPL indices directly in the regressions since these country-level variables are linear combinations of the set of country dummies. Instead, we interact the EPL index with the share of permanent workers in the firm. Note that while the share of permanent employees in every country is likely to be determined by the strictness of EPL, this effect should be captured by the country dummies included in the regression. Similarly, differences in technology across sectors would require different turnover rates, and hence an optimal mix of fixed and short-term contracts. Our sectoral dummies should, to some extent, capture these differences. Thus, our regression

exercise captures the effect of EPL on wage rigidities based on deviations in the mix of temporary versus permanent contracts from country and sectoral averages.

Table 9 presents the regression results for different values of the share of permanent workers and the EPL index. Note that since the interactive term is nonlinear, the estimated effects on the odds ratios are dependent on the values of the interacted variables. Appendix 4 presents the derivation of the formulas for computing the interaction effects in multinomial logit models following Rõõm (2009). The estimated odds ratios of DNWR and DRWR vs flexible wage can be calculated on the basis of formula (10) in Appendix 4, and the significance levels for the estimated effects are computed using the delta method. The estimated odds ratio for nominal wage rigidity vs flexible wage is significantly larger than one for approximately 81% of the observations. The value of the odds ratio is positively related with the values of both interacted variables. The odds ratio for real wage rigidity is insignificantly different from one.

**Table 9: Downward nominal and real wage rigidity – interaction of the EPL index with the share of permanent workers**

| Percentile (share of permanent workers, EPL index) | Value<br>Share of permanent workers | Value<br>EPL index | Odds ratio<br>DNWR / FW | Odds ratio<br>DRWR / FW |
|---|---|---|---|---|
| 10th, 10th | 0.692 | 1.726 | 2.158*** | 1.101 |
| | | | (0.038) | (0.707) |
| 10th, 50th | 0.692 | 2.413 | 3.488* | 1.069 |
| | | | (0.056) | (0.868) |
| 50th, 10th | 1.000 | 1.726 | 2.683** | 1.087 |
| | | | (0.04) | (0.795) |
| 50th, 50th | 1.000 | 2.413 | 4.362* | 1.054 |
| | | | (0.077) | (0.911) |
| 90th, 90th | 1.000 | 4.167 | 15.095 | 0.977 |
| | | | (0.259) | (0.979) |

Notes: The table presents the estimated odds ratios for the $10^{th}$, $50^{th}$ and $90^{th}$ percentile values of the two interacted variables. Probability values are presented in parentheses below the estimated effects, *** p<0.01, ** p<0.05, * p<0.1. The estimations are based on a multinomial logit regression that includes as control variables worker skill groups, % permanent workers, % labour cost, dummy variables for different types of union contracts and sector, size and country fixed effects. The full regression estimation is presented in Appendix 10.

The regression results indicate that strictness of labour regulations interacted with the share of permanent employees is positively related with the likelihood that a firm is subject to nominal

wage rigidity. The estimates also imply that the larger is the share of permanent workers and/or the larger is the EPL index, the stronger is this effect. These results are in line with our expectations, since the existence of permanent contracts complemented with strict labour regulations gives workers more leeway in wage negotiations, which in turn should lead to greater wage rigidity. In particular, it is harder for firms to cut workers' wages if the threat of lay-off is more difficult to implement. Thus, permanent contracts impose greater wage rigidity than temporary contracts as long as permanent workers are more protected by labour regulations. As a consequence, the effect of permanent contracts on wage rigidity should be more significant in countries with stricter employment protection.

The WDN survey contains information on the structure of agreements applicable for a given firm. Managers were asked if a collective wage agreement exists and if so, whether it is a firm-level agreement or a binding agreement that was negotiated at a level outside the firm (e.g. national, sector level, etc). We use this information to analyse the implications that the union contracts negotiated at different levels have on wage rigidity. For this purpose, we construct three non-nested dummy variables that characterise the type of union contract(s) applying to the firm; the first indicating the existence of only a firm-level agreement, the second signifying only an outside agreement, and the third being equal to one if a firm has both firm-level and outside agreements.

Appendix 7 gives an overview of the cross-country differences in the incidence of union contracts negotiated at different levels. This comparison reveals striking contrasts in the tendency of different types of union contracts across the sampled countries. In particular, there is a group of countries (Austria, Belgium, Spain, France, Italy and Slovenia) where almost all firms have union contracts and also display a very high incidence of higher-level bargaining agreements. On the other hand most of the sampled non-euro area countries (Estonia, Hungary, Lithuania and Poland) have very few firms with higher-level agreements.

We can expect that the effects of union contracts negotiated at different levels will be heterogeneous across countries, since different aspects of wage setting that matter for wage rigidity can be applied at the higher level (sectoral or national) in some countries and at the firm level in others. This is especially relevant regarding wage indexation, which we use as an indicator of real wage rigidity. Similarly, the impact of firm-level contracts is likely to differ across countries depending on the most prevalent wage-setting norm in the economy: a firm-level contract may buy some additional flexibility in countries where the most common negotiation is outside the firm, while it might impose additional rigidity in a country where

most negotiations are carried out at individual level. Therefore we analyse the union effects separately for each country.[19]

The regression results are presented in Table 10 on a country-by-country basis. Given that higher-level contracts are almost uniformly applicable in one subgroup of sampled countries and practically non-existent in another subgroup, we can only selectively enter the above-described union dummies in the country-level regressions. Several of the estimated odds ratios for the union dummies are insignificantly different from one. Significant results are more common within the subset of countries that have higher within-country variation in employment relations, and for which it was possible to include the three different dummies simultaneously in the regressions. These results reveal that the effects of different types of wage negotiation are indeed heterogeneous. The estimations imply that higher-level contracts are more likely to impose real wage rigidity in Poland for example, whereas firm-level contracts are positively associated with real wage rigidity in Ireland and Portugal. In addition, we find that higher-level agreements are associated with more nominal wage rigidity in Spain for example, whereas firm-level agreements are positively related to nominal wage rigidity in Portugal.

Next, we group the countries on the basis of firms covered by outside agreements.[20] The group of countries with high coverage by outside agreements includes Austria, Belgium, Spain, France, Italy and Slovenia; the group with medium coverage consists of Greece, Ireland and Portugal; and the low-coverage group includes the Czech Republic, Estonia, Hungary, Lithuania and Poland.[21] Due to the above-described heterogeneity of the cross-country results, it cannot be assumed that the estimated effects apply uniformly to all countries within the subgroups. Rather, we can interpret them as illustrating the effects that apply to the majority of enterprises within each subgroup.

[19] We were not able to estimate the multinomial logit regression for Belgium due to the very low number of firms subject to DNWR according to our definition. Therefore, Belgium is excluded from the following analysis. Note that almost all Belgian firms apply wage indexation and this is imposed by contracts negotiated at the outside (i.e. sectoral) level.

[20] See Table 2 for an overview of the incidence of higher-level union agreements.

[21] Greece is a country with a high coverage by outside agreements and thus could be included in the first group of countries. However, it has a relatively higher within-country variation of union contract types; we therefore include Greece in the medium-coverage group in order to exploit this variation for the purposes of our regression analysis.

**Table 10. Wage rigidity vs different types of union contracts. Separate regressions for each country.**

| | **Austria** | | **Spain** | | **France** | | **Italy** | | **Slovenia** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | DNWR | DRWR | DNWR | DRWR | DNWR | DRWR | DNWR | DRWR | DNWR | DRWR |
| Only outside agreement | 0.528 | 0.470** | 1.359** | 0.794 | 1.142 | 0.847 | 0.882 | 0.822 | 0.446 | 0.850 |
| | (0.168) | (0.049) | (0.036) | (0.704) | (0.526) | (0.402) | (0.741) | (0.740) | (0.140) | (0.521) |
| Observations | 392 | 392 | 1815 | 1815 | 1533 | 1533 | 782 | 782 | 639 | 639 |
| | **Estonia** | | **Hungary** | | **Lithuania** | | **Poland** | | | |
| | DNWR | DRWR | DNWR | DRWR | DNWR | DRWR | DNWR | DRWR | | |
| Only outside agreement | | | | | | | 1.174 | 4.811* | | |
| | | | | | | | (0.884) | (0.063) | | |
| Only firm-level agreement | 1.008 | 1.652 | 0.949 | 1.478 | 0.509 | 2.048 | 1.056 | 1.193 | | |
| | (0.991) | (0.739) | (0.888) | (0.192) | (0.164) | (0.126) | (0.880) | (0.636) | | |
| Observations | 307 | 307 | 1496 | 1496 | 321 | 321 | 784 | 784 | | |
| | **Greece** | | **Czech Republic** | | **Ireland** | | **Portugal** | | | |
| | DNWR | DRWR | DNWR | DRWR | DNWR | DRWR | DNWR | DRWR | | |
| Only outside agreement | 0.727 | 0.866 | 5.848** | 6.774** | 0.866 | 1.272 | 1.234 | 1.319 | | |
| | (0.456) | (0.696) | (0.026) | (0.049) | (0.670) | (0.535) | (0.253) | (0.302) | | |
| Only firm-level agreement | 0.672 | 0.285 | 1.004 | 1.567 | 1.371 | 3.250* | 2.275* | 5.324*** | | |
| | (0.658) | (0.266) | (0.988) | (0.357) | (0.637) | (0.059) | (0.059) | (0.001) | | |
| Both agreements | | | 0.718 | 2.893* | 0.469 | 3.615*** | 0.610 | 0.918 | | |
| | | | (0.478) | (0.071) | (0.151) | (0.002) | (0.208) | (0.872) | | |
| Observations | 315 | 315 | 364 | 364 | 752 | 752 | 1188 | 1188 | | |

Notes: The table presents the estimated odds ratios for nominal wage rigidity vs flexible wage (DNWR) and real wage rigidity vs flexible wage (DRWR). Worker skill groups, % permanent workers, % labour cost, and sector, size and country fixed effects are added in all specifications. P-values in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The reference group includes the firms having both types of contracts for Austria, France and Italy; the firms having only firm-level contracts for Spain and Slovenia; and the firms with no union contracts for the rest of the countries.

The regression results are presented in Table 11. The reference group is different for the first group (countries with a high incidence of outside agreements). For this subset, the excluded category consists (almost exclusively) of firms with firm-level agreements, which are implemented either simultaneously with outside agreements (Austria, France and Italy) or not (Spain and Slovenia).[22] For the other two groups of countries, the reference group includes firms with no union contracts.

**Table 11. Wage rigidity vs different types of union contracts – regressions for groups of countries with high, medium and low incidence of outside agreements**

| | High incidence | | Medium incidence | | Low incidence | |
|---|---|---|---|---|---|---|
| | DNWR/ FW | DRWR/ FW | DNWR/ FW | DRWR/ FW | DNWR /FW | DRWR/ FW |
| Only outside agreement | 0.915 | 0.794** | 1.087 | 1.345 | 1.485 | 2.558* |
| | (0.587) | (0.019) | (0.594) | (0.142) | (0.374) | (0.091) |
| Only firm-level agreement | | | 1.680 | 2.631** | 0.884 | 1.386* |
| | | | (0.108) | (0.013) | (0.467) | (0.086) |
| Both agreements | | | 0.565** | 1.956*** | 0.686 | 1.500 |
| | | | (0.041) | (0.009) | (0.303) | (0.329) |
| Observations | 5161 | | 2256 | | 3272 | |

Notes: The table presents the estimated odds ratios for nominal wage rigidity vs flexible wage and real wage rigidity vs flexible wage. Worker skill groups, % permanent workers, % labour cost, and sector, size and country fixed effects are added in all specifications. P-values in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The first group (countries with a high incidence of outside agreements) includes Austria, France, Italy, Spain and Slovenia. The second group (medium incidence) includes Greece, Ireland and Portugal. The third group (low incidence) includes the Czech Republic, Estonia, Hungary, Lithuania and Poland. The full regression estimations are presented in Appendix 10.

The regression results indicate that in countries with high or medium-level coverage by outside agreements, firm-level contracts are more likely to impose real wage rigidity than higher-level contracts. In countries with low coverage by outside agreements, either outside or firm-level contracts can increase real wage rigidity with respect to the reference category (the absence of unions in wage negotiations). On the basis of the country-level regressions for some countries, e.g. Poland, it seems that outside contracts are more restrictive for wages than firm-level contracts. For other countries with low coverage by outside agreements there is not sufficient data to analyse that (since very few firms have higher-level union contracts).

Overall, we find clear indications suggesting that the participation of unions in the wage-setting process is associated with a higher extent of DRWR. In countries with a higher level

[22] Only 18 firms (0.3% of the sample) do not have collective wage agreements in these countries.

of union coverage and more centralised wage setting, firm-level negotiations tend to have a stronger impact on real wage rigidity, but this result is not uniform across countries.

## 6. Conclusions

This paper examines the flexibility of wages across European firms. We look at the extent of rigidities in base wages by estimating the frequency of wage freezes (downward nominal wage rigidity) and the incidence of wage indexation (downward real wage rigidity). We address these issues using a unique survey with a large sample of firms and data from fourteen countries. A substantial proportion of firms who participated in the survey report that they have frozen wages or that there exists an automatic link between wages and inflation. Instead, less than 1% of the more than 47 million workers that the survey represents have experienced a wage cut during the five-year period prior to the survey. This leads us to the conclusion that wage rigidities, both nominal and real, are quite prevalent in Europe.

We use multinomial logit regressions to analyse what factors are related to wage rigidity. Our estimations indicate that country effects appear to be significant determinants of downward wage rigidities and that institutional differences between countries are an important factor behind this finding. The regression results imply that high collective bargaining coverage increases real wage rigidity. Analysis of the union contracts negotiated at different levels (firm-level vs higher-level bargaining contracts) implies that firm-level contracts are a more likely source of real wage rigidity in centralised wage-setting environments. However, there is substantial heterogeneity across countries regarding the impact of different types of union contracts. For example, for Belgium we know a priori that 98% of firms are subject to real wage rigidity by our definition (i.e. imply wage indexation) and that this is implemented by sector-level bargaining agreements. For some non-euro area countries (e.g. Poland) outside contracts appear to be more restrictive for wages than firm-level contracts. Another institutional aspect that influences wage rigidity is related to how difficult it is for employers to lay off workers. We find that nominal wage rigidity is positively associated with the extent of permanent contracts. In addition, permanent contracts have a stronger effect on wage rigidity in countries with stricter labour regulations.

Workforce composition also appears to play a significant role in the determination of wage rigidities. Both types of wage rigidity are positively related with the share of high-skilled white collars; downward nominal wage rigidity is positively related with employees' tenure in the firms under study. Both of these significant relationships are consistent with the

implications of related theoretical models. In addition, we find that firms employing labour-intensive technologies are more likely to have rigid wages.

Finally, there seems to be a positive (although non-monotonous) relationship between product market competition and downward nominal wage rigidity. A possible cause of this empirical result is that in highly competitive industries rents should be low, and therefore so should wages. This leaves smaller margins to reduce wages, because firms paying low wages that are closer to a collectively agreed or legislative minimum level have less flexibility than firms having a so-called wage cushion between the minimum and the actual wage level. We find that the positive relationship between competition and wage rigidity is more significant in non-euro area countries, which lends further support to the above-described cause of this finding, since it is more likely that in these countries severe competition is associated with low wage levels. However, this positive significant relationship is not present in all the regression specifications, indicating that the results are dependent on the way competition is measured.

Our findings of the patterns and determinants of wage rigidities in 15 European Union countries contribute to the discussion of the role of monetary policy and its effects. The analysis of the monetary policy implications of wage rigidities was motivated by the conclusions of the Eurosystem Inflation Persistence Network (IPN). One of the key results reported by the IPN was that there is a substantial degree of persistence in inflation, which needs to be taken into account when implementing common monetary policy. It was further suggested that in the current monetary policy regime inflation persistence may originate from wage rigidities.[23] Similarly to the IPN's finding of heterogeneity in inflation persistence across European countries, our results indicate the presence of country-specific patterns of downward nominal and real wage rigidities. To the extent that rigidities and their variation across regions of a monetary union complicate the design of optimal monetary policy (Carlsson and Westermark, 2008; Fahr and Smets, 2008), policies that facilitate adjustment in the monetary union in the presence of imbalances may need to be considered.

[23] See Altissimo, Ehrmann and Smets (2006) for a summary of the IPN's findings.

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**Appendix 1: Main characteristics of the national surveys**

| Country | Sectors covered | Firms' size | Sample | Number of responding firms (response rate) | How the survey was carried out |
|---|---|---|---|---|---|
| Austria | Manufacturing, Energy, Construction, Trade, Market services, Financial intermediation | ≥5 | 3,500 | 557 (16%) | External company: traditional mail |
| Belgium | Manufacturing, Energy, Construction, Trade, Market services, Financial intermediation | ≥5 | 4,100 | 1,431 (35%) | NBB: traditional mail |
| Czech Republic | Manufacturing, Construction, Trade, Market services | ≥20 | 1,591 | 399 (25%) | CNB branches: internet |
| Estonia | Manufacturing, Construction, Trade, Market services | ≥5 | 1,400 | 366 (26%) | External company: internet |
| France | Manufacturing, Trade, Market services, Non-market services | ≥5 | 6,500 | 2,029 (31%) | Local branches: phone, mail and face to face |
| Germany | Manufacturing, Market services, Non-market services | All | 4,600 | 1,832 (40%) | IFO: traditional mail |
| Greece | Manufacturing, Trade, Market services, Non-market services | All | 5,000 | 429 (9%) | External company: traditional mail |
| Hungary | Manufacturing, Energy, Construction, Trade, Market services, Financial intermediation | ≥5 | 3,785 | 2,006 (53%) | External company: face-to-face interviews |

| Country | Sectors covered | Firms' size | Sample | Number of responding firms (response rate) | How the survey was carried out |
|---|---|---|---|---|---|
| Ireland | Manufacturing, Energy, Construction, Trade, Market services, Financial intermediation, Non-market services | ≥5 | 4,000 | 985 (25%) | External company: traditional mail, phone |
| Italy | Manufacturing, Trade, Market services, Financial intermediation | ≥5 | 4,000 | 953 (24%) | External company: internet |
| Lithuania | Manufacturing, Energy, Construction, Trade, Market services, Financial intermediation, | All | 2,810 | 343 (12%) | External company: phone, mail and face to face |
| Netherlands | Manufacturing, Construction, Trade, Market services, Financial intermediation, | ≥5 | 2,116 | 1,068 (50%) | External company: internet |
| Poland | Manufacturing, Energy, Construction, Trade, Market services, Financial intermediation | All | 1,600 | 1,161 (73%) | National Bank of Poland branches: traditional mail |
| Portugal | Manufacturing, Energy, Construction, Trade, Market services, Financial intermediation, Non-market services | ≥5 | 5,000 | 1,436 (29%) | Banco de Portugal: traditional mail, internet |
| Slovenia | Manufacturing, Energy, Construction, Trade, Market services, Financial intermediation | ≥5 | 3,000 | 666 (22%) | Banka Slovenije: traditional mail and internet |
| Spain | Manufacturing, Energy, Trade, Market services | All | 3000 | 1,835 (61%) | External company: mail, phone, fax, internet |

## Appendix 2: Sample characteristics

| Table A1: Country composition of the sample | | |
|---|---|---|
| Country | Number of observations | Per cent of total |
| Austria | 557 | 3.89 |
| Belgium | 1,431 | 10 |
| Czech Republic | 399 | 2.79 |
| Estonia | 366 | 2.56 |
| Spain | 1,834 | 12.82 |
| France | 2,029 | 14.18 |
| Greece | 402 | 2.81 |
| Hungary | 2,006 | 14.02 |
| Ireland | 985 | 6.88 |
| Italy | 953 | 6.66 |
| Lithuania | 337 | 2.36 |
| Poland | 908 | 6.35 |
| Portugal | 1,436 | 10.04 |
| Slovenia | 666 | 4.65 |
| Euro area | 10,293 | 71.93 |
| Non euro area | 4,016 | 28.07 |
| Total | 14,309 | 100 |

| Table A2: Sectoral composition of the sample | | |
|---|---|---|
| Sector | Number of firms | Per cent of total |
| Manufacturing | 5,960 | 41.84 |
| Energy | 178 | 1.25 |
| Construction | 1,018 | 7.15 |
| Trade | 2,834 | 19.89 |
| Market services | 3,805 | 26.71 |
| Financial intermediation | 258 | 1.81 |
| Non-market services | 192 | 1.35 |
| Total | 14,245 | 100 |

| Table A3: Size composition of the sample | | |
|---|---|---|
| Size | Number of firms | Per cent of total |
| 5–19 | 3,556 | 24.86 |
| 20–49 | 3,271 | 22.86 |
| 50–199 | 4,390 | 30.69 |
| 200+ | 3,089 | 21.59 |

**Appendix 3: Employment-adjusted sampling weight**

Formally, the employment-adjusted sampling weight is the product of three individual weights:

$$w_l = w_1 w_2 w_3$$

$w_1$: adjusts for the unequal probability of firms being included in the intended sample, i.e. the probability of receiving a questionnaire

$$w_1 = \left( N_h \middle/ n_h^* \right)$$

$N_h$ : population of firms within each stratum

$n_h^*$ : intended gross sample of firms within each stratum

$w_2$ : adjusts for non response

$$w_2 = \left( n_h^* \middle/ n_h \right)$$

$n_h$ : realised sample of firms within each stratum, i.e. the actual number of firms that receive and reply to the questionnaire

The product of $w_1$ and $w_2$, which differ by construction across strata, is equal to $w_1 w_2 = \left( N_h \middle/ n_h \right)$ and corrects for the unequal probability of firms being included in the realised sample.

$w_3$ : adjusts for differences in the average firm size (in the population) across different strata

$$w_3 = \left( L_h \middle/ N_h \right)$$

$L_h$ : is population employment in each stratum

By combining the expressions for $w_1$, $w_2$ and $w_3$, we obtain the following expression for the employment-adjusted weight: $w_l = \left( L_h \middle/ n_h \right)$. Therefore, the employment-adjusted weight is equal to the population employment in each stratum divided by the number of firms, in each stratum, in the realised sample.

**Appendix 4: Derivation of the odds ratios for interactive variables in the multinomial logit model**

1. General case

Let us assume that the multinomial logit model is estimated for a categorical variable that has N outcomes. Let's call the estimated sets of coefficients for the different values of the dependent variable:

$\beta^{(1)}, \beta^{(2)}, \ldots, \beta^{(N)}$.

Then the corresponding probabilities for each outcome are:

$$\Pr(y=1) = \frac{e^{X\beta^{(1)}}}{e^{X\beta^{(1)}} + e^{X\beta^{(2)}} + \ldots + e^{X\beta^{(N)}}} \quad (1)$$

$$\Pr(y=2) = \frac{e^{X\beta^{(2)}}}{e^{X\beta^{(1)}} + e^{X\beta^{(2)}} + \ldots + e^{X\beta^{(N)}}} \quad (2)$$

…

$$\Pr(y=N) = \frac{e^{X\beta^{(N)}}}{e^{X\beta^{(N)}} + e^{X\beta^{(N)}} + \ldots + e^{X\beta^{(N)}}} \quad (3)$$

where y is the dependent variable and X is the vector of control variables. The estimation of this set of equations yields multiple solutions. Therefore, the outcomes are normalised by equalising the coefficients for the base outcome to zero. Let's assume (without loss of generality) that y = 1 is the base outcome:

$\beta^{(1)} = 0$

Then equations (1) to (N) become:

$$\Pr(y=1) = \frac{1}{1 + e^{X\beta^{(2)}} + \ldots + e^{X\beta^{(N)}}} \quad (4)$$

$$\Pr(y=2) = \frac{e^{X\beta^{(2)}}}{1 + e^{X\beta^{(2)}} + \ldots + e^{X\beta^{(N)}}} \quad (5)$$

…

$$\Pr(y=N) = \frac{e^{X\beta^{(N)}}}{1 + e^{X\beta^{(2)}} + \ldots + e^{X\beta^{(N)}}} \quad (6)$$

The relative probability (or the odds) for y = m to the base outcome is

$$\frac{\Pr(y=m)}{\Pr(y=1)} = e^{X\beta(m)} \tag{7}$$

Generally, if $x_i$ changes by one unit, then the odds ratio for y = m to the base outcome will be:

$$OR_i^m = \frac{e^{\beta_1^{(m)}x_1+\ldots+\beta_i^{(m)}(x_i+1)+\ldots+\beta_k^{(m)}x_k}}{e^{\beta_1^{(m)}x_1+\ldots+\beta_i^{(m)}x_i+\ldots+\beta_k^{(m)}x_k}} = e^{\beta_i^{(m)}} \tag{8}$$

This can be interpreted as follows: For a unit change in $x_i$ the odds of y = m versus y = 1 are expected to change by a factor of $e^{\beta_i^{(m)}}$, ceteris paribus.

2. Model includes an interactive term (two continuous variables)

Let us assume that the regression equation includes an interactive variable $x_i x_j$. Let's assume further that $x_i$ and $x_j$ are continuous variables. In this case the ceteris paribus assumption cannot be invoked, since if $x_i$ changes by one unit, then $x_i x_j$ will also change. Therefore, if $x_i$ changes by one unit then the corresponding change in the odds is:

$$OR_i^m = \frac{e^{\beta_1^{(m)}x_1+\ldots+\beta_i^{(m)}(x_i+1)+\beta_{ij}^{(m)}(x_i+1)x_j\ldots+\beta_k^{(m)}x_k}}{e^{\beta_1^{(m)}x_1+\ldots+\beta_i^{(m)}x_i+\beta_{ij}^{(m)}x_ix_j+\ldots+\beta_k^{(m)}x_k}} = e^{\beta_i^{(m)}+\beta_{ij}^{(m)}x_j} \tag{9}$$

This odds ratio is conditional on the value of $x_j$.

Let us assume that $x_i$ changes by one unit and $x_j$ changes by one unit. Then the corresponding change in the odds of y = m to the base outcome is:

$$OR_{ij}^m = \frac{e^{\beta_1^{(m)}x_1+\ldots+\beta_i^{(m)}(x_i+1)+\beta_j^{(m)}(x_j+1)+\beta_{ij}^{(m)}(x_i+1)(x_j+1)\ldots+\beta_k^{(m)}x_k}}{e^{\beta_1^{(m)}x_1+\ldots+\beta_i^{(m)}x_i+\beta_{ij}^{(m)}x_ix_j+\ldots+\beta_k^{(m)}x_k}} =$$

$$= e^{\beta_i^{(m)}+\beta_j^{(m)}+\beta_{ij}^{(m)}(x_i+x_j+1)} \tag{10}$$

3. Model includes an interactive term (a continuous variable and a dummy variable)

Let us assume that the regression equation includes an interactive variable $x_i x_j$. Let us further assume that $x_i$ is a dummy variable and $x_j$ is a continuous variable. If $x_i$ changes from zero to one then the corresponding change in the odds is:

$$OR_i^m = \frac{e^{\beta_1^{(m)} x_1 + \ldots + \beta_i^{(m)} \cdot 1 + \beta_{ij}^{(m)} x_j \ldots + \beta_k^{(m)} x_k}}{e^{\beta_1^{(m)} x_1 + \ldots + \beta_i^{(m)} \cdot 0 + 0 + \ldots + \beta_k^{(m)} x_k}} = e^{\beta_i^{(m)} + \beta_{ij}^{(m)} x_j} \tag{11}$$

The change in the odds ratio is analogous to (9).

If $x_j$ changes by one unit then the odds ratio is:

$$OR_j^m = e^{\beta_j^{(m)} + \beta_{ij}^{(m)} x_i} \tag{12}$$

This simplifies to $OR_j^m = e^{\beta_j^{(m)} + \beta_{ij}^{(m)}}$ if $x_i = 1$ and $OR_j^m = e^{\beta_j^{(m)}}$ if $x_i = 0$.

Let's assume that $x_i$ changes from zero to one and $x_j$ changes by one unit. The total effect of these changes is:

$$OR_{ij}^m = \frac{e^{\beta_1^{(m)} x_1 + \ldots + \beta_i^{(m)} \cdot 1 + \beta_{ij}^{(m)} (x_j + 1) + \beta_j^{(m)} (x_j + 1) + \ldots + \beta_k^{(m)} x_k}}{e^{\beta_1^{(m)} x_1 + \ldots + \beta_i^{(m)} \cdot 0 + \beta_{ij}^{(m)} \cdot 0 + \beta_j^{(m)} x_j + \ldots . + \beta_k^{(m)} x_k}} =$$

$$= e^{\beta_i^{(m)} + \beta_{ij}^{(m)} (x_j + 1) + \beta_j^{(m)}} \tag{13}$$

4. Model includes an interactive term (two dummy variables)

Let us assume that the regression equation includes an interactive variable $x_i x_j$. Let us further assume $x_i$ and $x_j$ are dummy variables. The effect of only one variable from the interactive term changing from 0 to 1 is analogous to (12).

The total effect of both variables changing from zero to one is as follows:

$$OR_{ij}^m = \frac{e^{\beta_1^{(m)} x_1 + \ldots + \beta_i^{(m)} \cdot 1 + \beta_{ij}^{(m)} \cdot 1 + \beta_j^{(m)} \cdot 1 + \ldots + \beta_k^{(m)} x_k}}{e^{\beta_1^{(m)} x_1 + \ldots + \beta_i^{(m)} \cdot 0 + \beta_{ij}^{(m)} \cdot 0 + \beta_j^{(m)} \cdot 0 + \ldots . + \beta_k^{(m)} x_k}} = e^{\beta_i^{(m)} + \beta_{ij}^{(m)} + \beta_j^{(m)}} \tag{14}$$

## Appendix 5: Questions used for the creation of the dependent variables

***Question 6*** *– Does your firm have a policy that adapts changes in base wages to inflation?*

*Definition of base wage – direct remuneration excluding bonuses (regular wage and salary, commissions, piecework payments).*

No □

Yes □

***Question 7*** *– If "yes" in question 6, please select the option that best reflects the policy followed:*

Wage changes are <u>automatically linked</u> to:

- past inflation □
- expected inflation □

Although there is no formal rule, wage changes <u>take into account</u>:

- past inflation □
- expected inflation □

***Question 14*** *– Over the last five years, has the base wage of some employees in your firm ever been frozen?*

*Definition of freeze in base wage – base wage in nominal terms remains unchanged from a pay negotiation to the next.*

- No □
- Yes (indicate for what percentage of your employees) _____%

**Appendix 6: Variable definitions**

*Dependent variable:* A categorical variable that takes three values (0 = flexible wage; 1 = nominal wage rigidity; 2 = real wage rigidity)

*Low-skilled blue-collar (%):* Proportion of workers belonging to this category (as a share of total employment)

*Low-skilled white-collar (%):* Ditto

*High-skilled blue-collar (%):* Ditto

*High-skilled white-collar (%):* Ditto

*Covered workers (%):* Proportion of workers covered by collective bargaining contract(s)

*Permanent workers (%):* Proportion of permanent employees

*Only outside agreement:* Firm applies only an agreement concluded outside the firm

*Only firm-level agreement:* Firm applies only an agreement concluded within the firm

*Both agreements:* Firm applies both firm-level and outside agreements

*Labour cost (%)*: The share of labour cost in total cost

*Price comp – likely etc*: Implied competition capturing whether firms are likely or not to follow competitors' price changes (ranges from *very likely* to *not at all*, 4 categories)

*Perceived comp – severe etc:* Self-defined competition capturing firms' perception regarding the intensity of product market competition (ranges from *severe* to *none*, 4 categories)

*EPL:* An index measuring the strictness of employment protection legislation, which ranges from 0 (weak) to 4 (strong)

*Permanent workers (%) * EPL:* Interaction of the variable capturing the strictness of employment protection legislation with the proportion of permanent employees

*Tenure up to 1 year (%):* Proportion of permanent employees with tenure less than a year

*Tenure 1–5 yrs (%):* Proportion of permanent employees with tenure between 1 and 5 years

*Tenure over 5 years (%)*: Proportion of permanent employees with tenure above 5 years

*Bonus*: Dummy variable taking the value of 1 if firm pays bonuses and zero otherwise

**Appendix 7. Cross-country variation in the incidence of different types of union contracts**

| | Only firm-level agreement | Only outside agreement | Both agreements | No collective agreement |
|---|---|---|---|---|
| Austria | 0.006 | 0.765 | 0.211 | 0.018 |
| Belgium | 0.006 | 0.727 | 0.256 | 0.011 |
| Czech Republic | 0.356 | 0.025 | 0.150 | 0.468 |
| Estonia | 0.068 | 0.019 | 0.011 | 0.902 |
| Spain | 0.176 | 0.824 | 0.000 | 0.000 |
| France | 0.001 | 0.430 | 0.568 | 0.001 |
| Greece | 0.057 | 0.679 | 0.179 | 0.085 |
| Hungary | 0.098 | 0.000 | 0.000 | 0.902 |
| Ireland | 0.034 | 0.435 | 0.209 | 0.322 |
| Italy | 0.001 | 0.583 | 0.409 | 0.006 |
| Lithuania | 0.199 | 0.009 | 0.006 | 0.786 |
| Poland | 0.149 | 0.014 | 0.022 | 0.814 |
| Portugal | 0.029 | 0.524 | 0.070 | 0.377 |
| Slovenia | 0.202 | 0.798 | 0.000 | 0.000 |
| Total | 0.080 | 0.449 | 0.172 | 0.299 |

Notes: The share of firms applying a given contract type. Non-weighted averages.

**Appendix 8: Wage rigidity vs firm characteristics. Multinomial logit regressions.**

| | Tenure structure | | Bonus | | Perceived competition | | Price competition | |
|---|---|---|---|---|---|---|---|---|
| | DNWR/ flexible | DRWR/ flexible | DNWR/ flexible | DRWR/ flexible | DNWR/ flexible | DRWR/ flexible | DNWR/ flexible | DRWR/ flexible |
| Low-skilled blue-collar (%) | 0.625*** | 0.785 | 0.517*** | 0.944 | 0.489*** | 0.879 | 0.507*** | 0.995 |
| | (0.008) | (0.213) | (0.000) | (0.723) | (0.000) | (0.494) | (0.000) | (0.978) |
| High-skilled blue-collar (%) | 0.707* | 0.988 | 0.705** | 0.572*** | 0.710* | 1.010 | 0.723* | 0.627** |
| | (0.062) | (0.955) | (0.046) | (0.002) | (0.050) | (0.961) | (0.066) | (0.014) |
| Low-skilled white-collar (%) | 0.747 | 0.691 | 0.723 | 0.555** | 0.552** | 0.661 | 0.814 | 0.684* |
| | (0.226) | (0.142) | (0.174) | (0.011) | (0.012) | (0.104) | (0.369) | (0.091) |
| Labour cost (%) | 1.425* | 1.329 | 1.614** | 1.366* | 1.540** | 1.317 | 1.767*** | 1.277 |
| | (0.091) | (0.182) | (0.013) | (0.066) | (0.029) | (0.179) | (0.004) | (0.164) |
| Outside contract only | 0.954 | 1.106 | 1.039 | 1.175 | 1.034 | 1.335* | 1.017 | 1.185 |
| | (0.734) | (0.510) | (0.773) | (0.240) | (0.803) | (0.056) | (0.904) | (0.257) |
| Firm-level contract only | 0.991 | 1.446** | 1.120 | 1.516*** | 1.033 | 1.604*** | 1.076 | 1.627*** |
| | (0.953) | (0.015) | (0.432) | (0.002) | (0.826) | (0.002) | (0.627) | (0.001) |
| Both contracts | 0.608** | 1.546** | 0.737* | 1.286 | 0.675** | 1.591** | 0.759 | 1.320 |
| | (0.013) | (0.026) | (0.067) | (0.155) | (0.023) | (0.012) | (0.110) | (0.132) |
| Permanent workers (%) | 1.366 | 1.001 | 1.631** | 1.078 | 1.580* | 1.051 | 1.497* | 1.044 |
| | (0.200) | (0.997) | (0.047) | (0.669) | (0.050) | (0.824) | (0.080) | (0.809) |
| Size = 20–49 | 1.248* | 1.032 | 1.145 | 1.055 | 1.152 | 1.141 | 1.191 | 1.037 |
| | (0.083) | (0.802) | (0.265) | (0.573) | (0.242) | (0.268) | (0.150) | (0.708) |
| Size = 50–199 | 1.388*** | 0.811 | 1.301** | 0.903 | 1.196 | 0.934 | 1.376*** | 0.955 |
| | (0.009) | (0.107) | (0.027) | (0.270) | (0.130) | (0.578) | (0.006) | (0.615) |
| Size = 200+ | 1.434** | 0.958 | 1.184 | 0.972 | 1.072 | 0.888 | 1.181 | 0.959 |
| | (0.016) | (0.764) | (0.226) | (0.768) | (0.626) | (0.392) | (0.236) | (0.670) |
| Sector = Energy | 0.450 | 0.967 | 0.374 | 1.658*** | 0.604 | 1.221 | 0.245 | 1.767** |
| | (0.139) | (0.920) | (0.106) | (0.007) | (0.364) | (0.579) | (0.176) | (0.017) |
| Sector = Construction | 0.772* | 1.128 | 0.827 | 1.001 | 0.773* | 1.044 | 0.670** | 1.072 |
| | (0.094) | (0.440) | (0.216) | (0.996) | (0.095) | (0.791) | (0.013) | (0.647) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sector = Trade | 0.818 | 1.004 | 0.802* | 0.961 | 0.760** | 1.018 | 0.773** | 0.941 |
| | (0.101) | (0.974) | (0.061) | (0.649) | (0.022) | (0.883) | (0.027) | (0.499) |
| Sector = Market services | 0.845 | 1.136 | 0.864 | 0.955 | 0.777** | 1.037 | 0.844 | 0.958 |
| | (0.147) | (0.293) | (0.157) | (0.562) | (0.019) | (0.739) | (0.108) | (0.605) |
| Sector = Financial interm. | 0.839 | 1.401 | 0.907 | 1.492 | 0.794 | 1.567* | 0.814 | 1.455 |
| | (0.573) | (0.183) | (0.749) | (0.100) | (0.482) | (0.099) | (0.514) | (0.141) |
| Sector = Non-market serv. | 0.885 | 0.686 | 0.817 | 0.889 | 0.975 | 0.681 | 0.868 | 0.636 |
| | (0.668) | (0.367) | (0.487) | (0.748) | (0.928) | (0.354) | (0.654) | (0.342) |
| Tenure 1–5 years (%) | 2.593*** | 0.822 | | | | | | |
| | (0.003) | (0.508) | | | | | | |
| Tenure above 5 years (%) | 2.719*** | 1.032 | | | | | | |
| | (0.000) | (0.899) | | | | | | |
| Bonus | | | 1.015 | 1.098 | | | | |
| | | | (0.883) | (0.196) | | | | |
| Perceived comp = strong | | | | | 0.674*** | 1.128 | | |
| | | | | | (0.000) | (0.161) | | |
| Perceived comp = weak | | | | | 0.770* | 1.255 | | |
| | | | | | (0.079) | (0.128) | | |
| Perceived comp = none | | | | | 0.696 | 0.662 | | |
| | | | | | (0.154) | (0.150) | | |
| Price comp = likely | | | | | | | 0.920 | 0.887 |
| | | | | | | | (0.423) | (0.161) |
| Price comp = not likely | | | | | | | 0.881 | 0.851* |
| | | | | | | | (0.261) | (0.089) |
| Price comp = not at all | | | | | | | 1.019 | 1.039 |
| | | | | | | | (0.915) | (0.782) |
| Observations | 6449 | 6449 | 10298 | 10298 | 7549 | 7549 | 9969 | 9969 |

Notes: The table presents the estimated odds ratios for nominal wage rigidity vs flexible wage and real wage rigidity vs flexible wage. The regression includes country fixed effects (not shown). Robust P-values in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

**Appendix 9: Wage rigidity vs competition. Regressions for euro area and non-euro area countries**

| | Euro area | | Non-euro area | | Euro area | | Non-euro area | |
|---|---|---|---|---|---|---|---|---|
| | DNWR/ flexible | DRWR/ flexible | DNWR/ flexible | DRWR/ flexible | DNWR/ flexible | DRWR/ flexible | DNWR/ flexible | DRWR/ flexible |
| Low-skilled blue-collar (%) | 0.383*** | 1.465 | 0.612* | 0.471*** | 0.398*** | 1.552** | 0.629* | 0.379*** |
| | (0.000) | (0.128) | (0.050) | (0.007) | (0.000) | (0.027) | (0.073) | (0.001) |
| High-skilled blue-collar (%) | 0.777 | 1.394 | 0.558** | 0.755 | 0.866 | 0.842 | 0.505** | 0.561* |
| | (0.261) | (0.221) | (0.047) | (0.382) | (0.517) | (0.443) | (0.025) | (0.092) |
| Low-skilled white-collar (%) | 0.553* | 0.878 | 0.596 | 0.461* | 1.020 | 0.933 | 0.647 | 0.422* |
| | (0.075) | (0.673) | (0.122) | (0.075) | (0.948) | (0.785) | (0.201) | (0.064) |
| Labour cost (%) | 1.642* | 1.747** | 1.492 | 0.931 | 1.776** | 1.531** | 1.752* | 0.816 |
| | (0.072) | (0.030) | (0.171) | (0.836) | (0.033) | (0.036) | (0.063) | (0.581) |
| Outside contract only | 1.176 | 1.516** | 1.620 | 2.822* | 1.197 | 1.429 | 1.709 | 3.389** |
| | (0.303) | (0.037) | (0.287) | (0.064) | (0.281) | (0.127) | (0.263) | (0.031) |
| Firm-level contract only | 2.072** | 2.227*** | 0.832 | 1.500** | 2.416*** | 2.220*** | 0.816 | 1.436* |
| | (0.010) | (0.005) | (0.292) | (0.037) | (0.002) | (0.003) | (0.269) | (0.074) |
| Both contracts | 0.773 | 1.829*** | 0.651 | 1.592 | 0.900 | 1.582* | 0.684 | 1.282 |
| | (0.215) | (0.010) | (0.245) | (0.269) | (0.611) | (0.078) | (0.327) | (0.593) |
| Permanent workers (%) | 1.764* | 1.036 | 1.383 | 1.022 | 1.644 | 1.160 | 1.314 | 0.711 |
| | (0.080) | (0.897) | (0.340) | (0.957) | (0.113) | (0.455) | (0.432) | (0.397) |
| Size = 20–49 | 0.951 | 1.245 | 1.419* | 0.846 | 1.013 | 1.043 | 1.416* | 0.810 |
| | (0.762) | (0.142) | (0.052) | (0.423) | (0.934) | (0.699) | (0.058) | (0.345) |
| Size = 50–199 | 1.088 | 1.013 | 1.359* | 0.695* | 1.345** | 0.971 | 1.407* | 0.729 |
| | (0.594) | (0.934) | (0.091) | (0.089) | (0.050) | (0.770) | (0.065) | (0.152) |
| Size = 200+ | 0.847 | 0.895 | 1.479* | 0.707 | 0.995 | 0.958 | 1.514* | 0.694 |
| | (0.364) | (0.503) | (0.094) | (0.201) | (0.979) | (0.687) | (0.088) | (0.189) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sector = Energy | 1.457 | 3.125** | 0.316 | 0.396 | 0.000*** | 2.178*** | 0.480 | 0.664 |
| | (0.606) | (0.016) | (0.284) | (0.241) | (0.000) | (0.007) | (0.492) | (0.597) |
| Sector = Construction | 0.655* | 0.842 | 0.879 | 1.311 | 0.475*** | 0.880 | 0.859 | 1.306 |
| | (0.074) | (0.469) | (0.529) | (0.225) | (0.004) | (0.532) | (0.473) | (0.257) |
| Sector = Trade | 0.742* | 1.235 | 0.766 | 0.819 | 0.731* | 0.996 | 0.835 | 0.758 |
| | (0.092) | (0.178) | (0.109) | (0.301) | (0.058) | (0.967) | (0.282) | (0.166) |
| Sector = Market services | 0.698** | 1.006 | 0.834 | 1.094 | 0.873 | 0.944 | 0.785 | 0.921 |
| | (0.016) | (0.968) | (0.258) | (0.616) | (0.332) | (0.530) | (0.142) | (0.663) |
| Sector = Financial interm. | 0.893 | 2.069** | 0.691 | 1.090 | 0.858 | 1.780* | 0.784 | 0.877 |
| | (0.806) | (0.038) | (0.438) | (0.846) | (0.717) | (0.066) | (0.613) | (0.779) |
| Sector = Non-market serv. | 0.837 | 0.686 | | | 0.811 | 0.645 | | |
| | (0.537) | (0.371) | | | (0.523) | (0.355) | | |
| Perceived comp = strong | 0.763** | 1.033 | 0.581*** | 1.290* | | | | |
| | (0.018) | (0.762) | (0.000) | (0.080) | | | | |
| Perceived comp = weak | 0.926 | 1.158 | 0.616** | 1.388 | | | | |
| | (0.715) | (0.463) | (0.023) | (0.156) | | | | |
| Perceived comp = none | 1.155 | 0.780 | 0.260** | 0.627 | | | | |
| | (0.636) | (0.514) | (0.014) | (0.277) | | | | |
| Price comp = likely | | | | | 0.956 | 0.889 | 0.867 | 0.915 |
| | | | | | (0.744) | (0.225) | (0.372) | (0.657) |
| Price comp = not likely | | | | | 0.825 | 0.803** | 0.951 | 1.059 |
| | | | | | (0.203) | (0.041) | (0.770) | (0.784) |
| Price comp = not at all | | | | | 1.172 | 1.032 | 0.791 | 1.087 |
| | | | | | (0.465) | (0.840) | (0.449) | (0.796) |
| Observations | 4319 | 4319 | 3230 | 3230 | 6982 | 6982 | 2987 | 2987 |

Notes: The table presents the estimated odds ratios for nominal wage rigidity vs flexible wage and real wage rigidity vs flexible wage. The regression includes country fixed effects (not shown). Robust P-values in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

**Appendix 10: Wage rigidity vs institutions**

| | Collective bargaining coverage | | Employment protection legislation | | Union effects: High coverage by outside agreements | | Union effects: Medium coverage by outside agreements | | Union effects: Low coverage by outside agreements | |
|---|---|---|---|---|---|---|---|---|---|---|
| | DNWR/ flexible | DRWR/ flexible | DNWR/ flexible | DRWR/ flexible | DNWR/ flexible | DRWR/ flexible | DNWR/ flexible | DRWR/ flexible | DNWR/ flexible | DRWR/ flexible |
| Low-skilled blue-collar (%) | 0.553*** | 1.092 | 0.541*** | 1.068 | 0.588 | 1.394 | 0.505** | 1.658 | 0.622* | 0.470*** |
| | (0.000) | (0.605) | (0.000) | (0.671) | (0.116) | (0.165) | (0.012) | (0.149) | (0.056) | (0.006) |
| High-skilled blue-collar (%) | 0.755* | 0.681** | 0.716** | 0.688** | 1.105 | 0.705 | 0.704 | 1.367 | 0.537** | 0.751 |
| | (0.094) | (0.042) | (0.042) | (0.032) | (0.777) | (0.186) | (0.175) | (0.381) | (0.032) | (0.367) |
| Low-skilled white-collar (%) | 0.696 | 0.708 | 0.722 | 0.685* | 2.079 | 0.794 | 0.566 | 1.013 | 0.630 | 0.471* |
| | (0.119) | (0.132) | (0.140) | (0.069) | (0.113) | (0.473) | (0.143) | (0.973) | (0.160) | (0.083) |
| Labour cost (%) | 1.530** | 1.251 | 1.572** | 1.378* | 2.005* | 1.629** | 1.432 | 1.634 | 1.453 | 0.996 |
| | (0.026) | (0.207) | (0.015) | (0.051) | (0.066) | (0.030) | (0.274) | (0.190) | (0.195) | (0.991) |
| Outside contract only | | | 1.004 | 1.268* | 0.915 | 0.794** | 1.087 | 1.345 | 1.485 | 2.558* |
| | | | (0.974) | (0.091) | (0.587) | (0.019) | (0.594) | (0.142) | (0.374) | (0.091) |
| Firm-level contract only | | | 1.126 | 1.606*** | | | 1.680 | 2.631** | 0.884 | 1.386* |
| | | | (0.394) | (0.001) | | | (0.108) | (0.013) | (0.467) | (0.086) |
| Both contracts | | | 0.740* | 1.451** | | | 0.565** | 1.956*** | 0.686 | 1.500 |
| | | | (0.063) | (0.031) | | | (0.041) | (0.009) | (0.303) | (0.329) |
| Permanent workers (%) | 1.613** | 1.264 | 0.192** | 1.278 | 0.780 | 1.086 | 2.486** | 1.611 | 1.405 | 0.938 |
| | (0.041) | (0.198) | (0.020) | (0.731) | (0.628) | (0.708) | (0.012) | (0.196) | (0.311) | (0.874) |
| Size = 20–49 | 1.153 | 1.079 | 1.134 | 1.092 | 0.870 | 1.103 | 1.094 | 1.132 | 1.405* | 0.844 |
| | (0.238) | (0.441) | (0.272) | (0.326) | (0.531) | (0.401) | (0.661) | (0.551) | (0.056) | (0.411) |
| Size = 50–199 | 1.166 | 1.001 | 1.246** | 0.953 | 0.902 | 0.998 | 1.485** | 0.981 | 1.383* | 0.678* |
| | (0.187) | (0.994) | (0.048) | (0.576) | (0.640) | (0.986) | (0.037) | (0.929) | (0.069) | (0.065) |
| Size = 200+ | 0.989 | 0.988 | 1.095 | 0.977 | 0.560** | 0.989 | 1.394 | 0.895 | 1.540* | 0.753 |
| | (0.935) | (0.901) | (0.488) | (0.798) | (0.017) | (0.923) | (0.125) | (0.663) | (0.061) | (0.283) |
| Sector = Energy | 0.426 | 1.710*** | 0.653 | 1.634*** | 1.168 | 3.048*** | 1.056 | 0.000*** | 0.178* | 0.321 |
| | (0.157) | (0.003) | (0.385) | (0.009) | (0.885) | (0.000) | (0.949) | (0.000) | (0.096) | (0.131) |
| Sector = Construction | 0.788 | 1.261 | 0.777* | 1.068 | 0.096** | 0.574* | 0.747 | 1.263 | 0.912 | 1.288 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (0.127) | (0.140) | (0.096) | (0.648) | (0.024) | (0.074) | (0.240) | (0.402) | (0.651) | (0.250) |
| Sector = Trade | 0.847 | 0.943 | 0.822* | 0.976 | 0.765 | 1.011 | 0.764 | 1.119 | 0.825 | 0.762 |
| | (0.155) | (0.515) | (0.082) | (0.770) | (0.298) | (0.917) | (0.176) | (0.591) | (0.243) | (0.150) |
| Sector = Market services | 0.854 | 0.962 | 0.868 | 0.963 | 1.001 | 0.895 | 0.710* | 1.213 | 0.801 | 1.017 |
| | (0.122) | (0.637) | (0.153) | (0.625) | (0.995) | (0.237) | (0.078) | (0.378) | (0.159) | (0.922) |
| Sector = Financial interm. | 0.611 | 1.278 | 0.816 | 1.451 | 1.144 | 1.750 | 0.735 | 1.424 | 0.748 | 0.957 |
| | (0.162) | (0.391) | (0.499) | (0.116) | (0.821) | (0.133) | (0.563) | (0.496) | (0.541) | (0.921) |
| Sector = Non-market serv. | 1.057 | 0.906 | 0.983 | 0.814 | 2.023 | 1.892 | 0.876 | 0.823 | | |
| | (0.842) | (0.799) | (0.948) | (0.572) | (0.408) | (0.533) | (0.655) | (0.645) | | |
| Covered workers (%) | 1.010 | 1.273** | | | | | | | | |
| | (0.922) | (0.030) | | | | | | | | |
| Permanent workers (%) * EPL | | | 2.030*** | 0.957 | | | | | | |
| | | | (0.003) | (0.864) | | | | | | |
| Observations | 10309 | 10309 | 11837 | 11837 | 5161 | 5161 | 2256 | 2256 | 3272 | 3272 |

Notes: The table presents the estimated odds ratios for nominal wage rigidity vs flexible wage and real wage rigidity vs flexible wage. The regression includes country fixed effects (not shown). Robust P-values in parentheses, *** p<0.01, ** p<0.05, * p<0.1.