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

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## Abstract

We present new evidence from a unique survey of firms across Europe on downward wage rigidity in both real and nominal terms. Our results indicate that wage rigidities are related to workforce composition in a manner that is consistent with related theoretical models. We also find 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.

*Keywords*: Wage indexation; wage rigidity; survey data; European Union
*JEL classification*: *J*30; *J*31; *J*32; *C*81; *P*5

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## I. Introduction

The success of central banks in achieving price stability during the last two decades has renewed the academic interest in the possible 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, as it becomes more difficult to adjust real wages. A sizeable body of literature identifies resistance to nominal wage cuts in the US.[1] European evidence, led by the International Wage Flexibility Project (Dickens *et al.*, 2007), suggests lower levels of downward nominal wage rigidity (DNWR) than in the US, but higher resistance to real wage cuts; this feature is 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 current article aims to analyse the factors associated with downward nominal and real wage rigidity. We use a novel major firm-level survey containing 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. This is the first firm-level survey with a harmonised design covering a large number of countries and 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 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 is significantly correlated with wage rigidity (Dickens *et al.*, 2007; Holden and Wulfsberg, 2008, 2009; Messina *et al.*, 2010). We benefit from the detailed firm-level information to extend this analysis to the specific features of the institutional environment in which the firm operates; for example, the characteristics of wage bargaining.

[1] See, among others, Card and Hyslop (1997), Kahn (1997), Altonji and Devereux (1999), and Lebow *et al.* (2003).

[2] See, for example, Blinder and Choi (1990), Agell and Lundborg (1995, 2003), Campbell and Kamlani (1997), and Bewley (2004).

We define DNWR on the basis of nominal wage freezes, while our measure of downward real wage rigidity is defined on the basis of wage indexation. We consider as subject to DRWR those firms that have an automatic link between wages and past or expected inflation. These measures, albeit different in nature, are closely related to alternative indicators derived from wage change distributions based on individual-level data (see, e.g., Dickens *et al*., 2007; Messina *et al*., 2010).

Approximately 10% of firms experienced wage freezes and 17% of firms applied wage indexation mechanisms among the sampled EU member states. The incidence of wage freezes is more common in non-euro area economies, whereas indexation mechanisms are more widely used in the euro area countries. We employ bivariate probit regressions to analyse how DNWR and DRWR relate to a number of firm-level and labour market characteristics in the countries covered by our sample. The 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 to explain the importance of maintaining the real income level to workers (Dickens *et al*., 2007). DNWR, however, is higher in countries where firing is costly due to employment protection legislation provisions, and within firms with a higher share of workers who hold open-ended contracts. This is consistent with Holden (2004), who shows that as renegotiation of labour contracts in most countries requires mutual consent, employment protection provisions strengthen the workers' position if they resist wage cut demands from the firm.

Our 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 both for 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 to those with high replacement costs. These characteristics are typical for high-skilled white-collar workers. Implications of other firm characteristics, such as size, the tenure structure, flexible payment schemes, are also discussed in the text.

The rest of the paper is organised as follows. Section II describes the survey and the definitions of wage rigidities. Section III presents some theoretical predictions for the impact of firm characteristics and institutions on rigidity, and previous findings in the empirical literature are discussed. Section IV concentrates on the survey evidence regarding wage freezes and indexation. Section V examines how nominal and real wage rigidities

are related to various firm-level characteristics and institutional measures. Section VI concludes.

## II. Survey Design and Definitions of Wage Rigidities

### *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, Czech Republic, Estonia, France, Greece, Hungary, Ireland, Italy, Netherlands, Lithuania, Poland, Portugal, Slovenia, and Spain.[3] The survey was carried out by the National Central Banks. As the basis for the survey, all countries used a harmonised questionnaire, which was developed in the context of the Eurosystem Wage Dynamics Network (WDN), 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. This was adapted by some countries to account for specific country characteristics and differences in institutional frameworks. As a result, some countries opted for shorter versions of this questionnaire, while others extended it in several dimensions. For example, the Netherlands did not include questions on indexations, and we therefore include it only in the discussion of nominal wage rigidity.

The sample frame in each country was based on firms with at least five 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 approximately 47.5 million employees. In order to make the results representative of the total population, the cross-country statistics presented in the following sections use employment-adjusted weights.[4]

[3] The survey was conducted either by traditional mail, phone, and face-to-face interviews, or through the internet. The survey was also conducted in Germany, but with a different questionnaire (Radowski and Bonin, 2009). Hence, it is not included in our sample. A detailed analysis of the main characteristics of the national surveys and the distribution of sample by country, sector, and size is provided in Babecký *et al*. (2009).

[4] 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.

### *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 real or nominal wages adjust. In this paper, rigidity refers to obstacles to wage adjustment, rather than to infrequent adjustment or stickiness of wages. We asked firms about wage freezes and indexation mechanisms, which we relate to downward nominal and real wage rigidity, respectively, as explained below.

Our survey asked firms: "Over the last five years, has the base wage of some employees in your firm ever been frozen?"[5] On the basis of this question, we regard firms that froze wages at any point as showing evidence of downward nominal wage rigidity. We also asked firms: "Does your firm have a policy that adapts changes in base wages to inflation?" Firms that replied yes to this question were further asked if the link with inflation was automatic or discretionary and if the link was with past or expected inflation. Using this information, we consider as subject to downward real wage rigidity those firms that have an automatic link between wages and past or expected inflation; that is, firms that apply automatic wage indexation. The idea here is that workers not only resist nominal wage cuts but also 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.

We should note that the prevalence of wage cuts in the survey is 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. In general, wage cuts affected a smaller share of the workforce than wage freezes. The employment-weighted average share of employees who experienced wage cuts (in firms that cut wages) was 36%, whereas this share was 56% in the case of wage freezes.

Some limitations apply to our measures of DNWR and DRWR. Strictly speaking, our survey-based measures of real and nominal wage rigidity do not capture only downward wage rigidity. It is possible that due to menu costs a wage freeze can indicate upward as well as downward wage rigidity. 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. Perhaps more

[5] They were provided with the following definition of a freeze in base wage: "A base wage freeze describes a situation where the base wage remains unchanged after the usual period of revision". Firms that froze wages were also asked about the proportion of workers to whom the freeze applied.

troubling is the fact that the incidence of wage freezes is a function of the underlying rationales for downward nominal wage rigidity plus the evolution of individual-level productivity and demand growth. Hence, it is plausible that a firm that is subject to DNWR in our sample answers negatively to the question above regarding wage freezes, simply because it went through a sustained period of high productivity/demand growth during the preceding five years. We will discuss this issue further in Section V. Similarly, wage indexation could also impose upward rigidity in addition to downward rigidity, at least in theory. However, indexation mechanisms are generally disconnected from the wage-bargaining calendar and present an asymmetric structure. In most countries, 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 is more likely reflecting downward than upward rigidity.[6]

Given the limitations of our measures, we tried to validate them by comparing them with estimates obtained by earlier studies based on individual micro datasets. The indicators defined in this study are highly correlated with measures of downward nominal and real wage rigidity that are derived from household surveys and administrative data on individuals. 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.[7] Messina *et al.* (2010) report measures of DNWR and DRWR for 13 sectors in three countries covered also by our study: Belgium, Portugal, and Spain. We have tabulated our measures of rigidity for those sectors and computed the correlations with the average rigidity in each sector and country, and we find that the correlation of sector averages is 0.82 for downward nominal and 0.86 for downward real wage rigidity. These high correlations, although not offering a formal proof, are reassuring of the validity of our indicators of nominal and real rigidity.

## III. Discussion of Related Theories and Previous Empirical Findings

In this section, we discuss several labour market theories (e.g., efficiency wage, insider–outsider, and contract theories) that imply predictions regarding the degree of rigidity for different categories of workers and firms. These theories often try to explain wages above a level that is consistent with full employment, but as Holden and Wulfsberg (2009) point out, the

[6] Belgium constitutes an exception. Wage indexation can take place when the relevant inflation indicator increases by an agreed amount, or indexation can take place at fixed time intervals, which in principle results in symmetric effects.

[7] Evaluated for six countries: Austria, Belgium, France, Greece, Italy, and Portugal.

arguments they put forward also apply to downward wage rigidity if workers find it costly to change consumption patterns (after a real wage cut) or if they are loss averse.

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. For example, 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, reducing effort. Because the effort of high-skilled workers is difficult to monitor and more valuable (in terms of value-added), firms may be more reluctant to cut their wages, leading to the prediction that the wages of these workers are more rigid than the wages of the lower skilled.

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 high-skilled and/or white-collar workers, the turnover model predicts that their wages are more rigid. The turnover model also predicts that firms with high turnover costs invest in creatng 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 being 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. The prediction again is a lower incidence of wage cuts among the high-skilled and/or high-tenured workers (inasmuch as productivity increases with firm-specific tenure).

According to the insider–outsider theory (Lindbeck and Snower, 1988), firms do not dismiss their current workers and replace them with 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 and downward rigid wages for the former groups.

In summary, almost all of the theories discussed above predict higher wage rigidity for high-skilled and/or white-collar workers. These models also predict that workers with higher tenure and permanent contracts have more rigid wages. The impact of the workforce composition on DNWR has been empirically investigated for the US by Campbell (1997), and on

DNWR and DRWR 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, implying a positive relationship between tenure and wage rigidity.

Another firm characteristic that is likely to affect wage rigidity is production technology. There is substantial evidence that wages are higher in more capital-intensive firms. This positive relationship is first and foremost caused by higher labour productivity in such firms. However, it may also result from a higher tendency to pay efficiency wages. This can be the case if worker effort is more valuable in firms that use more capital-intensive technology (Layard *et al*., 2005). Thus, since the payment of efficiency wages is positively associated with downward wage rigidity, it can be expected that more labour-intensive firms are less likely to have rigid wages.

Howitt (2002) puts forward a similar argument for why capital-intensive firms are more likely to have downward rigid wages. He relates this argument to the reciprocity theory developed *inter alia* by Rabin (1993). According to this theory, workers are very sensitive to wage cuts, because these are considered as "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 a firm's total costs, because the direct increase in profit from the reduction in unit labour costs will be small relative to the damage that a disgruntled workforce can inflict on the firm's profit.

It can be expected on the basis of the theoretical literature that firm size is positively associated with wage rigidity. Related models predict that larger firms are more likely to pay efficiency wages because monitoring workers' efforts is more costly (Oi, 1983) and/or because costs related to workforce turnover (search and training) are higher than in small firms (Barron *et al.*, 1987). Since the likelihood of paying efficiency wages is positively related to firm size, it can be expected that downward wage rigidity is also more prevalent among large firms.

One of the institutional features 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 to wage rigidity. For example, models developed by Shishter (1943), Dunlop (1944), and Oswald (1986) assume that unions try to maximise 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 that unions negotiating at the firm level might be more flexible in accepting

wage cuts in exchange for the maintenance of employment if business conditions turn bad.

According to Holden (2004), employment protection legislation (EPL) increases wage rigidity, because with collectively negotiated wage agreements, wage cuts need the mutual consent of employers and employees. Such cuts are less easily obtained if strong EPL means that a lay-off threat is more difficult for the firm to implement.

In the empirical literature on wage rigidity, 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 (2008, 2009) 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*. (2010), using individual data for four European countries, both 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, with Dickens *et al*. (2007) finding that EPL indices are not significantly correlated with country-level incidence of wage rigidity, and Holden and Wulfsberg (2008, 2009) indicating a positive relationship.

## IV. Firms, Wage Rigidity, and Institutional Characteristics

### *The Incidence of DNWR and DRWR in Sampled Countries*

The survey data we use allow us to examine the extent of wage freezes in 15 European Union member states. The data on wage indexation are available for 14 countries, since the Netherlands did not include this question. Table 1 shows that indexation is much more prevalent (17% of firms are affected) than wage freezes (10% of firms are affected), which is consistent with other evidence on wage rigidity in most continental European countries, as opposed to the US and the UK (see, e.g., Dickens *et al*., 2007).

There are sizeable differences between the EU countries in 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 rarer than average in Italy, Slovenia, and Spain. Indexation mechanisms are especially prevalent in Belgium and Spain, whereas fewer than 5% of firms use indexation in Estonia and Italy. Overall, we find that the non-euro area member states of the EU are more likely to experience wage freezes than the euro area member states, but that the reverse is true for indexation

Table 1. *Incidence of wage freezes and indexation mechanisms*

| Country | Wage freezes | Indexation |
|---|---|---|
| Austria | 0.13 | 0.10 |
| Belgium | 0.12 | 0.98 |
| Czech Republic | 0.27 | 0.12 |
| Estonia | 0.22 | 0.04 |
| France | 0.07 | 0.10 |
| Greece | 0.13 | 0.20 |
| Hungary | 0.06 | 0.11 |
| Ireland | 0.09 | 0.10 |
| Italy | 0.04 | 0.02 |
| Lithuania | 0.20 | 0.11 |
| Netherlands | 0.23 | N/A |
| Poland | 0.10 | 0.07 |
| Portugal | 0.15 | 0.09 |
| Slovenia | 0.03 | 0.24 |
| Spain | 0.02 | 0.55 |
| Total | 0.10 | 0.17 |
| Euro area | 0.09 | 0.20 |
| Non-euro area | 0.13 | 0.09 |

*Notes*: The table presents the proportion of firms having frozen wages over the past five years and applying an automatic indexation mechanism. Figures are employment-weighted and rescaled to exclude non-responses.

mechanisms. Note that almost all firms in Belgium apply automatic indexation mechanisms.[8]

## *Labour Market Institutions in the Sampled Countries*

The sample statistics presented in Table 1 show substantial differences in the incidence of wage rigidity across the sampled countries. A natural candidate for explaining this variation is differences in the national labour market institutions. We explore the impact of the institutional environment in the regression analysis in the next section of this paper, focusing on two aspects: collective bargaining and employment protection legislation. In this subsection, 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

[8] This is caused by an institutionalised wage indexation process, which covers all firms falling under the jurisdiction of a so-called "joint committee"; that is, the 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 2. *Collective bargaining coverage and strictness of employment protection*

| Country | Covered employees (%) | Firms with union agreements (any level, %) | Firms with firm-level agreements (%) | Firms with higher-level agreements (%) | EPL index |
|---|---|---|---|---|---|
| Austria | 95 (H) | 98 | 23 (N) | 96 | 2.15 |
| Belgium | 89 (H) | 99 | 35 (N) | 98 | 2.50 |
| Czech Republic | 50 (M) | 54 | 51 (D) | 18 | 2.02 |
| Estonia | 9 (L) | 12 | 10 (D) | 3 | 2.33 |
| France | 67 (M) | 100 | 59 (D) | 99 | 2.89 |
| Greece | 91 (H) | 93 | 21 (N) | 86 | 2.90 |
| Hungary | 18 (L) | 19 | 19 (D) | 0 | 1.65 |
| Ireland | 42 (L) | 72 | 31 (N) | 68 | 1.32 |
| Italy | 97 (H) | 100 | 43 (N) | 100 | 2.44 |
| Lithuania | 16 (VL) | 24 | 24 (D) | 1 | 2.81 |
| Netherlands | 68 (H) | 76 | 30 (N) | 45 | 2.27 |
| Poland | 19 (VL) | 23 | 21 (D) | 5 | 2.22 |
| Portugal | 56 (VL) | 62 | 10 (N) | 59 | 3.49 |
| Slovenia | N/A (H) | 100 | 26 (N) | 74 | 2.63 |
| Spain | 97 (H) | 100 | 17 (N) | 83 | 3.07 |
| Total | 68 | 76 | 33 | 66 | 2.50 |
| Euro area | 85 | 94 | 36 | 87 | 2.63 |
| Non-euro area | 24 | 28 | 26 | 6 | 2.15 |

*Notes*: Figures are employment-weighted and re-scaled to exclude non-responses. Total and euro area country aggregates exclude Germany. The information in brackets comes from Du Caju *et al*. (2008). 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.

firms 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).

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 looking 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. The percentage of workers who are covered by some form of collective wage agreement is considerably higher in the euro area than in non-euro countries.

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

EPL indices for the 15 EU member states are based on OECD (2004), and analogous indices for the new member states are based on Tonin (2005), which replicates the OECD methodology. The EPL index ranges from 0 to 6, with higher scores representing stricter regulation. There is some variability across countries in the EPL index, with Ireland ranking the lowest (the most flexible) and Portugal the highest in terms of firing restrictions.

### *Typology of Firms According to Wage Rigidity*

We have three types of firms in the dataset: (1) firms that have frozen wages are considered as subject to downward nominal wage rigidity (DNWR firms); (2) firms that apply an automatic wage indexation mechanism are considered as subject to downward real wage rigidity (DRWR firms); (3) firms that do not show signs of nominal wage rigidity or real wage rigidity according to our indicators are considered as flexible wage firms (FW firms). A small proportion of the sampled firms (about 1%) gave positive answers to questions related to both nominal and real wage rigidity. This overlap is either attributable to the partial incidence of rigidities (applies only to some workers within firms), to different reference periods in the survey questions regarding the two types of rigidities, or measurement errors. 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 A), and it tests the significance of differences in means for these variables across the three firm types.

Differences in institutional 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; this difference is statistically significant. Interestingly, the share of union coverage in firms subject to DNWR is even lower, at 46%.

This large gap 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. While 65% of firms featuring DRWR have outside agreements, the same is true for only 40% of the FW firms. These gaps are probably highly correlated with the differences across countries that are also reported in Table 3, inasmuch as such high-coverage countries as Belgium and Spain clearly present a higher level of DRWR firms.

Some firm characteristics reflecting the workforce composition also seem to be related to the incidence of different types of wage rigidities. While the share of high-skilled white-collar workers and the share of labour costs in total costs appear more important among DNWR firms, the

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*-Statistic DNWR/ FW | *t*-Statistic DRWR/ FW | Obs. (total) |
|---|---|---|---|---|---|---|
| Low-skilled blue-collar (%) | 0.36 | 0.43 | 0.34 | −3.93 | 4.83 | 13,408 |
| High-skilled blue-collar (%) | 0.28 | 0.21 | 0.25 | 2.92 | −6.42 | 13,408 |
| Low-skilled white-collar (%) | 0.14 | 0.19 | 0.15 | −1.97 | 8.27 | 13,408 |
| High-skilled white-collar (%) | 0.23 | 0.17 | 0.20 | 3.70 | −6.62 | 13,408 |
| Covered workers (%) | 0.46 | 0.80 | 0.52 | −3.65 | 25.94 | 11,696 |
| Only firm-level agreement | 0.10 | 0.10 | 0.08 | 2.53 | 3.84 | 13,426 |
| Only outside agreement | 0.33 | 0.65 | 0.39 | −3.62 | 25.86 | 13,426 |
| Firm-level and outside agreements | 0.14 | 0.15 | 0.18 | −2.96 | −3.51 | 13,426 |
| No union contract | 0.43 | 0.11 | 0.36 | 4.58 | −27.82 | 13,426 |
| Permanent workers (%) | 0.91 | 0.91 | 0.90 | 1.80 | 2.21 | 13,449 |
| Tenure up to 1 year (%) | 0.14 | 0.15 | 0.16 | −2.90 | −1.20 | 7,608 |
| Tenure 1–5 years (%) | 0.37 | 0.35 | 0.38 | −0.98 | −2.30 | 7,605 |
| Tenure over 5 years (%) | 0.49 | 0.50 | 0.47 | 2.32 | 2.60 | 7,605 |
| Labour cost (%) | 0.35 | 0.33 | 0.33 | 2.33 | −0.67 | 12,243 |
| Sector = Manufacturing | 0.43 | 0.41 | 0.41 | 0.86 | 0.22 | 13,551 |
| Sector = Energy | 0.01 | 0.02 | 0.01 | −1.63 | 5.29 | 13,551 |
| Sector = Construction | 0.07 | 0.09 | 0.07 | 0.05 | 3.56 | 13,551 |
| Sector = Trade | 0.18 | 0.21 | 0.20 | −1.39 | 0.80 | 13,551 |
| Sector = Market services | 0.27 | 0.25 | 0.27 | 0.10 | −2.86 | 13,551 |
| Sector = Financial intermediation | 0.02 | 0.02 | 0.02 | −0.94 | −1.16 | 13,551 |
| Sector = Non-market services | 0.03 | 0.01 | 0.02 | 2.94 | −5.07 | 13,551 |
| Country = Austria | 0.04 | 0.02 | 0.05 | −0.22 | −6.61 | 13,614 |
| Country = Belgium | 0.00 | 0.40 | 0.00 | −0.71 | 77.70 | 13,614 |
| Country = Czech Republic | 0.09 | 0.01 | 0.03 | 11.38 | −5.08 | 13,614 |
| Country = Estonia | 0.07 | 0.01 | 0.03 | 7.22 | −7.74 | 13,614 |
| Country = France | 0.14 | 0.05 | 0.16 | −0.97 | −16.53 | 13,614 |
| Country = Greece | 0.04 | 0.02 | 0.03 | 2.11 | −1.72 | 13,614 |
| Country = Hungary | 0.12 | 0.07 | 0.18 | −4.19 | −14.75 | 13,614 |
| Country = Ireland | 0.07 | 0.02 | 0.09 | −1.63 | −12.25 | 13,614 |
| Country = Italy | 0.04 | 0.01 | 0.09 | −6.14 | −17.30 | 13,614 |
| Country = Lithuania | 0.06 | 0.01 | 0.03 | 5.40 | −6.44 | 13,614 |
| Country = Poland | 0.08 | 0.02 | 0.08 | 0.16 | −12.65 | 13,614 |
| Country = Portugal | 0.21 | 0.03 | 0.12 | 8.31 | −13.85 | 13,614 |
| Country = Slovenia | 0.02 | 0.04 | 0.05 | −4.72 | −2.35 | 13,614 |
| Country = Spain | 0.02 | 0.30 | 0.09 | −7.56 | 30.92 | 13,614 |
| Size = 5–19 | 0.21 | 0.32 | 0.23 | −1.39 | 10.33 | 13,612 |
| Size = 20–49 | 0.22 | 0.24 | 0.23 | −0.83 | 0.71 | 13,612 |
| Size = 50–199 | 0.37 | 0.25 | 0.32 | 3.06 | −7.08 | 13,612 |
| Size = 200+ | 0.21 | 0.19 | 0.22 | −1.20 | −3.72 | 13,612 |

unconditional means suggest a negative effect on DRWR. 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. In addition, they might be related to the specificities of the samples in each country. The next section

will review how important firm characteristics are, controlling for country effects.

## V. The Determinants of Nominal and Real Wage Rigidity

This section presents the results of the regression analysis on the relationships between wage rigidity and various firm-level and institutional characteristics. We start by examining firm-level characteristics, and move next to study the impact of the labour market institutions. As discussed above, a given firm can in principle be subject to both types of downward rigidity, but this cannot be observed simultaneously unless the share of workers covered is less than 100%.[9] This implies that the observed cross-sectional measures of DNWR and DRWR should be negatively correlated. We use a bivariate probit estimation method to account for this interdependence. All regression specifications presented below include fixed effects for country and sector. The fixed effects enable us to control in a cross-sectional context for the variation in relevant omitted variables that can influence the likelihood that a firm is subject to nominal or real wage rigidity. They will account for differences in the survey design across countries, for country- and sector-specific economic shocks, etc.

### *Estimation Results—Firm Characteristics*

We begin by examining the effects of a range of firm characteristics on nominal and real wage rigidity, using a bivariate probit estimation. The first column in Table 4 reports the estimated marginal effects of RHS variables on a dummy variable of wage freeze, which is interpreted as an indicator of DNWR. The second column in Table 4 reports corresponding marginal effects on a dummy of wage indexation, which signals DRWR. Heteroscedasticity-robust $p$-values are given in the parentheses.

As we expected, the estimated correlation coefficient between the error terms of the two equations is significantly negative. This warrants the use of a bivariate probit estimation method.

The regression results indicate that workforce composition is related to wage rigidity in a manner that is predicted by theoretical models discussed in Section III. 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 DRWR.

[9] It would only be possible when the inflation rate is zero—in this case both types of wage rigidity coincide.

Table 4. *Bivariate probit regression results—baseline regression*

| Variable | Wage freezes (DNWR) | Indexation (DRWR) |
|---|---|---|
| Low-skilled blue-collar (%) | −0.048*** | 0.01 |
| | (0.00) | (0.473) |
| High-skilled blue-collar (%) | −0.02* | −0.030* |
| | (0.099) | (0.069) |
| Low-skilled white-collar (%) | −0.022 | −0.036* |
| | (0.155) | (0.073) |
| Labour cost (%) | 0.034*** | 0.021 |
| | (0.01) | (0.2) |
| Permanent workers (%) | 0.031** | 0.014 |
| | (0.05) | (0.39) |
| Size = 20–49 | 0.017** | 0.009 |
| | (0.016) | (0.342) |
| Size = 50–199 | 0.027*** | −0.007 |
| | (0.00) | (0.389) |
| Size = 200+ | 0.028*** | −0.001 |
| | (0.001) | (0.892) |
| Sector = Energy | −0.052*** | 0.047* |
| | (0.005) | (0.066) |
| Sector = Construction | −0.027*** | 0.008 |
| | (0.004) | (0.574) |
| Sector = Trade | −0.012 | −0.003 |
| | (0.138) | (0.701) |
| Sector = Market services | −0.013* | −0.001 |
| | (0.059) | (0.864) |
| Sector = Financial intermediation | −0.006 | 0.044* |
| | (0.785) | (0.091) |
| Sector = Non-market services | −0.002 | −0.014 |
| | (0.914) | (0.632) |
| Only firm-level agreement | 0.008 | 0.049*** |
| | (0.439) | (0.001) |
| Only outside agreement | 0.000 | 0.024* |
| | (0.979) | (0.079) |
| Both agreements | −0.014 | 0.042** |
| | (0.173) | (0.016) |
| Observations | 11,920 | |
| Rho | −1.63*** | |

*Notes*: The table presents estimated marginal effects (averaged across observations) for binomial probit regression. Estimated equation also includes country fixed effects. Robust $p$-values in parentheses; $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Rho = estimated correlation coefficient between the residuals.

Firms employing more blue-collar workers have a lower tendency to be subject to DNWR, and this effect is more significant for low-skilled blue-collar workers.

The estimated marginal effect for the share of labour cost in total cost is significantly positive in the regression for a wage freeze. This shows that production technology is related to wage rigidity: firms employing labour-intensive technologies are more likely to be subject to nominal wage rigidity. This positive relationship is contrary to our expectations because

of the reasons outlined in Section III. In this context, it is worth mentioning that there is other evidence obtained in the framework of WDN according to which price setting is more rigid in firms employing labour-intensive production technology (Druant *et al.*, 2009). This is in correspondence with our finding, since price and wage rigidity are positively related.

A larger share of permanent workers is associated with greater nominal wage rigidity. 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 III. The estimated marginal effects presented in Table 4 also indicate that firm size is positively related with downward nominal wage rigidity. This finding is in accordance with theoretical models implying that large firms are more likely to pay efficiency wages.

Sector dummies in Table 4 indicate that in comparison to manufacturing, firms in the energy, construction, and market services 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 and financial intermediation sectors. However, most of the sectoral fixed effects are insignificant, whereas country effects appear significant and quite sizeable for almost all countries.[10] A similar finding is reached in Messina *et al.* (2010), which shows that country factors are much more important predictors of rigidity than sectors.

Finally, the baseline regression includes dummy variables indicating the existence of union agreements signed at different levels. Based on the information of the questionnaire, we construct three non-nested dummy variables for the level at which union contract(s) relevant for the firm are signed. The first indicates the existence of only firm-level agreements, the second signifies only outside agreements, and the third is equal to one if a firm has both firm-level and outside agreements. The reference group consists of firms with no union contracts. Our results indicate that the existence of a union contract or contracts (of any type) is associated with a greater likelihood that a firm is subject to DRWR, but not to DNWR. The impact of collective bargaining is discussed later.

[10] The estimated marginal effects for the country dummies are presented in Table A1 in Appendix B.

In addition to average effects, we estimated marginal effects at 10th and 90th percentile values of (continuous) regression covariates. Changing the values of the underlying variables has only moderate effects on the magnitude of the estimated effects, and all the previously described relationships remain significant. We also experimented with the inclusion of country–sector interactive effects with the purpose of controlling for economic shocks that are country and sector specific, but this had only a very modest effect on the estimated coefficients. Although we control for country- and sector-specific fixed effects, which should account for macroeconomic developments, we do not have information on the idiosyncratic shocks hitting the firms in our sample. As discussed earlier, this implies that there might be firms in our sample potentially subject to DNWR, which did not freeze wages during the previous five years since they had not been hit by a negative shock and therefore had no need to lower the labour costs. This could bias the estimated coefficients of the determinants of downward nominal wage rigidity that are based on wage freezes, to the extent that the excluded variable (the size of the shocks) is significantly correlated with the regression covariates. While we do not have data on the size of shocks in this dataset, we were able to repeat the previous regressions on a recently obtained new dataset, which included information on wage freezes and the severity of the negative demand shock experienced by firms during the current economic crisis. The estimation results on the basis of these data confirmed the finding described earlier, and the estimated effects did not change much when the controls for idiosyncratic negative shocks were added to the regression.[11]

Table 5 presents the estimations for two additional regression specifications. The first specification includes two variables related with worker tenure in a firm, and the second specification includes a dummy for the payment of bonuses.[12] The estimated effects imply that the larger 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 III.

[11] The data were collected by a follow-up WDN survey. The sample includes the following countries: Austria, Belgium, Cyprus, Czech Republic, Estonia, France, Italy, Luxembourg, Netherlands, Poland, and Spain. A more detailed overview of the new survey is given in Messina and Rõõm (2010).

[12] The variables included in the additional regression specifications were not included in the baseline regression because their inclusion considerably reduces the sample size. The measure of tenure is not available for Belgium, France, Italy, and Spain. The question for the bonuses was formulated differently in the Greek questionnaire; hence, Greece is excluded from the analysis of performance-related bonuses.

Table 5. *Bivariate probit regression results—additional firm characteristics*

| | Wage freezes (DNWR) | Indexation (DRWR) | Wage freezes (DNWR) | Indexation (DRWR) |
|---|---|---|---|---|
| Tenure 1–5 years (%) | 0.0923*** | −0.0144 | | |
| | (0.001) | (0.586) | | |
| Tenure above 5 years (%) | 0.0989*** | 0.0018 | | |
| | (0.000) | (0.937) | | |
| Bonus | | | 0.0063 | 0.0112 |
| | | | (0.371) | (0.144) |
| Observations | 6,466 | | 10,359 | |
| Rho | −0.210*** | | −0.152*** | |

*Notes*: Regression specifications are similar to Table 4. Worker skill groups, % permanent workers, % labour cost, dummy variables for different types of union contracts, and sector, size, and country fixed effects are also added in the regressions. Reference category of tenure is the share of workers with tenure less than one year. Bonus refers to having bonus payments as a remuneration method.

The effect of bonuses and flexible pay components is ambiguous in principle. On the one hand, firms paying a higher proportion of bonuses might be able to afford higher rigidity in base wages at little cost, implying a positive association. On the other hand, bonuses and wage flexibility might be limited by the same factors (e.g., institutional obstacles), suggesting a negative association between wage rigidity and flexible pay. Our results suggest a similar weight to both arguments, since the estimated effects of having bonuses in the pay structure for nominal and real wage rigidity were both insignificant.[13]

## *Estimation Results—Labour Market Institutions*

In the regressions described previously, almost all dummy variables for countries have highly significant estimated effects for both types of wage rigidity, suggesting that national labour market institutions are an important determinant of downward wage rigidity. Previous research has demonstrated that indicators of institutional environment, such as the collective bargaining coverage and employment protection, are significantly correlated with wage rigidity. We extend this analysis to a larger number of countries, exploiting substantial cross-country variation in the institutions governing the wage-setting process between the euro area and non-euro area economies.

[13] Besides analysing the role of performance-related bonuses, we investigated whether different remuneration methods are related to wage rigidity. For that purpose, we ran a similar regression to the one described above, replacing the variable measuring bonuses with a set of dummy variables indicating different remuneration methods (hourly wage, piece-rate pay, other), whereby the reference category was monthly wage. The marginal effects for these variables were all insignificant, suggesting no differences in the incidence of rigidities across payment methods.

Table 6. *Bivariate probit regression results—institutions*

| | Collective bargaining coverage | | Employment protection legislation | |
|---|---|---|---|---|
| | Wage freezes (DNWR) | Indexation (DRWR) | Wage freezes (DNWR) | Indexation (DRWR) |
| Covered workers (%) | 0.0016 | 0.0232** | | |
| | (0.834) | (0.025) | | |
| Permanent workers (%) | | | 0.0210 | 0.0116 |
| | | | (0.187) | (0.492) |
| EPL index | | | 0.0643*** | 0.0182 |
| | | | (0.001) | (0.463) |
| Observations | 10,363 | | 11,920 | |
| Rho | −0.151*** | | −0.162*** | |

*Notes*: Regression specifications are similar to Table 4. Worker skill groups, % permanent workers, % labour cost, and sector, size, and country fixed effects are also added in the regressions.

All our specifications 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 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 6. The estimations indicate that bargaining coverage is positively associated with real wage rigidity and insignificantly related to nominal wage rigidity. This finding is in accordance with the results of the earlier empirical studies, which were based on country-level measures of rigidity (Dickens *et al.*, 2007; Holden and Wulfsberg, 2009).

In addition to bargaining coverage, we explore the effect of employment protection legislation on wage rigidity. For this purpose, we employ the EPL index presented in Table 2 that measures the overall strictness of individual dismissals (OECD, 2004; Tonin, 2005). We cannot enter the measure of EPL directly in the regressions since this country-level variable is a linear combination 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 affected 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 permanent 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

Table 7. *Interaction of the EPL index with the share of permanent workers—marginal effects*

| | | Marginal effect (DNWR) | |
|---|---|---|---|
| Percentile | Value | Permanent workers (%) | EPL |
| **EPL index** | | | |
| 25th | 2.15 | −0.004 | 0.055*** |
| | | (0.777) | (0) |
| 50th | 2.50 | 0.02 | 0.067*** |
| | | (0.228) | (0.003) |
| 75th | 3.07 | 0.08*** | 0.089** |
| | | (0.007) | (0.012) |
| Maximum value | 3.49 | 0.142*** | 0.105** |
| | | (0.007) | (0.018) |
| **Share of permanent workers (%)** | | | |
| 10th | 0.68 | 0.017 | 0.046*** |
| | | (0.273) | (0.002) |
| 30th | 0.92 | 0.022 | 0.066*** |
| | | (0.179) | (0.002) |
| 50th | 0.99 | 0.024 | 0.072*** |
| | | (0.159) | (0.002) |
| Maximum value | 1.00 | 0.024 | 0.073*** |
| | | (0.157) | (0.002) |

*Notes*: The table presents marginal effects for DNWR, estimated at different values of the two interacted variables. Robust $p$-values in parentheses; $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. The estimations are based on bivariate probit regression that additionally includes as control variables worker skill groups, % labour cost, dummy variables for different types of union contracts, and sector, size, and country fixed effects.

mix of temporary versus permanent contracts from country and sectoral averages.

The estimated marginal effects for both interacted variables are presented in the two last columns of Table 6. The strictness of employment protection legislation is positively related with DNWR and insignificantly with DRWR. The inclusion of this interactive variable renders the estimated marginal effect for the share of permanent workers insignificant. Although the average marginal effect is insignificant, the estimated effects are positive for a range of EPL index values that exceed the median, as shown later.

To further explore the relationship between permanent employment and EPL, we assessed the associated marginal effects at different levels of these variables, keeping other covariates constant at the mean value. We only present the results for DNWR, since the marginal effects for DRWR are insignificant for the whole range of values of the two interacted variables. Table 7 presents the estimated effects first for different percentiles of the EPL index and thereafter for different percentiles of the share of permanent workers (while varying one interactive variable, the other is kept constant at the mean).

The figures presented in Table 7 show that the magnitude of the estimated marginal effects for the EPL index increase with the share of permanent workers. This indicates that DNWR is positively associated with the strictness of EPL and that this effect is stronger in firms with a larger proportion of employees who have open-ended contracts. We also find that the estimated marginal effects for the share of permanent workers increase with the value of the EPL index, and they become significantly positive when the latter exceeds the 50th percentile (the level for Belgium). These results are in line with our expectations, since the existence of permanent contracts complemented by strict labour regulations gives workers more leeway in wage negotiations, which in turn should lead to greater wage rigidity.

We end this discussion by further exploring the impact of the level at which collectively bargained wage agreements are negotiated. We reported previously a positive association between collective bargaining (at any level) and DRWR. It can be expected 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 in some countries and at the firm level in others. For instance, the impact of collective bargaining 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 collective negotiation is outside the firm, while it might impose additional rigidity in a country where most negotiations are carried out bilaterally, at the individual level. In order to shed some light on these issues, we group the countries on the basis of the share of firms covered by outside-determined union agreements in the economy.[14] The group of countries with high coverage by outside agreements includes Austria, Belgium, France, Italy, Slovenia, and Spain; 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.[15]

The regression results are presented in Table 8. Note that the reference category is not the same for the various groups of countries. This depends on the incidence of the various types of contracts. Thus, for

[14] See Table 2 for an overview of the incidence of union agreements negotiated at different levels.

[15] As Table 2 indicates, Greece is a country with high coverage by outside agreements and thus could be included in the first group of countries. However, the proportion of firms applying exclusively an agreement concluded at a higher level is around 68%. It has therefore a relatively higher within-country variation of union contract types; we therefore include it in the medium-coverage group in order to exploit this variation for the purposes of our regression analysis.

Table 8. *Wage rigidity vs. different types of union contracts—regressions for groups of countries with a high, medium, and low incidence of outside agreements*

| | High incidence | | Medium incidence | | Low incidence | |
|---|---|---|---|---|---|---|
| | DNWR | DRWR | DNWR | DRWR | DNWR | DRWR |
| Only firm-level agreement | | | 0.051 | 0.085* | −0.015 | 0.028 |
| | | | (0.239) | (0.08) | (0.338) | (0.104) |
| Only outside agreement | −0.006 | −0.012 | 0.018 | 0.023 | 0.022 | 0.067 |
| | (0.378) | (0.272) | (0.254) | (0.141) | (0.682) | (0.32) |
| Both agreements | | | −0.04* | 0.071*** | −0.042 | 0.017 |
| | | | (0.066) | (0.01) | (0.145) | (0.659) |
| Observations | 6,376 | | 2,262 | | 3,282 | |

*Notes*: The table presents estimated marginal effects on the basis of bivariate probit regressions. Worker skill groups, % permanent workers, % labour cost, size, sector, and country fixed effects are added in all regressions. $p$-Values in parentheses; $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. The group of countries with high incidence of outside agreements includes Austria, Belgium, France, Italy, Slovenia, and Spain. 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 first group (countries with a high incidence of outside agreements), the excluded category consists (almost exclusively) of firms with firm-level agreements, which are implemented either simultaneously with outside agreements (Austria, Belgium, France, and Italy) or not (Slovenia and Spain). Only 0.4% of the sampled firms do not have collective wage agreements in these countries. For the other two subsets of countries, the reference group consists of firms with no union contracts.

In countries with medium-level coverage by outside agreements, firms applying multiple contracts negotiated at different levels are more likely to be subject to DRWR than firms with no union contracts. We also find that for this group of countries, firms applying only firm-level contracts are more prone to DRWR, but this effect is significant only at the 90% level. These results suggest that firm-level contracts are a more likely source of wage rigidity than outside contracts. Presumably, in countries with medium coverage, agreements concluded outside the firm shape the general framework for the employment relationships, whereas firm-level agreements have a more important role in shaping the wage policy. Given that the existence of a union contract of any type implies some bargaining power for the workers, indexation mechanisms can be applied in this context.

The estimated marginal effects are insignificant in regressions on samples of the two other groups of countries (high and low incidence of unionisation). For the group of high-coverage countries, the insignificant result may be caused by low variation in the dummy variable of higher-level agreement. Practically all firms in these countries are covered by

outside-determined union contracts. Thus, even if these contracts were a source of real wage rigidity, the regression would not pick up this correlation. In fact, the sample statistics (shown in Table 3) show that the incidence of higher-level union agreements is substantially larger among firms subject to DRWR than among other firms, which may indicate that higher-level contracts may be a source of DRWR.

A similar reason may be the cause of insignificant estimates for the group of countries with low levels of unionisation. In these countries, the share of firms for which higher-level or both types of contracts apply is very low and therefore the related measures have insufficient variation.

Overall, the regression results presented in the previous tables indicate that the participation of unions in the wage-setting process is associated with a higher extent of DRWR. However, the impact of various contract types does not seem to be uniform across subsets of countries with different levels of unionisation.

## VI. Conclusions

This paper examines the flexibility of wages across European firms. We look at the extent of rigidities in base wages on the basis of wage freezes (downward nominal wage rigidity) and wage indexation (downward real wage rigidity). Our analysis is based on a unique survey with a large sample of firms and data from 15 countries. A substantial proportion of firms that participated in the survey report that they have frozen wages or that there exists an automatic link between wages and inflation. Fewer than 1% of the more than 47 million workers that the survey represents have experienced a wage cut during a 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 bivariate probit 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. Regression results imply that high collective bargaining coverage increases real wage rigidity. 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 strictness of EPL. 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 to the share of high-skilled white-collar workers; downward nominal wage rigidity is positively related to employees' tenure and firm size in

the firms under study. These relationships are consistent with the implications of the related labour market theories; for example, efficiency wage, insider–outsider, and contract theories.

## Appendix A. Variable Definitions

### *Dependent Variables*

- *Wage freezes (DNWR)*: A dummy variable that equals one if a firm has frozen the base wages of at least some employees during the five-year period prior to the survey.
- *Indexation (DRWR)*: A dummy variable that equals one if a firm applies an automatic indexation mechanism based on past or expected inflation.

### *RHS Variables*

- *Low-skilled blue-collar (%)*: The proportion of workers belonging to this category (as a share of total employment).
- *Low-skilled white-collar (%)*: The proportion of workers belonging to this category (as a share of total employment).
- *High-skilled blue-collar (%)*: The proportion of workers belonging to this category (as a share of total employment).
- *High-skilled white-collar (%)*: The proportion of workers belonging to this category (as a share of total employment).
- *Covered workers (%)*: The proportion of workers covered by collective bargaining.
- *Permanent workers (%)*: The proportion of permanent employees.
- *Only outside agreement*: A dummy variable that equals one if a firm applies only an agreement concluded outside the firm.
- *Only firm-level agreement*: A dummy variable that equals one if a firm applies only an agreement concluded within the firm.
- *Both agreements*: A dummy variable that equals one if a firm applies both firm-level and outside agreements.
- *Labour cost (%)*: The share of labour cost in total cost.
- *EPL*: An index measuring the strictness of employment protection legislation, which ranges from 0 (weak) to 6 (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 (%)*: The proportion of permanent employees with tenure less than one year.
- *Tenure 1–5 years (%)*: The proportion of permanent employees with tenure between one and five years.
- *Tenure over 5 years (%)*: The proportion of permanent employees with tenure above five years.
- *Bonus*: A dummy variable that equals one if a firm pays performance-related bonuses.

## Appendix B

Table A1. *Bivariate probit regressions—estimated average marginal effects (baseline regression)*

| Variable | DNWR | DRWR |
|---|---|---|
| Country = Belgium | −0.013 | 0.871*** |
| | (0.411) | (0) |
| Country = Czech Republic | 0.182*** | −0.013 |
| | (0) | (0.603) |
| Country = Estonia | 0.136*** | −0.059** |
| | (0) | (0.014) |
| Country = France | 0.014 | −0.037** |
| | (0.387) | (0.04) |
| Country = Greece | 0.024 | 0.076*** |
| | (0.265) | (0.007) |
| Country = Hungary | −0.011 | 0.003 |
| | (0.515) | (0.911) |
| Country = Ireland | 0.004 | −0.032 |
| | (0.825) | (0.112) |
| Country = Italy | −0.042*** | −0.096*** |
| | (0.006) | (0) |
| Country = Lithuania | 0.111*** | −0.02 |
| | (0) | (0.435) |
| Country = Poland | 0.027 | −0.036* |
| | (0.185) | (0.095) |
| Country = Portugal | 0.071*** | −0.032* |
| | (0) | (0.097) |
| Country = Slovenia | −0.04** | 0.086*** |
| | (0.012) | (0) |
| Country = Spain | −0.056*** | 0.425*** |
| | (0) | (0) |

*Notes*: The table presents estimated average marginal effects of country fixed effects. Robust $p$-values in parentheses; $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

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