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Shocks and labour cost adjustment: evidence from a survey of European firms

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Abstract

We use firm-level survey data from 25 EU countries to analyse how firms adjust their labour costs (employment, wages and hours) in response to shocks. We develop a theoretical model to understand how firms choose between different ways to adjust their labour costs. The basic intuition is that firms choose the cheapest way to adjust labour costs. Our empirical findings are in line with the theoretical model and show that the pattern of adjustment is not much affected by the type of the shock (demand shock, access-to-finance shock, 'availability of supplies' shock), but differs according to the direction of the shock (positive or negative), its size and persistence. In 2010–13, firms responding to negative shocks were most likely to reduce employment, then hourly wages and then hours worked, regardless of the source of the shock. Results for the 2008–09 period indicate that the ranking might change during deep recession as the likelihood of wage cuts increases. In response to positive shocks in 2010–13, firms were more likely to increase wages, followed by increases in employment and then hours worked suggesting an asymmetric reaction to positive and negative shocks. Finally, we show that strict employment protection legislation and high centralisation or coordination of wage bargaining make it less likely that firms reduce wages when facing negative shocks.

Key words: Shocks, firms, labour cost adjustment, wages, employment, hours, survey.

JEL classification: D21, D22, D24.

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1. Introduction

The Great Recession that followed the financial crisis of 2007-2008 resulted in a large fall in output and a rise in unemployment across Europe. The subsequent experiences of different countries in terms of wages, hours and employment adjustment differed significantly, as some countries saw a recovery in economic growth, while other countries continued to see stagnant, or even declining, output.

The aim of this paper is to assess how European firms responded to the financial and economic crisis. More specifically, we study how firms adjusted their employment, wages and hours worked in response to shocks that they experienced. Our central hypothesis is that firms follow a 'hierarchy' of strategies, using easier and less costly adjustment mechanisms first. This is, for example, more likely if firms judge the shock to be temporary or not very sizeable. On the other hand, firms are expected to resort to more costly adjustment mechanisms (such as cutting permanent staff or cutting wages) if the shock is large and/or expected to be persistent. The adjustment may also differ across types of shock. For example, a demand-related shock may result in a different adjustment than a supply-related shock. Also, we might expect some strategies to be complementary and others to be substitutes.

We contribute to the literature along several dimensions. First, we consider both the early phase of the crisis (2008-2009) [1] and the ensuing sovereign debt crisis (2010-2013) allowing us to compare the firms' responses to shocks over time. Second, we consider three types of shocks – demand, access to finance and availability of supplies. In addition, we compare the responses to moderate and strong shocks, persistent and temporary shocks, as well as positive and negative shocks. Third, we analyse how labour market institutions influenced the adjustment of firms facing different shocks.

We develop a theoretical model to help us understand how firms might choose between different ways to adjust their labour costs. The basic intuition in the model is that, in response to shocks affecting their activity, firms choose the cheapest way to adjust labour costs: hourly wages, employment or hours worked. In other words, the margin of adjustment selected will depend on its cost. In this model, the optimisation problem is the same, whatever the type of the shock. However, the model allows firms to adjust differently to positive and negative shocks.

To analyse firms' responses to shocks, we use data from a survey conducted in 2014-15 by the Wage Dynamics Network (WDN) of the European System of Central Banks (ESCB). The survey collected detailed information from about 25,000 firms in different sectors and size classes in 25 EU countries.

Our empirical findings are in line with the theoretical model and show that the pattern of adjustment is not much affected by the type of shock (demand shock, access-to-finance shock, 'availability of supplies' shock), but differs according to the direction of the shock (positive or negative), its size and persistence. We find that the most common response to a shock is "no adjustment" in terms of labour costs, except for demand shocks. In response to negative shocks in 2010-13, firms were most likely to

[1] The reference period for the core questionnaire of the WDN survey was 2010 – 2013. The non-core part also covered the earlier period of 2008-2009, but the non-core questions were asked in only a subsample of the surveyed EU countries (Bulgaria, Estonia, Ireland, Latvia, Lithuania, Luxembourg and Poland).

reduce employment, then wages and then hours. In response to positive shocks, however, firms were more likely to increase wages, followed by increases in employment and then hours worked.

While firms are typically more likely to adjust employment than wages in response to negative shocks, i.e. wages are more rigid, in times of strong economic decline the ranking of these adjustment channels might switch and firms adjust wages with higher probability than employment. These findings imply that nominal wages tend to be downward rigid, but deep recessions can relax the constraint. Concerning the role of institutions, we find that strict employment protection and high centralization or coordination of wage bargaining make it less likely that firms reduce wages when facing negative shocks.

Last, we analyse in more detail the effects of demand shocks, the most prevalent shock in the 2010-13 period. Both base wages and bonuses were less likely to react to negative than to positive demand shocks. In the case of base wages, this reflects downward nominal wage rigidity and has been widely discussed in the literature. Bonuses were also more rigid downward than upward. Regarding adjustment of employment, the response to negative and positive demand shocks appears rather symmetrical. Thus there is no indication that the costs of reducing employment (firing cost plus potential cost of later rehiring and retraining workers) differed significantly from the costs of increasing employment (hiring and training costs).

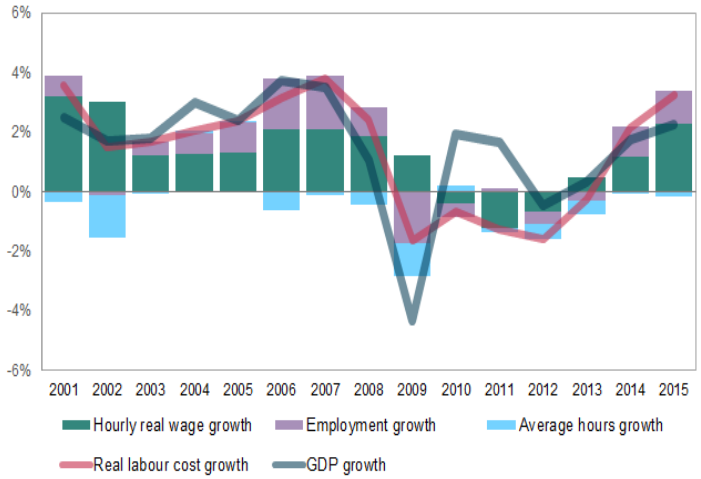
The remainder of the paper is structured as follows. Section 2 describes the dynamics of labour cost and its subcomponents at the aggregate level. Section 3 reviews the existing empirical literature on shocks and labour cost adjustment. In Section 4, we lay out a theoretical framework within which we can think about how firms decide which adjustment methods to use in response to different shocks. Section 5 gives an overview of the WDN survey data used in the study and presents a comparison of these data with macro-level variables. Section 6 shows descriptive evidence based on the responses firms gave to the questions in the WDN survey. Section 7 describes our econometric approach and gives an overview of the estimated results. Finally, Section 8 concludes.

2. The dynamics of aggregate real labour costs

Figure 1 plots the overall labour-market experience of the 25 EU countries covered by the WDN survey over the recent decades. Specifically, it decomposes employment-weighted changes in the aggregate real labour cost across all countries into changes in real hourly wages, employment and hours. As can be seen, in 2009, during the financial crisis, falling employment contributed about 2 percentage points to the fall in labour costs with hours contributing the rest. At the same time, hourly real wages grew by about 1%. This suggests the presence of downward wage rigidity. In 2010, the fall in employment and fall in real hourly wages contributed equally to the roughly 1% fall in the real labour cost whereas in 2011 it was falling hourly wages that contributed more or less all of the fall in labour costs. These developments suggest that wages responded to earlier shocks with a lag. In contrast to what happened in 2009 and 2010, the recovery in labour costs in 2014 and 2015 was driven by rises in both wages and employment. As we will show in the following sections of this

paper, the evidence based on firm-level data supports the view that firms adjust differently to negative and positive shocks.

Figure 1: Changes in aggregate real labour costs and their components, 2001-2015.



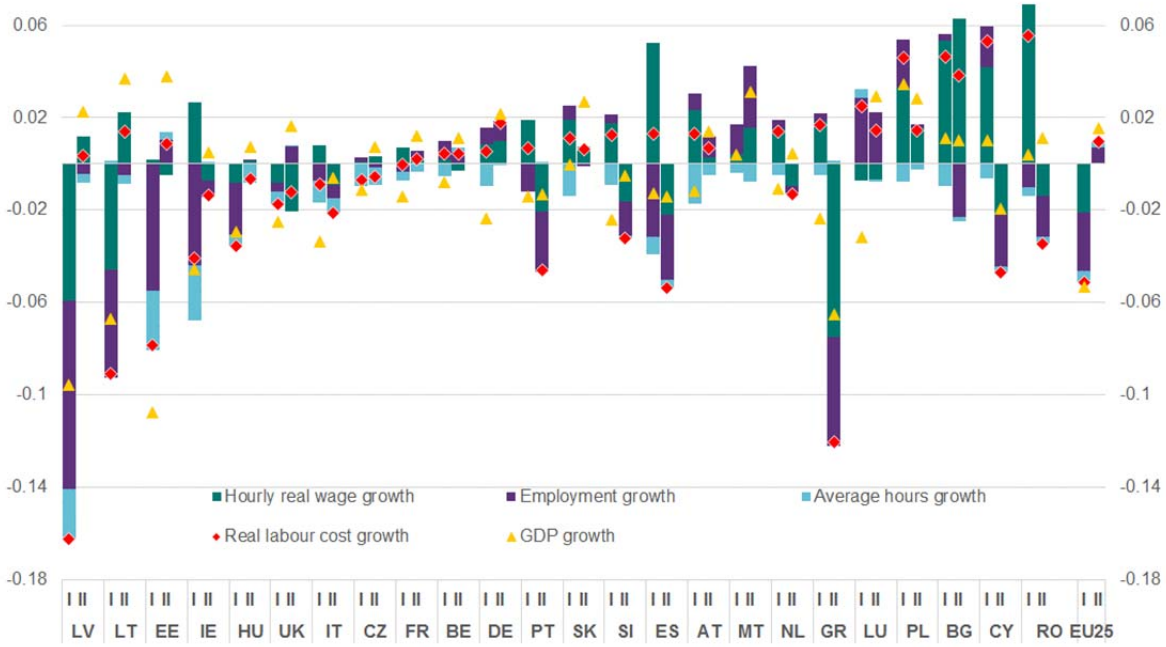
Source: Eurostat
Notes: The graph presents the average annual log changes across 25 EU countries that conducted the WDN survey. The figures are employment-weighted.

But this aggregate picture hides a large degree of heterogeneity across countries with regard to the way firms adjusted their real labour costs. Figure 2 depicts the decomposition of real labour costs into the same three main components country by country. First and foremost, the choice of adjustment channels for labour cost reductions is influenced by the severity of the shock, but even for countries experiencing GDP drops of similar magnitude (as well as having a similar institutional environment) the aggregate adjustment can differ. For example, a decomposition of changes in aggregate labour costs for the Baltic States – Estonia, Latvia and Lithuania – in 2008-2009 shows that all three channels of adjustment were used in Latvia, whereas in Lithuania real wages and employment were reduced and in Estonia the adjustment mainly occurred through the reduction of employment and hours. In 2010-2013, which was the period of economic recovery in the three Baltic States, labour cost adjustment was also different across countries. In Latvia and Lithuania employment declined slightly and real wages increased, while in Estonia it was the other way around.

This suggests that not only the intensity of the crisis but also other determinants played a role. Izquierdo *et al.* (2017), analysing the group of countries surveyed by the WDN, point to a range of factors determining the heterogeneity of the response of the unemployment rate to GDP changes in the context of Okun's law. These factors also explain the causes of the different paths of wages, employment and hours across countries. Apart from the various degrees of business cycle synchronisation in some of the EU regions, they also refer to differences in the sectoral structure of these economies, as well as the institutional environments conditioning wage, employment and hours adjustment. All these factors are likely to influence the speed at which shocks are propagated through the economy, their persistence and also the way real labour costs are adjusted. Taking the example of the Baltic States, the more similar adjustment of employment and wages in the cases of Lithuania and Latvia could result from a relatively higher trade union representation there, compared to the more

flexible Estonian labour market where the Employment Protection Legislation index has also declined remarkably since 2008.

Figure 2: Wage bill decomposition in 25 EU countries covered by the WDN survey



Source: Eurostat
Notes: Period I refers to 2008-09; Period II refers to 2010-13.

Most of the Southern European countries - Cyprus, Greece, Italy, Portugal, and Spain - experienced two negative shocks to GDP, the first (rather moderate) in 2008-2009 and the second (stronger and more persistent) in 2011-2013. Real wages increased in all these countries in 2008-2009, but the changes in hours and employment varied, both in terms of the composition of adjustment channels as well as the magnitude of the adjustment. In the first period, the most significant employment reduction occurred in Spain, where it was combined with some working hours reduction. By contrast, all Southern European countries experienced substantial declines in real wages and employment in 2010–2013, which was, to certain extent, the effect of the introduction of different labour market reforms at the national level. Nonetheless, hours worked only fell significantly in Italy, although the reforms in Portugal and Spain were also aimed at increasing the flexibility of working hours (Izquierdo *et al.* 2017). Perhaps this was due to trade union representation being strongest in Italy, which favoured reducing hours to save jobs.[2]

Several countries that experienced milder negative shocks than the two groups discussed above reacted to the economic decline in 2008-2009 by only adjusting hours downward at the aggregate level, whereas real wages and employment either stayed constant or increased. The countries that reacted to the Great Recession in this manner were e.g. the Czech Republic, Slovakia, Germany, Austria, Belgium, the Netherlands, and to a lesser extent also Malta and France. This particular pattern of adjustment was the consequence mainly of a relatively shallow or short-lasting recession in

[2] According to OECD the trade union density in Italy increased even from 34.7% in 2009 to 36.8% in 2013, compared to ca. 17% in Portugal (2014), 15.6% in Spain (2013) or 24.7% in Greece (2013).

this group of countries but also of a specific institutional environment. In most of these countries trade unions and collective bargaining mechanisms were still important and in some of them (e.g. Germany and Austria) the hours reduction was subsidised for companies at that time (the so-called 'Kurzarbeit' schemes). In general, Central European Economies were characterized by a common timing of the shocks, but differed significantly with respect to the depth of the shock, as well as the composition of adjustment. While the recession was the strongest in Hungary, Polish GDP continued to grow during the whole period of observation. In both of these countries the reduction of working hours was rather a marginal channel of labour cost adjustment.

The overall decomposition of real labour cost changes for each country illustrates how the labour market responses differed across countries in the survey (Figure 2). Of course, the question remains to what extent these differences result from different shocks in the countries, different timing of the shocks, different labour market institutions across countries that might constrain the choice of adjustment channel, or different responses over time. By using our survey data, we are able to isolate the responses of firms to each shock in each country and quantify the real impact of particular factors.

3. Shocks and adjustment: Literature review

There is extensive literature dealing both with economic shocks per se (Reinhart and Rogoff, 2014; Reinhart and Rogoff, 2009; Boorman *et al.*, 2000) as well as with labour market adjustment to those shocks. Although there is a common consensus about the large cross-country heterogeneity in labour market outcomes in recessions (ECB, 2014; OECD, 2010), research varies strongly in identifying the main causes of this heterogeneity. They also tend to emphasize different aspects of the adjustment processes in labour markets.

Nonetheless, it is customary to divide labour market adjustment into three main channels i.e. wages, employment and hours, a strategy also applied in this paper. Erken *et al.* (2015) in their cross-country macroeconomic analysis of the Great Recession emphasise the existence of a trade-off between these three channels, while at the same time distinguishing three groups of selected developed countries characterised by a relatively similar pattern of response to shocks. According to them real wage adjustment dominated in the first group (the United Kingdom, the United States and Germany) and was accompanied by a low level of long-term unemployment. The second group (the Netherlands, France, Czech Republic, Belgium, Sweden, Switzerland, Denmark, Finland, Japan, Canada and Norway) experienced hardly any real wage adjustment and somewhat higher levels of unemployment as a consequence of adjustment at the extensive margin. The third group (Italy, Spain and Ireland) experienced a large deviation of wage costs from productivity and a high level of long-term unemployment. Eichhorst *et al.* (2010) take into account two additional adjustment channels related to functional or qualitative adjustment, i.e. by improving the internal (across production processes) or external (across sectors or occupations) reallocation of resources. Roys (2016) uses a dataset of French enterprises and argues that adjustment costs may dampen this reallocation. According to him removing adjustment costs should lead to productivity gains, but this institutional change would be

more influential when shocks are purely transitory.[3] Transitory shocks would lead to more misallocation due to obstacles to adjustment than permanent shocks.

There is no one universal conclusion concerning the way in which various types of shocks may determine differences in adjustment strategies between firms and in particular their choice of adjustment channels. While some argue that wages are changed more often in case of transitory shocks and permanent shocks have a stronger effect on employment (Roys, 2016), others stress the importance of wage rigidity and provide evidence that nominal wages are rarely adjusted downward. According to the latter strand of literature if the shock is temporary, firms are less likely to cut wages than if they perceive the shock as permanent (Guiso, Pistaferri and Schivardi, 2005; Sanchez-Romeu and Rattia-Lima, 2013; Kwapil 2010).

There is a long literature on the effects of labour adjustment costs. In particular, Nickell (1986) discusses the literature up to that point on dynamic models of labour demand and how firms adjust employment and/or wages in the presence of concave, linear, or more general labour adjustment costs. Van Wijnbergen and Willems (2013) and Pfann and Palm (1993) indicate that in the presence of labour adjustment costs employers respond sluggishly to shocks, as the positive option value to waiting induces them to gather more information on the nature of the shock. As a result the labour input cycle lags the business cycle. Carlsson *et al.* (2014) constrain their analysis only to employment changes in Swedish manufacturing firms. Similar to Guiso and Pistaferri (2005), they conclude that Swedish firms' responses to transitory demand shocks are heavily muted, because they adjust employment only in response to long-lasting shocks.

Apart from the nature of shocks, the choice of adjustment strategies may also be influenced by institutional framework, and in particular the presence of collective bargaining mechanisms, as well as the activity of trade unions. Holden (2004) argues that unionisation and firing costs increase workers' bargaining power, thus increasing downward nominal wage rigidity. Yamane (1993) emphasises that the consequences of shocks on employment may be more persistent in more unionized labour markets, a result that follows from the wage rigidity theory of unions.

Our analysis starts from the recent papers of Fabiani *et al.* (2015), Kwapil (2010) and Lünnemann and Mathä (2011), who use a previous wave of the WDN survey to analyse firms' responses during the initial phase of the financial crisis in nine EU countries, Austria and Luxembourg, respectively. They found that firms that adjusted labour costs did so by adjusting labour quantities; cuts to base wages almost never happened, except in the highly flexible labour market of Estonia. They found that 'efficiency wage' theories, based around lower worker effort and morale and adverse selection in quits (i.e. the best workers leave in response to wage cuts) explained why there was so much reluctance among employers to cut wages. There was also some evidence that collectively bargained wages were less likely to be cut, even when the agreement did not itself pose any legal obstacles to wage cuts. In terms of adjusting labour market quantities, firms primarily responded to the crisis by

[3] Some papers distinguish additionally between hiring costs and net costs of employment, which in different ways influence the adjustment of firms' labour demand (Hamermesh and Pfann, 1996; Pfann and Palm, 1993). We do the same in our theoretical framework, outlined below.

laying off temporary employees, particularly in those countries where such employees formed a relatively larger proportion of employed workers, and reducing hours worked, particularly in those countries where there were government funded short-time work schemes. Firms only laid off permanent employees as a last resort, although this was more likely in companies with labour-intensive production technologies and/or firms employing a high share of young or low-skilled employees. A key difference between their work and ours is that they were examining only how firms adjusted to a common negative demand shock. In the period we are considering, i.e. 2010-2013, different firms had very different experiences with some experiencing positive shocks and some negative shocks, and some experiencing demand shocks while others were experiencing external financing shocks. And of course, the different countries of our sample performed very differently over this period with some experiencing a strong recovery while others were seeing a worsening of the recession that had begun with the financial crisis and was exacerbated by the European sovereign debt crisis.

4. Labour cost adjustment: Theoretical framework

Inspired by the basic model of labour adjustment costs discussed in Nickell (1986), we organise our thoughts and develop a simple model to help us understand how firms might use different methods of adjusting their labour input and labour costs depending on the source and direction of shocks affecting them. The basic intuition is that, in response to shocks affecting their activity (to use the words of the WDN survey question), firms will adjust labour costs in the cheapest possible way. So, the margin of adjustment used will depend on the respective costs of using that margin of adjustment.

In the simple model, we try and capture the main costs associated both with the ongoing use of employees and hours and the costs of changing employment, hours and wages. Clearly, firms have to pay the wages of employed workers. Typically, these consist of a standard hourly wage, W, up to a standard number of hours worked, which we denote $\overline{h}$, and a higher 'overtime' wage, $(1+\gamma)W$, for each hour worked in excess of $\overline{h}$ (we assume that $\overline{h}$ is given 'off model' and assume that initially – i.e. before any shocks arrive – all workers are working $\overline{h}$ hours). Firms typically also have to pay 'overheads' for each worker they employ, covering such things as administrative and legal costs. In our simple model, we assume a fixed cost of χ per worker employed.

Hiring new workers is costly for firms as they have to spend money on recruitment and training. In our simple model, we denote this cost as ϕ per worker hired. But, firing is also costly, as firms typically have to give workers redundancy notices and/or payments. And, in some countries, where firms wish to make collective layoffs, they have to go through a complicated and costly process for the layoffs to take place. In our simple model, we denote this cost as φ per worker fired.

Finally, to capture the possibility of downward nominal wage rigidity, we suppose that firms have to pay a cost $\eta\Delta W$ in order to reduce wages by ΔW. This cost captures all the well-known reasons for the reluctance of firms to cut wages suggested by efficiency wage theories: e.g. the effects of wage cuts on general morale, which may induce the better workers to leave the company, and the effects of

wage cuts on effort, i.e. the increased incentive to shirk.[4] As these issues are not relevant for the case of wage increases, we assume that firms do not have to pay any cost to raise wages.

We consider the problem faced by a firm that uses only labour to produce output according to a production function, $y = ANh^{\alpha}$ where $\alpha < 1$. Here, y denotes output, A denotes a productivity shock, N denotes employment and h denotes average hours worked. As can be seen, there are constant returns to scale in employment but decreasing returns to hours worked. Finally, we assume that firms have to borrow to finance their wage bill and the fixed costs of employing workers, proxying the need for firms to borrow for 'working capital' purposes and using their revenues accrued at the end of the period to pay back these loans with interest (at a net interest rate of i). In addition, firms have to borrow to finance the costs of hiring new workers.

Putting this all together, and denoting the firm's selling price by P, we can write its profits as:

$$\begin{aligned}\Pi = PANh^{\alpha} - (1+i)\left(WNh + \gamma WN\left(h-\bar{h}\right)I\left(h>\bar{h}\right) + \chi N\right) \\ - \varphi\Delta NI(\Delta N<0) - (1+i)\phi\Delta NI(\Delta N>0) - \eta\Delta WI(\Delta W<0)\end{aligned} \tag{1}$$

where $I(\bullet)$ is an indicator function taking the value 1 if the expression inside the brackets is true and 0 otherwise.

Now, we are interested in how firms adjust their labour costs in response to a shock. So, suppose that demand for the firm's product falls by x%. The production function tells us that, in order to ensure that supply equals demand, the firm could cut employment by x% or could cut hours by $\frac{x}{\alpha}$%. Alternatively, the firm could 'hoard' labour: that is, it could keep the same labour input while reducing wages by $\frac{W\bar{h}+\chi}{(1+i)W\bar{h}}x$% to reduce costs by the same proportion as the reduction in revenue.

Now, if the firm responds to the shock by reducing average hours, the reduction in its costs will equal $\frac{(1+i)WN\bar{h}}{\alpha}x$. If, on the other hand, the firm responds by reducing employment, the reduction in its costs will equal $\left((1+i)\left(W\bar{h}N+\chi N\right)-\varphi N\right)x$. Finally, if the firm responds by reducing wages while keeping labour input constant, the reduction in its costs will equal $\frac{\left((1+i)N\bar{h}-\eta\right)\left(W\bar{h}+\chi\right)}{(1+i)\bar{h}}x$.

Putting this together allows us to derive the following proposition:

Proposition 1

A firm will respond to a reduction in demand by lowering employment rather than average hours if $(1+i)\chi > \frac{1-\alpha}{\alpha}(1+i)W\bar{h}+\varphi$ and will lower average hours rather than employment if the opposite is the case.

[4] These theories are strongly supported by the evidence of the first WDN wage-setting survey reported in, eg, Babecký *et al* (2010), Fabiani *et al.* (2015), Kwapil (2010), Lünnemann and Mathä (2011)).

A firm will respond to a reduction in demand by lowering employment rather than wages if $\eta > (1+i)\bar{h}N\left(\frac{\varphi}{W\bar{h}+\chi} - i\right)$ and will lower employment rather than wages if the opposite is the case.

Finally, a firm will respond to a reduction in demand by lowering average hours rather than wages if $\eta > \frac{(1+i)N\bar{h}}{\alpha(W\bar{h}+\chi)}\left(\alpha\chi - (1+i-\alpha)W\bar{h}\right)$ and will lower wages rather than average hours if the opposite is the case.

Proof

Follows from a straightforward comparison of the reduction in costs resulting from each adjustment strategy, as laid out above.

Consider first the decision over whether to lower employment or average hours. Proposition 1 suggests, intuitively, that if the fixed costs associated with employing workers, χ, are high and firing costs, φ, are low, then firms will respond to falls in demand by reducing employment and *vice versa*. Reducing hours means that the fixed employment cost is spread over a smaller labour input and so becomes larger per hour of labour input; in other words, these fixed costs effectively represent the cost of reducing hours. Next, consider the decision over whether to lower employment or wages. Proposition 1 suggests that the key to this decision is the relative size of the fixed costs of changing employment, φ, and wages, η. The larger is the cost of changing wages (the degree of downward nominal wage rigidity), the less likely are firms to change wages rather than employment. Finally, consider the decision over whether to lower hours or wages. Proposition 1 suggests that this decision depends crucially on the relative sizes of the cost of adjusting wages, η, and the fixed costs associated with employment, χ. The higher are these fixed costs, the more costly it is to reduce hours – for the same reasons as outlined above – and so the more likely firms are to cut wages.

Next we consider a positive demand shock, where the demand for the firm's product rises by x%. If the firm responds to the shock by increasing average hours, the increase in its costs will equal $\frac{(1+i)(1+\gamma)WN\bar{h}}{\alpha}x$. If, on the other hand, the firm responds by increasing employment, the increase in its costs will equal $(1+i)(W\bar{h}N + \chi N + \phi N)x$.

Putting this together allows us to derive the following proposition:

Proposition 2

A firm will respond to an increase in demand by raising employment rather than raising average hours if $\chi + \phi < \frac{(1+\gamma-\alpha)}{\alpha}w\bar{h}$ whereas it will increase average hours if the opposite is the case.

Intuitively, as long as the cost of employing an additional worker is small enough relative to the cost of paying workers to work overtime, adjusted for the decreasing returns to the additional hours, then

firms will respond to demand increases by increasing employment rather than hours and *vice versa*. The cost of employing an additional worker will equal the sum of the hiring cost and the fixed employment cost.

But, what about changes in wages in this case? Whichever method of increasing labour input the firm decides to use, it is likely that it will need to pay a higher wage in order to increase its labour input. Alternatively, if firms sought to choke off some of the extra demand by raising their prices, the marginal revenue product of their workers will still have increased, again implying a need to increase wages. On the other hand, raising wages will be costly to the firm as doing so will reduce the firm's profits. So, given a positive demand shock, whether raising wages or raising employment would be the preferred adjustment mechanism would depend on the ability of the firm to attract new workers without paying a higher wage. Similarly, whether raising wages or raising hours would be the preferred mechanism would depend on the ability of the firm's workers to bargain for higher wages.

Next, we consider a shock to firms' ability to access external financing. Within the model, this is proxied by the interest rate, *i*. An increase (decrease) in *i* will increase (reduce) costs, leading firms to reduce (increase) output. Whether they do this by adjusting hourly wages, hours or employment involves the same calculus as above. In other words, Propositions 1 and 2 apply equally for reductions/increases in output that are driven by reductions/improvements in firms' ability to access external financing. Finally, a shock to the availability of the firm's inputs, what we think of as a 'supply' shock, will again affect their non-labour costs leading to the same need to adjust labour costs. But the calculus as to which aspect of labour costs to adjust – hourly wages, employment or hours – would be unchanged.

To summarise this section, the most likely adjustment strategy of firms will depend on the relative costs of adjusting hourly wages, employment and hours. The cost of adjusting wages downwards depends on the degree of downward nominal wage rigidity. Intuitively, we might imagine that downward nominal wage rigidity might be more of an issue in firms that were bound by collective wage agreements, firms in which bonuses and other flexible pay components were less important and firms in those countries with generally less flexible labour markets. That said, downward nominal wage rigidity also results from the effects of wage cuts on morale and effort, factors that are likely to affect all firms. The cost of adjusting hours downwards depends on the fixed costs associated with employing workers; the higher are these fixed costs, the higher the cost of reducing hours. This is likely to be more of an issue in larger firms and firms in those countries where the regulatory burden faced by firms is higher. The cost of adjusting hours upwards depends on overtime payments – again, likely to be higher in those firms facing collective wage agreements, heavily unionised firms and firms in those countries in which there are stringent regulations governing hours worked. Finally, the cost of adjusting employment downwards will depend on the extent of employment protection legislation faced by the firm while the cost of adjusting employment upwards will depend on the ease of recruiting workers – which is likely to be cyclical – and the costs of training them, which is likely to depend on the extent to which the firm uses skilled labour.

In what follows, we seek to use the WDN survey to assess the relative importance of these costs and the extent to which cross-country differences in adjustment mechanisms can be explained by differences in labour market institutions.

5. Data, firm-level and macro statistics

5.1. WDN data

This paper uses results from a survey of firms in EU countries carried out under the aegis of the WDN, a research network set up by the ESCB. The survey covers about 25,000 firms in 25 countries and was carried out in 2014-2015.[5] The aim of the survey was to collect information on firms' general wage-setting practices (most of which is not available from other sources) together with how they set their labour input and wages in response to the shocks that have been affecting them over the recent years.

For this purpose, the WDN developed a harmonised questionnaire. It contained core questions asked in all countries and non-core questions covered by only a subset of countries. In addition, national central banks were free to ask purely national-specific questions. The questionnaire contains five separate sections. Section 1 of the questionnaire collects basic structural information about the firm. This information provides variables for the descriptive statistics and covariates regarding differences in firm structures for regression analysis. Section 2 of the questionnaire asks firm managers to assess the main changes in the firms' economic environment during the period under investigation. Section 3 addresses firms' labour cost adjustments. Section 4 collects information on wage setting and the frequency of wage changes. Finally, Section 5 (which contained only non-core questions) collects information on firms' price setting behaviour and the frequency of price changes.

The questionnaire collected firm characteristics as well as qualitative views on economic shocks and firms' adjustment responses. A set of detailed questions asked how firms' activity was affected by various factors, in particular, the level of demand, the volatility/uncertainty in demand, access to external financing, customers' ability to pay and to meet contractual terms and the availability of supplies from the firm's usual suppliers.[6] Questions were designed to limit the response burden, for example, by requesting mainly qualitative information based on a set of pre-defined answers. Most questions use a 5-point Likert scale with possible answers being "strong decrease", "moderate decrease", "unchanged", "moderate increase" and "strong increase". In our analysis, we aggregate the answers by calculating the weighted net balance between positive and negative answers, whereby the answer categories "strong decrease", "moderate decrease", "unchanged", "moderate increase" and "strong increase" are assigned values -2, -1, 0, 1 and 2, respectively. In other words, "strong" responses receive twice the weight of "moderate" responses. The weighted net balance is then the sum of the values across firms.

5 See Izquierdo *et al*. (2017) for an overview and a discussion of the main results.

6 For the purposes of this paper, we concentrate on shocks to the level of demand, access to external financing, and the availability of supplies.

The core time period under investigation, common to all participating national central banks, was 2010-2013. A subset of eight countries (Bulgaria, Estonia, Germany, Ireland, Latvia, Lithuania, Luxembourg and Poland) also asked questions for the period 2008-2009. The earlier time period can loosely be associated with the initial phase of the economic and financial crisis while the years 2010-2013 capture the period of the European sovereign debt crisis.

The main sectors included in the survey were manufacturing (NACE2: C), construction (NACE2: F), wholesale and retail trade (NACE2: G), business services (NACE2: H, I, J, L, M and N) and financial services (NACE2: K). A few countries also included other sectors (e.g. public sector services and arts), which are however not part of the analysis in this paper. The firms were categorised into the following size classes: "1-4 employees" (micro firms), "5-19 employees" (very small firms), "20-49 employees" (small firms), "50-199 employees" (medium-sized firms) and "200+ employees" (large firms). The final sample size contains 24,869 firms of which we consider 24,106 for our analysis. The sample is post-stratified, so that results are representative of either the target population of firms or the number of employees in the target firm population.

Annex A shows the structure of the dataset with the number of firms reporting the effect of each of the three factors (i.e. the level of demand, access to external financing and the availability of supplies from usual suppliers) on their activity. It also reports the percentage of firms that reported a negative/no/positive impact on their activity. It shows that the number of observations per country ranges from 152 (MT) to 2354 (DE).

5.2 Comparison between macro-level and WDN survey statistics

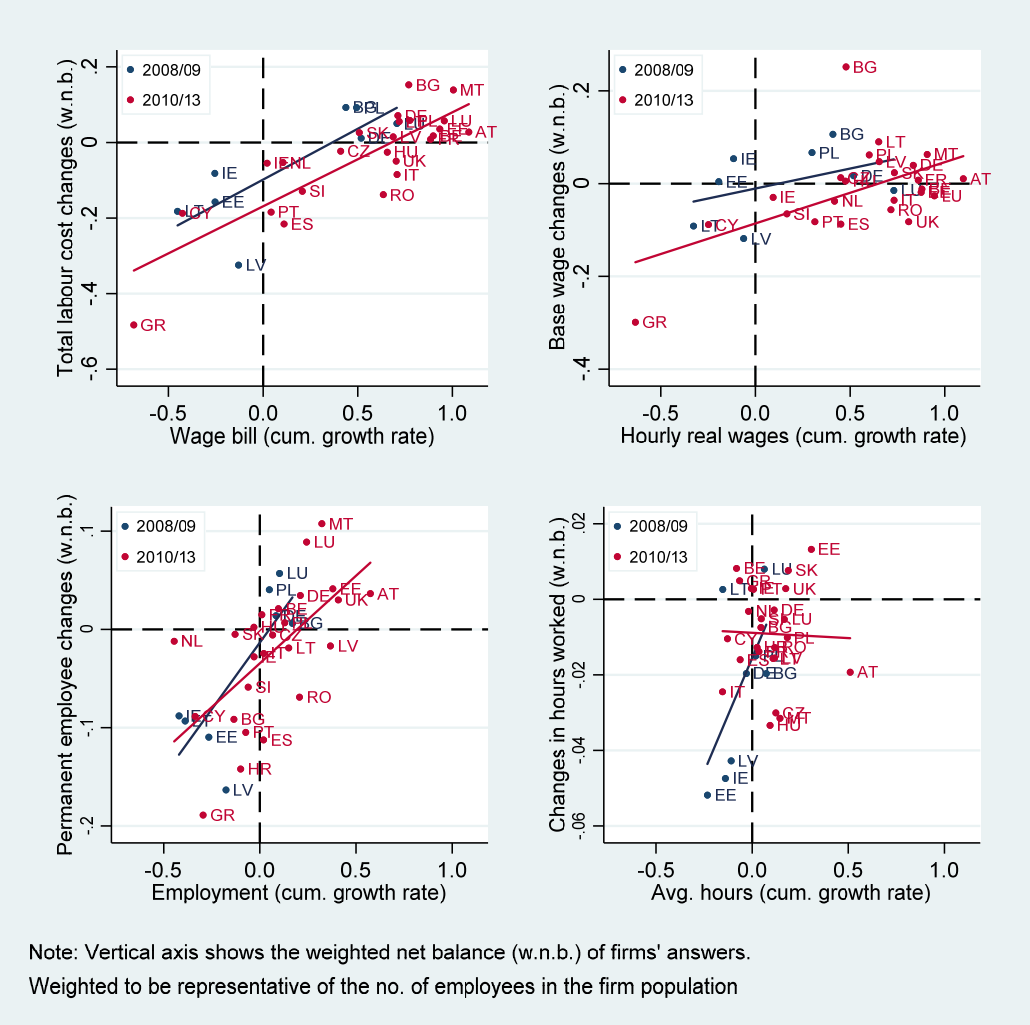
The answers from the surveys provide information on firms' adjustments to various changes in their economic environment that cannot be obtained from any other sources. Figure 3 shows that the survey answers can be linked to macroeconomic outcomes at the country level. This suggests that analysing firm responses to shocks can help us understand macroeconomic developments.

Figure 3 shows that the regularities coming from macroeconomic data, shown in Figure 2, are also apparent in the survey responses. First, the deep recession in the Baltic countries and Ireland in the Great Recession period of 2008-2009 is clearly discernible. The fall in employment, wages and hours is very distinctive compared to other EU countries in the sample in which the wage bill kept growing on balance. This mainly seems to be related to increasing wages. Second, during 2010-2013 the deep recessions in Greece and Cyprus are reflected by the substantial reduction in total labour cost. These changes are mainly related to reductions in employment and wages.

The period 2008-13 saw different countries facing a wide variety of economic outcomes with some recovering strongly from the Great Recession and others experiencing a worsening of their economic conditions as the sovereign debt crisis took hold. This is reflected in firms' answers to the survey. During the period 2010-2013, GDP fell in Croatia, Cyprus, Italy, Portugal, Slovenia and Spain, so we would expect firms in these countries to be more likely to report negative shocks to demand. During

the initial crisis period of 2008-2009, this was the case for the Baltic countries of Estonia, Latvia and Lithuania as well as for Ireland, which encountered a deep drop in GDP.

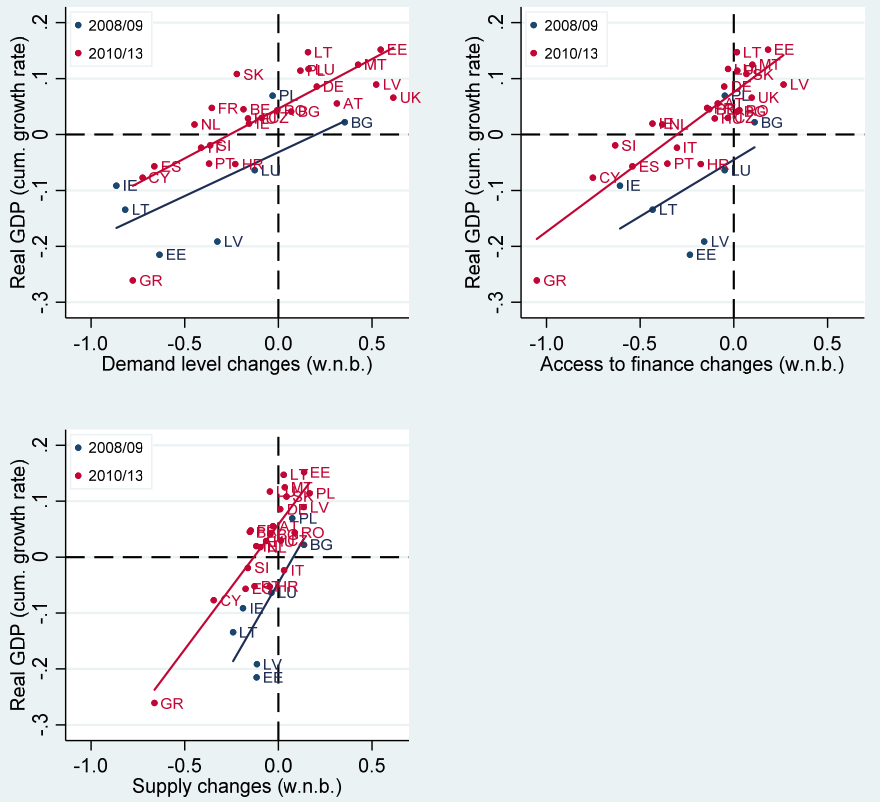
Figure 3: Labour cost changes across countries: Firm-level and aggregate descriptives



Source: WDN3 data, own calculations.

This is backed up by the evidence provided in Figure 4, which relates cumulative GDP growth in the period 2010-13 (2008-09) to the shocks experienced by firms. The figure shows that, on balance, firms in the most negatively affected countries were much more likely to report negative shocks to demand than positive shocks. Strangely, a similar proportion of firms in France and the Netherlands reported a negative demand shock as in some of these countries. While cumulative GDP growth during the period 2010-13 was highest in the Baltic countries, firms in these countries (together with those in Austria, Germany, Hungary, Luxembourg, Malta, Poland and the United Kingdom) also reported more positive demand shocks than negative demand shocks. A similar picture emerges for shocks to access to finance and supply. The correlation coefficients with the log change in GDP are high and range between 0.48-0.79 in 2008-2009 and 0.47-0.88 in 2010-2013.

Figure 4: The relationship between changes in GDP and shocks experienced by firms



Note: Weighted to be representative of the no. of employees in the firm population. Outlier UK excluded in the bottom chart. Horizontal axis shows the weighted net balance (w.n.b.) of firms' answers.

Source: WDN3 data, own calculations.

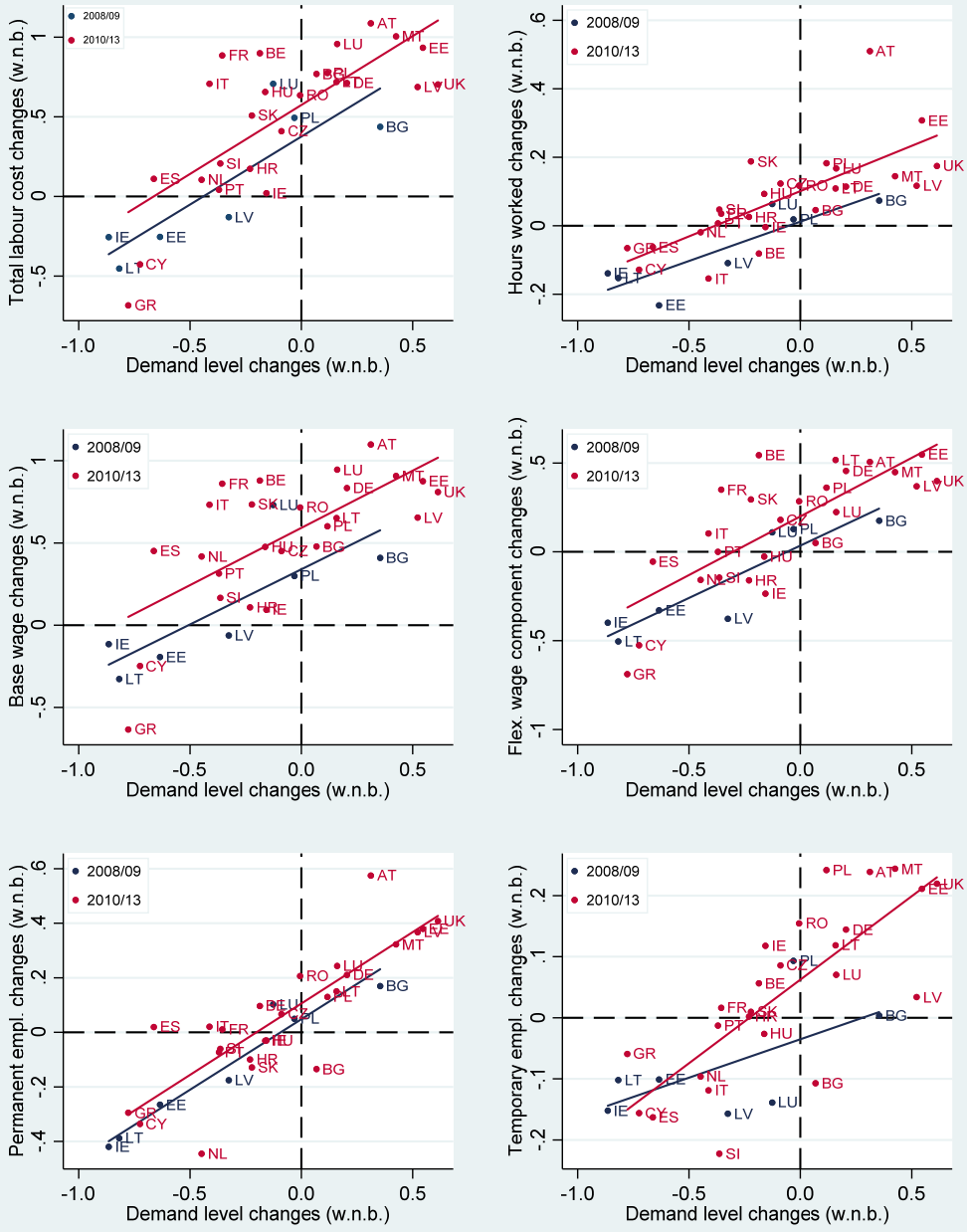
6. Descriptive results from the WDN survey

How do firms adjust their labour costs? And how are these adjustments related to shocks? In this section, we consider how firms have adjusted their labour costs over the past few years in response to particular shocks. Figures 5-7 provide a detailed descriptive illustration. They plot changes in labour costs and their components against various shocks that firms encountered. Labour cost components and shocks are aggregated to country level by using employment weights and, analogously to the preceding section, presented in terms of the (weighted) net balance. Note that the corresponding sub-charts in each of Figures 5-7 are identical with respect to the ordinate and the position of the countries only varies along the abscissa. Note that in each Figure the sub-charts are identical with respect to the abscissa and vary only along the ordinate.

Figure 5 shows the response of labour costs and their components to a demand level shock. First, we can see that only very strong demand shocks trigger reductions in total labour costs. This is the case of Estonia, Latvia, Lithuania and Ireland for the period 2008-2009 and Cyprus and Greece for the period 2010-2013. Figure 5 shows that total labour costs kept increasing in countries with moderate negative demand shocks on balance.

The lack of downward adjustment of total labour costs seems to be related to DNWR, as the second row of Figure 5 shows that many more countries cut employment than base wages. Only the countries that on balance lowered their base wage were able to lower their total labour costs at the same time. DNWR reflects firms' reluctance or inability to cut base wages in response to negative shocks. In several countries, firms suffering from negative demand shocks seem to be subject to a zero lower bound to base wage changes. In contrast, flexible pay components (bonuses) appear less rigid downward, as negative balances are reported for many more countries.

Figure 5: Response of labour costs to demand shocks

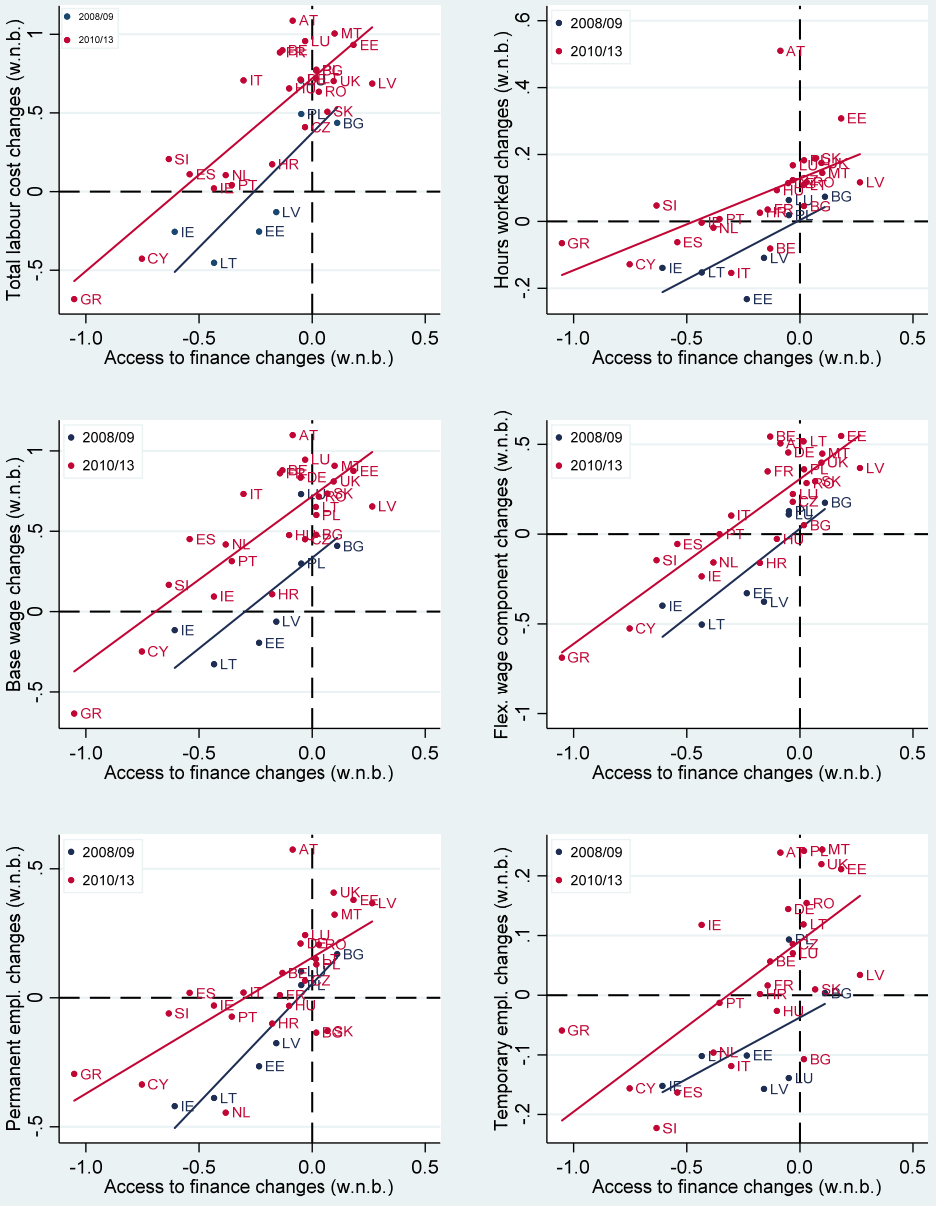


Note: Both axes show the weighted net balance (w.n.b.) of firms' answers.
Weighted to be representative of the no. of employees in the firm population

Source: WDN3 data, own calculations.

Employment changes are much more responsive to negative shocks than base wages, be it permanent or temporary employment. This finding extends to hours worked. Except for base wages, all these other labour cost components pass very closely to the point of origin.

Figure 6: Response of labour costs to access to finance shocks



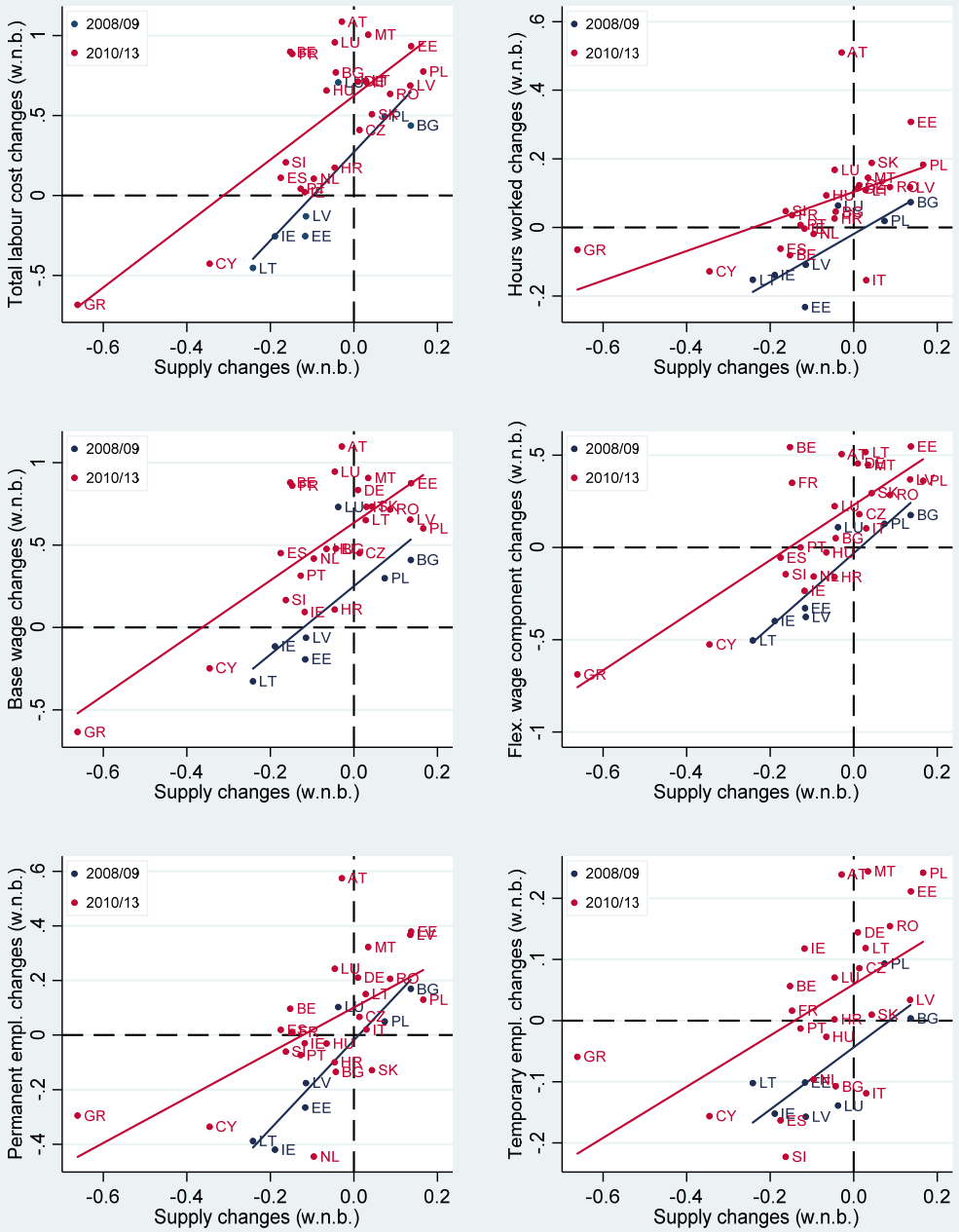
Note: Both axes show the weighted net balance (w.n.b.) of firms' answers.
Weighted to be representative of the no. of employees in the firm population

Source: WDN3 data, own calculations.

Figure 6 shows that, in 2010-2013, problems with access to external finance were most likely to be reported by firms in Greece, Cyprus, Slovenia, Spain, Ireland, the Netherlands, Portugal, Italy and Croatia (in decreasing order), whereas in 2008-2009 it was mainly firms in the Baltic countries and Ireland reporting negative shocks to access to external financing. The negative impact of access to

finance on firms could be related to deteriorating financing conditions of firms in the countries hit by the sovereign debt crisis. For the remaining countries, the balance between positive and negative replies is either close to zero or positive. Firms in Malta, Estonia, Slovakia and Latvia were least likely to report a negative shock to their ability to access external finance in 2010-2013.

Figure 7: Response of labour costs to 'availability of supplies' shocks



Note: Both axes show the weighted net balance (w.n.b.) of firms' answers. UK excluded as an outlier.
Weighted to be representative of the no. of employees in the firm population

Source: WDN3 data, own calculations.

Figure 7 shows that firms in Cyprus and Greece were on balance by far the most likely to be affected by a reduction in the availability of supplies in 2010-13 whereas in 2008-2009 the Baltic countries and Ireland were on balance most negatively affected. Again, this is in line with what might have been expected, given the macroeconomic performance of these countries (see Figure 3). The UK firms stand out with a large number reporting a positive shock to the availability of their inputs and therefore this country was excluded from the individual scatter plots in Figure 7.[7]

Summing up the descriptive evidence presented so far, firms appear likely to respond to negative shocks by cutting employment rather than base wages. In terms of the framework developed in Section 3, this suggests that the costs associated with cutting wages are large relative to those associated with reducing employment. In other words, downward nominal wage rigidity is an important feature of European labour markets that influences the choices of adjustment channels in response to shocks.

7. Econometric analysis

7.1. Estimation methodology

Having presented descriptive evidence, in this section we first examine econometrically the determinants of different channels for adjusting labour costs in response to shocks and then explore in more detail adjustment via changes in the different components of employment (permanent versus temporary employment) and wages (base wages versus flexible wage components). To assess the adjustment strategies of firms during the crisis we proceed in three steps.

In the *first step*, we run the following multinomial logit model for each country and period, separately for positive and negative shocks:

$$\eta_{ij} = log\frac{\pi_{ij}}{\pi_{iJ}} = \alpha_j + x'_i\beta_j, \text{ where } \pi_{ij} = Pr\{Y_i = j\}. \quad (2)$$

Y_i is a multinomial response variable for firm i that depends on a set of k explanatory variables included in the vector x_i. Y_i may take one of eight discrete values, which we index by $j = 1, 2, \ldots J$. In our case, the outcome variable Y_i is the adjustment of each firm in terms of cutting or increasing its wages (w), employment (l), hours (h) or any combination of them, or no adjustment at all (i.e. the possible values are 0, w, l, h, wl, wh, lh, wlh).[8] π_{ij} is the probability that the response of the ith firm falls in the jth category (adjustment strategy). Since the response categories are mutually exclusive

[7] When we dug deeper into the UK data, we found that this strong increase in the availability of inputs was most marked among smaller and medium-sized firms. This is suggestive that suppliers – particularly those supplying smaller and medium-sized firms – were hit particularly hard during the recession. Hence, as they recovered coming out of the recession, the firms they supplied to saw a strong increase in the availability of supplies. Those firms that reported a strong change in economic conditions also tended to think these changes were partly or fully permanent. That said, the result still looks highly unusual when compared with other countries, which was why we excluded the United Kingdom from Figure 7.

[8] When modelling responses to positive shocks, we consider only increases of labour market outcomes as adjustments. For instance if a firm cut wages following a positive shock, it would be treated as no adjustment in terms of wages in the model with positive shocks. Responses to negative shocks are modelled in the same manner.

and exhaustive, we have $\sum_{j=1}^{J} \pi_{ij} = 1$ for each *i*, i.e. the probabilities add up to one for each firm, and we have only *J-1* = 7 parameters.[9]

In equation (2), α is a constant and β_j is a vector of regression coefficients with *j* going from 1 to 7 and no adjustment being the base category. The matrix of explanatory variables **X** includes shock dummies equal to 1 if the firm faced a negative/positive shock (the three shocks – s1, s2, s3 -- considered separately)[10] and sector (sec) and size class (size) dummy variables. Formally, **X** = {*s1*, *s2*, *s3*, *sec1*, *sec2*, … *sec5*, *size1*, …, *size5*}.

In the *second step*, we use the estimated coefficients of equation (2) to calculate the predicted probability of adjusting via each of the eight margins (0, *w*, *l*, *h*, *wl*, *wh*, *lh*, *wlh*). From equation (2) we can derive the predicted probability as:

$$\pi_{ij} = \frac{exp\{\eta_{ij}\}}{\sum_{k=1}^{J} exp\{\eta_{ik}\}} \tag{3}$$

The conditional probability of outcome *j* given that firm *i* experiences only one shock at a time is then calculated as the predicted probability using the estimated β-coefficients from the first step with the subset of shock dummies in the matrix **X** set to the following three values $s^a = \{1, 0, 0\}$, $s^b = \{0, 1, 0\}$, $s^c = \{0, 0, 1\}$, where *a* to *c* denote the three shocks considered. In other words, we calculate what would be the probability of adjusting via each adjustment channel if the firm experienced only one particular shock. By doing so, we avoid the possibility that the results could be driven by correlation between shocks.[11]

Finally, in the *third step*, for presentational purposes, we aggregate the adjustments to the three main channels, i.e. wages, labour and hours and we infer the ranking of the probability of the three adjustment strategies for each shock, country and period.

7.2. Negative shocks and responses of employment, hours and wages

In the first step, we estimate the predicted probabilities of adjustment from equation (2) for each country, each sample period and for negative and positive shocks separately. In the second stage, we aggregate the adjustments into three main channels (wages, employment and hours) in addition to the "no adjustment" response. Thereafter we rank the channels in descending order on the basis of the probabilities of adjustment of labour costs. Given that there are three main channels of adjustment, - employment (*l*), hours (*h*) and wages (*w*) – disregarding the probability of no adjustment, there are six possible options for the ranking of these three channels: 1) labour–wages–hours (*l w h*); 2) labour–hours–wages (*l h w*); 3) wages–labour–hours (*w l h*); and 4) wages–hours–labour (*w h l*), 5) hours–labour–wages (*h l w*) and 6) hours–wages–labour (*h l w*).

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[9] The multinomial logit model comes with an underlying assumption called the independence of irrelevant alternatives (IIA), stating that any item added to the set of choices will decrease all other items' likelihood by an equal fraction. In other words, the odds of choosing A over B should not depend on whether some other alternative C is present or absent. We have performed the Hausman-McFadden test for IIA and found overwhelming support for the IIA in our data.

[10] Recall, the three shocks considered are: demand, access to finance, and availability of supplies.

[11] Purely descriptive results nevertheless look very similar.

"No adjustment" is the most common response to a negative shock (even a strong one) except for a demand shock. Annex B shows the predicted probabilities from equation (2) aggregated for the three main adjustment channels. More specifically, Table B.1 lists the predicted probabilities from a model considering moderate or strong negative shocks in 2010-2013. The table reveals a striking difference between the response to a negative demand level shock and the remaining negative shocks. In particular, following a negative (moderate or severe) demand shock, the most likely response in approximately half of the countries in the sample is no adjustment and for the remaining half cuts in employment. In response to the other two shocks, the most likely outcome is no adjustment (with only one exception). Employment adjustment is the most likely response after no adjustment with a few exceptions. It could nevertheless be that the negative demand shock experienced during the period was stronger than the other shocks. In Table B.2, we focus only on *strong* negative shocks in 2010-2013. As expected, the likelihood of no adjustment is now lower than in Table B.1, which combined both moderate and strong shocks (again with a few exceptions). The asymmetry between the negative demand shock and the remaining shocks remains – following a strong negative demand shock, the no adjustment strategy has the highest likelihood in only three countries (BG, EE, PL) while for the other two shocks, the most likely outcome is no adjustment (in 17 countries out of 24).

Table 1: Labour market responses to different *negative* shocks

		2010-2013				2008-2009			
		strong and moderate shock		strong shock		strong and moderate shock		strong shock	
Shock type	Strategy	Countries	(%)	Countries	(%)	Countries	(%)	Countries	(%)
Demand level	l w h	17	74	15	63	3	43	3	60
	l h w	4	17	5	21	1	14	0	0
	w l h	2	9	4	17	3	43	2	40
Access to finance	l w h	17	74	18	75	4	57	0	0
	l h w	5	22	2	8	0	0	0	0
	w l h	1	4	3	13	2	29	4	80
	w h l	0	0	0	0	0	0	1	20
	h l w	0	0	1	4	0	0	0	0
	h w l	0	0	0	0	1	14	0	0
Availability of supplies	l w h	15	65	12	50	1	14	2	40
	l h w	5	22	5	21	1	14	0	0
	w l h	2	9	5	21	3	43	3	60
	w h l	0	0	1	4	0	0	0	0
	h l w	1	4	1	4	0	0	0	0
	h w l	0	0	0	0	2	29	0	0

Note: MT excluded due to a small number of observations. Countries for which model (1) was not reliably estimated (no convergence, determined outcomes) are excluded. Ties between strategies are split. The percentages might not sum to 100% due to rounding.
Source: WDN3 data, own estimations.

Table 1 presents, for each type of negative shock, the number and share of countries for which the given adjustment ranking was the most common. In 2010-2013, the dominant adjustment pattern following negative shocks was "labour–wages–hours" in descending order, meaning that cutting employment had the highest predicted probability in most countries, cutting wages had the second highest probability and cutting hours ranked last. At least one half of the countries had this adjustment ranking following a negative shock in 2010-2013. The second most commonly observed ranking of

adjustment channels was "labour–hours–wages". This implies that cutting employment was the most likely response to a negative shock in 2010-2013, independently of the type of the shock or the country in our sample. Other adjustment strategies were rarely used following a negative shock.

In terms of our analytical framework, this result suggests that the costs of adjusting employment downwards are smaller than the costs of adjusting either wages or hours downwards. That is, the fixed costs of employment, which effectively act as a cost of reducing hours are large enough relative to firing costs that firms find it cheaper to lay off workers than to reduce their hours. Similarly, the costs of reducing wages – e.g. the effects of wage cuts on general morale, which may induce the better workers to leave the company, and the effects of wage cuts on effort, i.e. the increased incentive to shirk – are large enough relative to firing costs that firms find it cheaper to lay off workers than to reduce their wages. In addition, the result that the responses are independent of the type of shock is in line with what our simple model would predict.

Table 2 lists countries according to their adjustment strategy following a moderate or strong negative shock in 2010-2013. It shows that countries with very different labour market institutions often have the same ranking of adjustment strategies. Considering for instance the negative demand shock, we find the same adjustment strategy for both countries with relatively liberal labour markets (such as Estonia or the United Kingdom) and more regulated labour markets (e.g. France). This indicates that despite differences in the institutional framework the *relative* costs of adjusting via different channels – which is what matters for firm responses according to our simple model – were similar in the EU countries in the sample. In other words, although wages are more flexible in Latvia than in France, for example, it is still relatively more costly to adjust them downwards than to adjust employment.

Table 2: Adjustment strategies in response to moderate or strong negative shocks in 2010-2013

Shock	Strategy	Countries
Demand level	l w h	BG, CZ, EE, ES, FR, HR, HU, LT, LU, LV, NL, PL, PT, RO, SI, SK, UK
	l h w	AT, BE, DE, IT
	w l h	CY, IE
Access to finance	l w h	BG, CY, CZ, DE, ES, HR, IE, LT, LU, LV, NL, PL, PT, RO, SI, SK, UK
	l h w	AT, BE, EE, FR, IT
	w l h	HU
Availability of supplies	l w h	BG, CY, CZ, ES, FR, HR, LT, LV, NL, PL, PT, RO, SI, SK, UK
	l h w	AT, BE, DE, IT, LU
	w l h	HU, IE
	h l w	EE

Note: Strong and moderate negative shock combined.

Furthermore, Table 2 documents that for most countries in the sample, the adjustment strategy tends to be the same for different shocks. This would suggest that the type of shock is not the most important determinant of the adjustment strategy in most cases. This result is in accordance with the predictions of our theoretical model, which also indicated that the outcomes are determined by the relative costs of adjusting via different channels, whatever the type of shock that a firm is facing.

We also used the same three-step procedure for the period 2008-2009. However, as the number of countries asking the relevant questions for 2008-2009 is much lower (seven countries in total), the results should be interpreted with caution.[12] Table 3 shows that in 2008-2009, two adjustment strategies were very common: "wages–labour–hours," accounting for approximately one half of all adjustment strategies or 2/3 in the case of strong shocks, and "labour–wages–hours," as in 2010-2013.

Table 3: Adjustment strategies over time in response to negative shocks

	Demand level		Access to finance		Availability of supplies	
Country	08-09	10-13	08-09	10-13	08-09	10-13
BG	wlh	lwh	lwh	lwh	lwh	lwh
EE	wlh	lwh	wlh	lhw	wlh	hlw
IE	lwh	wlh	wlh	lwh	wlh	wlh
LT	wlh	lwh	hwl	lwh	hwl	lwh
LU	lhw	lwh	lwh	lwh	hwl	lhw
LV	lwh	lwh	lwh	lwh	lhw	lwh
PL	lwh	lwh	lwh	lwh	lwh	lwh

Note: Strong and moderate negative shock combined. Different adjustment strategies in different sub-periods highlighted in grey.

In Table 3, we constrain ourselves to the countries for which we have firm-level data for both 2010-2013 and 2008-2009. It shows the adjustment pattern following the same type of a negative shock in 2008-2009 and 2010-2013. It presents a mixed picture with slightly more than half of the adjustments being different between the two periods. Interestingly, countries with "labour–wages–hours" adjustment in 2008-2009 also followed this strategy in the latter period (with one exception). In contrast, "wages–labour–hours" adjustments in 2008-2009 changed into "labour–wages–hours" or "labour–hours-wages" in all cases except for two in 2010-2013.

Several of the countries for which we have comparable data for the two periods experienced deep recessions in 2008-2009, in particular Ireland and the Baltic countries (see Section 2). The study by Branten *et al.* (2018) that also relies on the WDN survey data shows that DNWR is usually strongly prevalent and this constraint on downward wage adjustment is only relaxed during periods of acute crisis (such as the Great Recession in the Baltic States or the sovereign debt crisis in Greece and Cyprus). This evidence is in line with our results, which indicate that typically firms are more likely to adjust employment than wages in response to negative shocks, i.e. wages are more rigid, but in times of strong economic decline the ranking of these adjustment channels switches and firms adjust wages with higher probability than employment.

Given our analytical framework, this suggests that once the shock is large enough then – in the presence of fixed costs – firms might flip from taking one action to taking another action and are in general more likely to use multiple adjustment channels simultaneously. The size and reach of the shock itself might have an impact on the costs of adjustment. For instance, in the face of a global crisis and a deep slump, employees (and social partners and trade unions) might be more willing to

[12] In addition, reliable estimates of model (1) with strong shocks only in 2008-2009 were not obtained for BG and LU.

accept wage cuts than they would be following a moderate shock. Similarly, wage cuts might be easier to implement in the face of an aggregate negative shock that is extensively covered by the media, since the effect of the wage cuts on morale and effort is likely to be lower where workers see general wage cuts affecting everyone, and where the alternative of losing their jobs is more clearly visible.

Furthermore, given that the two periods covered in our sample are very close, we cannot rule out that the reason for changes in the adjustment strategy between the two periods might be related to the fact that some of the adjustment channels (e.g. wage cuts) were "exhausted" already in response to the first shock. This would suggest that the costs of adjustment might be increasing with the size of adjustment that is needed and this non-linear relationship might differ across adjustment channels.

Last but not least, we cannot exclude the possibility that one of the shocks was predominantly seen as temporary and the same shock in the other period as permanent and this could be the reason why the adjustment strategies differ. Unfortunately, we do not have enough observations to compare adjustment strategies of firms facing permanent versus temporary shocks.

7.2.1. The role of labour market institutions in the context of negative shocks

To investigate the role of labour market institutions, we split the countries in the sample according to their level of employment protection legislation (EPL), wage bargaining centralisation and coordination. We take the median EPL across OECD countries and consider countries in the sample with a value of the EPL index above the median as countries with tight labour market regulation. Table 4 lists the average predicted probability of labour market adjustments across countries in each group following a strong or moderate negative shock in 2010-2013.

We expect tighter EPL to make reducing employment more difficult, leading firms to be more likely to adjust hours and less likely to adjust employment. In terms of our simple model, tighter EPL would raise firing costs. Countries with tight EPL indeed show higher likelihood of hours' adjustment following a moderate or strong negative shock.[13] But, contrary to expectations, the average probability of employment cuts is approximately the same following a negative demand and access to finance shock and even higher after an 'availability of supplies' shock. Furthermore, Table 4 shows that the average predicted probability of wage cuts following a moderate or strong negative shock is lower in countries with tight EPL. This finding is in accordance with the theoretical model of Holden (2004), which shows that high firing costs in combination with collective wage agreements increase workers' bargaining power, thus increasing downward nominal wage rigidity.

Table 4 shows that firms in those countries in which wage bargaining takes place predominantly at the firm level (i.e. low centralization) are less likely to cut employment or hours following a negative shock than firms in those countries with more centralized wage bargaining. This is to be expected given the increased wage flexibility that comes with a low degree of centralization or decentralized wage bargaining. The difference is statistically significant following a negative demand shock (based

[13] The differences are statistically significant at the 10% level (using two-sample t-test).

on a t-test) but the same does not hold for all types of shocks. At the same time, firms in those countries with centralized wage bargaining have significantly lower probability of cutting wages after a negative shock. This holds across the three types of shocks considered,[14] however, one has to bear in mind that only two countries in our sample have centralized wage bargaining. A very similar pattern appears when considering the level of wage setting coordination.[15]

Table 4: Predicted probability of adjustment following a strong or moderate negative shock in 2010-2013

		EPL		Wage bargaining centralization			Level of wage bargaining coordination		
Negative shock	Adjustment	Low	High	low	medium	high	Low	Med.	High
Demand	no adjustment	47.5	47.4	59.0[e]	43.9[f]	47.4	52.6	42.9	46.1
	wage cut	22.9	18.1	19.6	20.5	9.0	20.2	20.9	11.1
	labour cut	41.0	41.2	29.3[de]	45.6[f]	43.1[f]	36.8	45.5	44.0
	hours cut	10.6	16.3	10.1[d]	15.9	22.3[f]	11.0[a]	16.7[a]	26.0[cb]
Access to finance	no adjustment	66.8	70.3	72.5	65.4	75.3	67.6	65.6[a]	78.8[b]
	wage cut	11.7	11.0	11.7	12.2[d]	4.8[e]	11.9[a]	13.7[a]	4.4[cb]
	labour cut	24.4	22.3	19.0[e]	27.4[f]	18.7	25.3	24.7	16.7
	hours cut	5.2	7.5	5.9	7.7	7.4	6.7	8.3	6.7
Availability of supplies	no adjustment	76.6	71.6	78.3[e]	70.3[f]	75.3	74.6	70.9	72.7
	wage cut	11.7	8.4	11.1	9.6	4.0	10.9	9.6	3.6
	labour cut	14.6[a]	22.8[c]	13.9[e]	24.5[f]	18.7	19.7	21.9	22.1
	hours cut	3.3[a]	6.6[c]	2.8[de]	6.5[f]	7.0[f]	4.4[a]	6.5	7.7[c]
Countries		EE, HR, HU, IE, SK, UK	AT, BE, CZ, DE, ES, FR, IT, LT, LU, LV, NL, PL, PT, SI	EE, HU, IE, LT, LV, PL, UK	AT, BG, CY, CZ, DE, FR, HR, IT, LU, NL, PT, RO, SK	BE, ES	BG, CY, CZ, EE, FR, HR, HU, LT, LU, LV, PL, RO, UK	DE, IE, IT, NL, PT, SK	AT, BE, ES

Legend: (a) to (f) denotes statistically significant difference at 10% level relative to (a) high, (b) medium, (c) low, (d) centralized, (e) intermediate, (f) decentralized category.

Notes: Reliable estimates of model (1) were not obtained for GR. MT excluded due to a small number of observations. EPL data (OECD) refer to 2013 except for HR (2015) and LT (2014). Data on wage bargaining centralization and coordination are provided by the European Foundation for the Improvement of Living and Working Conditions (Eurofound) and refer to 2013. See https://www.eurofound.europa.eu/observatories/eurwork/collective-wage-bargaining/context, last accessed on 16/02/2018.

Overall, our results suggest that countries with decentralized and/or fragmented wage bargaining systems adjust via wage cuts and are less likely to reduce employment after a negative shock while the opposite is true for more centralized and/or coordinated bargaining institutions. In terms of our simple model, this suggests that the cost of adjusting wages downwards is lower in countries with decentralised and/or fragmented wage bargaining systems. An explanation for this result is provided by the insider-outsider theory, which suggests that insiders are more powerful in coordinated wage bargaining systems and so more able to resist wage cuts; this results in greater downward wage rigidity (Lindbeck and Snower, 1988).

[14] The difference is marginally not significant at the 10% level in case of the availability of supplies shock.

[15] The qualitative results are robust to using an alternative classification of wage bargaining level and wage setting coordination, the ICTWSS 5.1 database, see Visser (2016).

7.3. Positive shocks and responses of employment, hours and wages

While the period 2008-2013 is typically associated with negative aggregate shocks in the EU, at the disaggregated level, firms experienced both negative and positive shocks (see Annex A). In Table 5, we investigate the adjustment strategies followed by firms facing *positive* shocks. It shows that the most common adjustment strategy after a positive shock, independent of shock and period, was "wages–labour–hours" (in descending order), meaning that in most countries increasing wages has the highest predicted probability followed by increases in employment (disregarding the possibility of no adjustment). The results point to an asymmetric reaction of firms to positive and negative shocks, as cutting labour was the most common adjustment channel following a negative shock (Table 1).

This asymmetry is in line with the discussion accompanying our simple model. As we argued there, downward nominal wage rigidity results from the costs associated with cutting wages: e.g. the effects of wage cuts on general morale and on effort. These costs are simply not relevant for wage increases. In addition, in order to encourage their existing workers to increase their hours and/or to attract new workers, firms need to offer higher wages.

Table 5: Adjustment strategies across countries in response to positive shocks

		2010-2013				2008-2009			
		strong and moderate shock		strong shock		strong and moderate shock		strong shock	
Shock type	Strategy	Countries	(%)	Countries	(%)	Countries	(%)	Countries	(%)
Demand	w l h	15	68	10	59	7	100	3	100
	l w h	6	27	7	41	0	0	0	0
	l h w	1	5	0	0	0	0	0	0
Access to finance	w l h	18	82	11	65	6	86	3	100
	w h l	0	0	0	0	1	14	0	0
	l w h	3	14	4	24	0	0	0	0
	l h w	0	0	0	0	0	0	0	0
	h l w	0	0	2	12	0	0	0	0
	h w l	1	5	0	0	0	0	0	0
Availability of supplies	w l h	17	77	11	65	4	57	0	0
	w h l	1	5	4	24	2	29	0	0
	l w h	2	9	1	6	0	0	0	0
	l h w	2	9	1	6	0	0	0	0
	h l w	0	0	0	0	1	14	2	100

Note: MT excluded due to a small number of observations. Countries for which model (1) was not reliably estimated (no convergence, determined outcomes) are excluded. Ties between strategies are split. The percentages may not sum to 100% due to rounding.

Now, firms that respond to a positive shock by significantly increasing their production are likely to need to increase their labour input. Table 5 suggests that the likelihood of increasing employment is higher than that of increasing hours. Our simple model suggests that this would reflect the constraints and costs related to overtime work being large relative to the cost of hiring additional workers. Increasing employment is not only the second most likely adjustment in the dominant adjustment pattern "wages–labour–hours" but also has the highest probability in the remaining adjustment

patterns that were relatively common in 2010-13 ("labour–wages–hours" and "labour–hours–wages"). In the case of a strong positive shock, we expect that employment increases are even more likely (due to a substantially higher need to increase output) and that adjustment of hours per worker is, at best, limited and temporary (due to limits on overtime work). Indeed, following a strong positive shock in 2010-2013, adjustment strategies with employment increases appear more common.

7.4. Direction, strength and persistence of shocks and their effects on firms' labour cost adjustment responses

We assess how the direction, strength and persistence of the various shocks affect the labour cost adjustment response, i.e. the direction and strength of each of the five adjustment strategies: base wages, flexible wages, permanent employment, temporary employment and hours worked. First, it is clear that these adjustment strategies are interdependent, which would call for a simultaneous equation model, such as multivariate Probit. Second, the presence of downward nominal wage rigidities and other frictions will likely lead to asymmetric adjustments following a shock. The marginal effect of a demand shock, for example, might be expected to differ for negative and positive shocks.

A multivariate ordered Probit model combining the five adjustment strategies can capture these two elements in one single regression. We have estimated this model following Roodman (2011); however, estimating such models is a complex task carrying substantial computational burden. When comparing how cross equation correlation between the five strategies affects the coefficient estimates and standard errors compared to independently estimated adjustment equations, we found that the marginal effects and standard errors were only slightly affected (usually from the third decimal place onwards). As the survey responses are of qualitative nature, we judge that these differences in the estimated marginal effects are too small to justify the increased computational burden compared to the independently estimated single-equation models.[16]

In what follows, we investigate how the direction, strength and persistence of various shocks affect various labour cost adjustments in five single-equation ordered Probit models. We analyse changes in i) *base wages*, ii) *flexible wages*, iii) *permanent employees*, iv) *temporary employees* and v) *hours worked*. For this purpose, we transform the questionnaire's 5-point Likert scale[17] into an ordered choice model with three ordered outcomes y_i (i.e. decreased/unchanged/increased) for each firm i. We define the latent variable y_i^* as follows:[18]

$$y_i = \begin{cases} -1 \rightarrow decrease & if -\infty \leq y_i^* < \kappa_1 \\ 0 \rightarrow unchanged & if\ \kappa_1 \leq y_i^* < \kappa_2 \\ 1 \rightarrow increase & if\ \kappa_2 \leq y_i^* < \infty \end{cases} .$$

[16] Results are available from the authors upon request.

[17] The five possible adjustment answers were (1) "*strong decrease*", (2) "*moderate decrease*", (3) "*no change*", (4) "*moderate increase*" and (4) "*strong increase*".

[18] We could also have estimated an ordered Probit model with 5 different outcomes. This would, however, have increased the computational burden of the marginal effects. In particular, some outcomes are rarely observed in the data, which in some instances may impede convergence of the estimation algorithm.

Assuming further a standard normal distribution for the uncorrelated disturbance term ε with zero mean and variance σ, we estimate the following ordered Probit model separately for each adjustment channel:

$$\Pr(y_i = m) = \Pr(\kappa_{m-1} < x_i\beta + \varepsilon < \kappa_m) = \Phi(\kappa_m - x_i\beta) - \Phi(\kappa_{m-1} - x_i\beta)$$

where κ_m denotes the m^{th} threshold point of the continuous latent variable y^*. x and β denote the vector of observed values of the explanatory variables and the vector of coefficient estimates, respectively. Φ represents the standard normal cumulative distribution function.

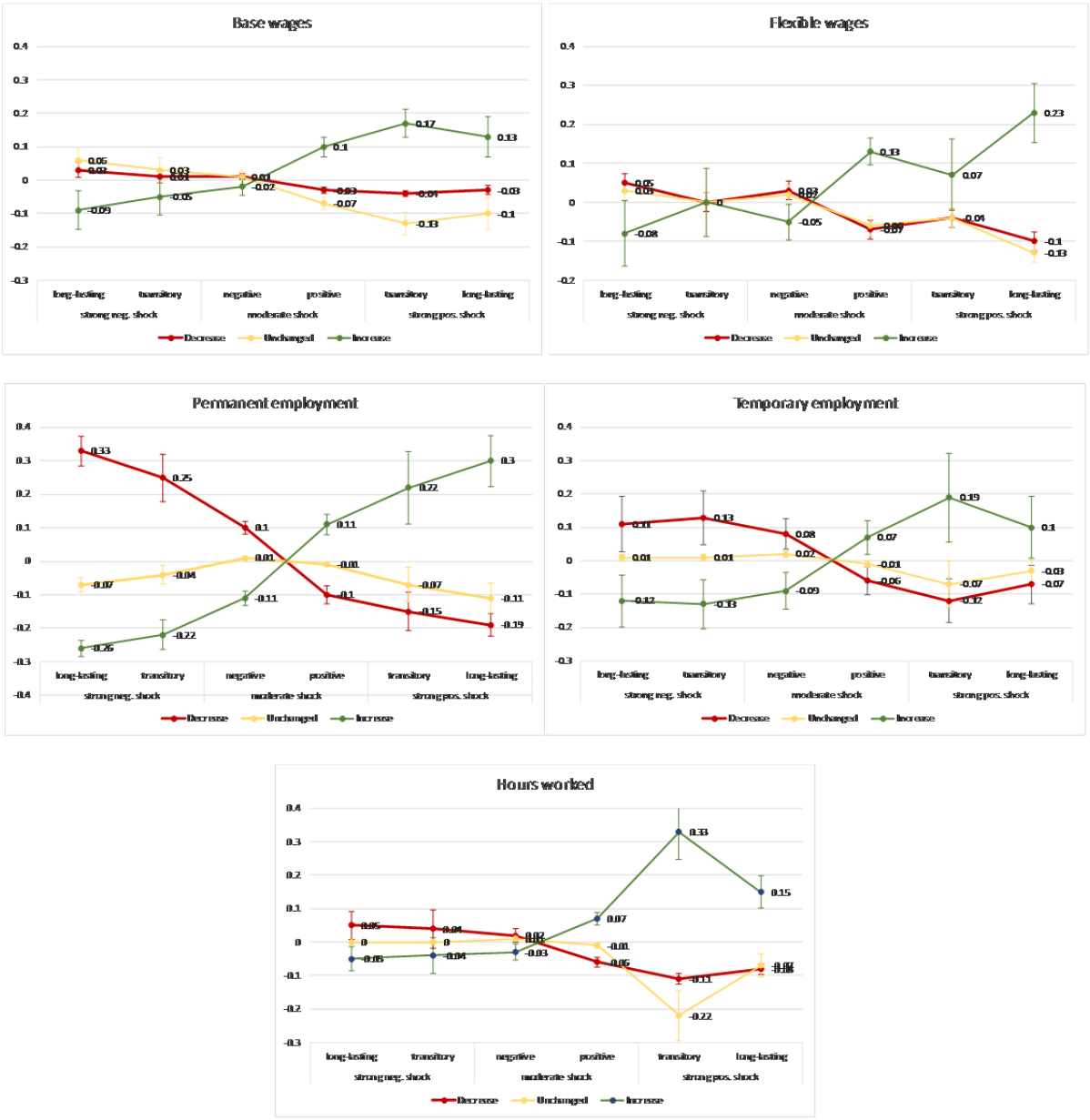
The covariates embody various shock variables, as well as variables related to structural firm characteristics potentially determining the firm's adjustment responses to a specific shock. We consider the same three shocks as before, i.e. shocks to a) *the level of demand,* b) *access to finance*, and c) *the availability of supplies from the usual suppliers*. We estimate a specification in which the shock variable is disentangled, into six different dummy variables: strong long-lasting positive shocks, strong transitory positive shocks, moderate positive shocks, moderate negative shocks, strong transitory negative shocks and strong long-lasting negative shocks. The base category is the outcome 'unchanged'. This specification enables us to assess whether the direction, size and persistence of the shocks matters for the response of firms.

In addition to the shock variable(s), we include firm-specific characteristics likely to affect the adjustment process. The *labour cost share* (in total costs) captures differences in production technology and labour intensity across firms. The *share of high-skilled employees*, the *share of permanent employees* and the *share of employees with tenure of more than 5 years* characterise the employee structure of the firm. The existence of a *collective pay agreement* at the firm, be it at firm level or an outside agreement, captures differences in the firms' flexibility to adjust employment and wages. Lastly, we include two dummy variables capturing the size of hiring and firing costs, which take the value of 1 if they are moderate or strong. Finally, we include country, sector and year fixed effects.

Turning to the results, we focus the presentation of the results on the effects of the demand shock on the five adjustment channels.[19] This is because firms considered them to be the most prevalent shock in the period of our study (e.g. Annex A). Figure 8 provides a graphical illustration of the estimated marginal effects of various sizes, signs and persistence of demand shocks on different channels of labour cost adjustments. All estimates are employment-weighted and clustered by country, sector and size. Detailed estimation results are provided in Annex C.

[19] Our results for the other shocks are shown in Annex C.

Figure 8: Marginal effects of a change in labour cost components following a demand shock



Source: WDN3 data, own calculations.

The results suggest the presence of important asymmetries in adjustment following a demand shock. The adjustment depends on the direction, severity and persistence of the shock, as would be expected a priori. First, the probability of reductions in base wages significantly increases only in the case of a negative strong persistent demand shock. However, the increase in the probability is relatively small. Moderate and strong transitory negative demand shocks do not significantly increase the probability of base wage reductions. Positive demand shocks, in contrast, tend to increase the probability significantly that firms respond with a base wage rise. In addition, no significant effects are found for negative shocks on the probability of reducing flexible wages. The pattern of reaction to demand shocks for the flexible wage component is similar to the base wage. As for the base wage, the response of flexible wages is stronger in the case of positive shocks than in the case of negative shocks. This asymmetric reaction pattern reflects the presence of downward wage rigidity in European countries.

The marginal effects of a negative demand shock on permanent and temporary employment are much more symmetric than in the case of wages. Negative demand level shocks significantly increase the probability of layoffs of permanent and temporary employees. The marginal effects for permanent layoffs increase with the strength and persistence of the shock. Positive demand level shocks increase the probability of hiring both permanent and temporary workers. Interestingly, the marginal effect on hiring temporary employees is at its highest for strong transitory shocks. In the case of permanent employees, the maximum is attained for strong persistent positive shocks. This might suggest that following strong persistent positive demand shocks, firms tend to hire permanent employees rather than temporary employees.

The effect of negative and positive shocks on hours worked resembles those on base wages, i.e. a negative shock has a muted impact on hours. In the case of a negative demand shock, hours worked are not significantly reduced. In contrast, there are strong effects in the case of positive demand shocks; the increase in the probability of raising hours worked peaks for a strong transitory positive demand shock. In the case of a persistent positive demand shock, the probability of increasing hours worked rises. The marginal effect is, however, half that corresponding to a transitory shock. Taken together with the results for employment adjustment, Figure 8 suggests that following transitory positive demand shocks, firms are more likely to adjust through hours and temporary employment, while following a long-lasting shock, the adjustment via permanent employment becomes more prominent.

8. Conclusions

In this paper, we used firm-level survey data from 25 EU countries to analyse how the responses of firms to shocks – that is, the adjustment strategies that they used – varied depending on the size, source and persistence of those shocks. We focused on the following channels of adjusting labour costs: hourly wages, employment and hours worked.

We developed a theoretical model to help us understand how firms might choose between different ways to adjust their labour costs. The basic intuition in the model is that, in response to shocks affecting their activity, firms choose the cheapest way to adjust labour costs. In other words, the margin of adjustment selected will depend on its cost. In this model, the optimisation problem is the same, whatever the type of the shock. However, the model allows firms to adjust differently to positive and negative shocks.

Our empirical findings are in line with our theoretical model. The estimated regression results showed that the pattern of adjustment was not much influenced by the type of the shock (demand shock, access-to-finance shock, 'availability of supplies' shock), but the direction of the shock (positive or negative), its size and persistence mattered. We found that the most common response to a shock is "no adjustment" in terms of labour costs, with the exception of a demand shock. In response to negative shocks in 2010-13, firms were most likely to reduce employment, then wages and then

hours. In response to positive shocks, however, firms were more likely to increase wages, followed by increases in employment and then hours worked.

The comparative evidence for two periods (2008-2009 and 2010-2013) is available only for a subset of seven countries. This comparison showed a mixed picture with slightly more than one half of the adjustments being different between the two periods. Several countries for which we had data for the two periods experienced deep recessions in 2008-2009. In particular, this was the case in the Baltic States and in Ireland, where the declines of GDP during the Great Recession were the strongest among the EU countries. Therefore, these comparative results suggest that in normal times, firms were more likely to adjust employment than wages in response to negative shocks, i.e. wages were more rigid, but in a deep recession, the ranking of these adjustment channels switched and firms adjusted wages with higher probability than employment. These findings are in line with the evidence from earlier empirical studies, which imply that nominal wages tend to be downward rigid, but the zero lower bound for wage changes is relaxed in deep recessions.

We also evaluated the reaction patterns of firms in response to negative shocks in different institutional settings. Our findings indicate that that strict employment protection and high centralization or coordination of wage bargaining make it less likely that firms reduce wages when facing negative shocks. This pattern was present irrespective of the type of negative shock we considered.

To explore various adjustment channels further, we analysed in more depth the choice between adjusting base wages and bonuses, and between adjusting permanent and temporary employment following demand shocks, the most prevalent shock in 2010-13. Both base wages and bonuses were less likely to react to negative than to positive demand shocks. In the case of base wages, this reflects downward nominal wage rigidity and has been widely discussed in the literature. Bonuses are also more rigid downward than upward. Regarding adjustment of employment, the response to negative and positive demand shocks appears rather symmetrical. Thus there is no indication that the costs of reducing employment (firing cost plus potential cost of later rehiring and retraining workers) differed significantly from the costs of increasing employment (hiring and training costs).

Firms in different countries experienced different economic shocks over the 2010-13 period, as some countries saw a recovery in economic growth, while other countries continued to see stagnant or even declining output. However, the way firms responded to shocks was remarkably similar across the countries we considered. This result has implications for how we think about the costs of adjusting hours, wages and employment upwards and downwards. For instance, one could aim to quantify the adjustment costs of each of these channels across different labour market institutions, different types of shocks etc. We leave this to future research.

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Annex A: Descriptive statistics (2010-13)

	Demand level				Access to finance				Supplies availability			
	Total	-	0	+	Total	-	0	+	Total	-	0	+
AT	778	32	21	46	764	17	73	10	758	11	81	8
BE	984	50	23	27	967	22	70	8	973	23	73	4
BG	420	42	29	30	406	17	69	14	420	20	64	17
CY	178	68	19	13	171	50	49	2	166	39	60	1
CZ	1006	44	19	37	991	15	74	11	1001	9	80	10
DE	2354	25	35	39	2266	20	65	15	2288	11	79	10
EE	482	22	16	62	482	8	76	16	482	10	73	17
ES	1957	70	14	16	1957	44	50	6	1957	22	72	6
FR	1144	57	15	28	1135	19	74	7	1139	19	78	4
GR	349	71	5	24	319	66	28	5	312	58	34	7
HR	301	53	19	29	301	24	64	12	301	27	62	11
HU	2018	33	48	19	1959	21	69	11	1962	17	71	12
IE	1230	51	16	33	1174	37	55	8	1206	21	71	8
IT	1081	58	12	30	1078	37	44	19	1081	22	54	24
LT	515	25	32	43	515	16	71	13	515	11	72	16
LU	673	35	29	36	668	21	71	8	672	12	82	6
LV	556	28	16	56	414	14	61	25	519	11	70	19
MT	163	23	19	58	152	5	80	15	163	4	90	7
NL	727	56	17	27	727	35	59	6	727	16	76	8
PL	1449	42	18	40	1421	18	67	15	1433	7	74	19
PT	1121	54	12	34	1097	32	55	13	1105	19	73	8
RO	2040	32	29	39	2031	15	64	21	2037	11	68	21
SI	1213	58	20	22	1213	45	51	3	1213	19	77	4
SK	600	47	15	38	594	15	67	18	594	11	75	13
UK	626	17	16	67	621	17	56	26	623	11	0	88

Note: -/0/+ denote the percentage of firms that reported negative/no/positive impact on their firm's activity in 2010-13. Total is the number of firms that replied to the question concerning the effect of each factor on firm's activity.

Annex B

Table B.1: Predicted probability of labour market adjustment following *moderate or strong negative shock* in 2010-2013

	Demand level				Access to finance				Supplies availability			
	none	w	l	h	none	w	l	h	none	w	l	h
AT*	43	15	46	33	86	4	13	5	68	3	29	9
BE*	41	3	48	32	78	1	17	8	74	1	20	10
BG	71	12	22	1	63	11	32	5	75	14	22	8
CY	46	41	36	34	51	23	45	19	61	22	34	7
CZ	34	34	55	18	64	16	26	8	69	14	24	7
DE	60	11	22	17	76	9	15	5	82	3	12	7
EE*	68	9	26	7	79	4	17	5	89	3	6	7
ES	54	15	38	13	73	9	20	6	77	7	18	4
FR	38	18	57	12	62	9	29	11	63	8	32	6
HR	33	24	55	3	59	12	33	3	79	13	15	4
HU	59	24	25	4	77	18	10	3	65	28	10	2
IE	51	33	33	15	67	19	21	8	74	17	12	4
IT	49	14	37	21	71	13	19	14	74	8	19	9
LT	66	14	23	13	92	4	6	2	84	6	12	1
LU	51	17	32	12	65	12	27	6	72	5	22	6
LV	72	9	20	7	69	13	21	8	79	9	19	3
NL	27	25	65	16	58	18	29	12	67	12	25	12
PL*	55	22	32	8	66	14	27	7	70	10	27	3
PT	39	22	56	14	62	15	30	6	62	14	30	5
RO	48	12	49	7	73	9	23	2	76	4	22	3
SI	35	35	47	13	63	16	32	5	61	18	33	10
SK	32	21	61	18	61	8	34	5	67	4	33	2
UK	42	26	46	17	58	8	32	8	87	5	12	1

Note: Predicted probability based on model (1) and aggregated to the three main adjustments (ie, *w*ages, *l*abour and *h*ours). Total is the number of firms that replied to the question concerning the effect of each factor on firm's activity. * denotes country models (1) estimated without size dummies (to obtain reliable estimates).

Table B.2: Predicted probability of labour market adjustment following a *severe negative shock* in 2010-2013

	Demand level				Access to finance				Supplies availabilities			
	none	w	l	h	none	w	l	h	none	w	l	h
AT*	14	30	79	42	83	9	15	8	26	0	74	0
BE*	26	8	64	41	56	2	39	18	57	3	29	20
BG	48	26	40	12	27	32	63	9	49	28	40	24
CY*	29	47	59	30	36	42	41	29	31	47	45	31
CZ	18	46	74	22	45	28	40	13	42	1	58	46
DE	36	15	43	26	53	24	39	18	80	10	14	14
EE*	58	35	28	7	65	29	18	12	81	19	3	0
ES	34	23	59	22	57	19	31	13	61	12	28	12
FR	24	27	70	23	50	15	44	11	53	12	44	6
GR	14	76	67	15	13	76	50	12	52	44	19	6
HR+	26	40	54	2	45	22	55	5	68	10	32	0
HU	26	50	60	15	82	13	16	5	72	21	10	3
IE	39	45	42	22	50	30	35	17	73	21	13	5
IT	33	31	52	38	50	21	36	28	60	5	34	22
LT	37	40	33	22	71	19	20	12	61	18	28	4
LU	39	26	54	17	52	16	31	12	36	32	37	32
LV	20	43	80	17	68	12	14	23	38	24	62	16
NL	14	36	82	24	30	34	55	23	69	8	31	4
PL+	50	25	35	10	54	22	42	3	90	10	10	0
PT	36	28	57	17	42	25	53	10	20	55	36	46
RO	27	17	71	17	50	19	42	8	71	6	29	3
SI	26	52	59	33	33	39	57	10	55	31	33	10
SK	12	37	84	20	55	17	32	14	44	22	56	18
UK	12	37	77	35	51	14	45	8	83	17	17	0

Note: Predicted probability based on model (1) and aggregated to the three main adjustments (ie, wages, labour and hours). Total is the number of firms that replied to the question concerning the effect of each factor on firm's activity. * and + denote country models (1) estimated without size and sector dummies, respectively (to obtain reliable estimates).

Annex C: Marginal effects from the ordered Probit model – base wages, flexible wages, permanent employment, temporary employment and hours worked

VARIABLES	(1) bw_d y1	(2) bw_0 y1	(3) bw_u y1	(1) fw_d y1	(2) fw_0 y1	(3) fw_u y1	(1) pe_d y1	(2) pe_0 y1	(3) pe_u y1	(1) te_d y1	(2) te_0 y1	(3) te_u y1	(1) hr_d y1	(2) hr_0 y1	(3) hr_u y1
Demand level - strong down - long-lasting	0.03**	0.06***	-0.09***	0.05	0.03*	-0.08	0.33***	-0.07***	-0.26***	0.11**	0.01	-0.12***	0.05*	0.00	-0.05**
	(0.014)	(0.022)	(0.035)	(0.035)	(0.016)	(0.051)	(0.027)	(0.013)	(0.015)	(0.051)	(0.006)	(0.047)	(0.025)	(0.004)	(0.022)
Demand level - strong down - transitory	0.01	0.03	-0.05	0.00	0.00	-0.00	0.25***	-0.04**	-0.22***	0.13**	0.01	-0.13***	0.04	0.00	-0.04
	(0.011)	(0.022)	(0.033)	(0.030)	(0.023)	(0.053)	(0.043)	(0.017)	(0.027)	(0.049)	(0.006)	(0.045)	(0.035)	(0.003)	(0.033)
Demand level - moderate down	0.01	0.01	-0.02	0.03*	0.02*	-0.05*	0.10***	0.01***	-0.11***	0.08***	0.02***	-0.09***	0.02*	0.01*	-0.03*
	(0.005)	(0.010)	(0.015)	(0.016)	(0.012)	(0.028)	(0.011)	(0.003)	(0.013)	(0.028)	(0.006)	(0.033)	(0.012)	(0.003)	(0.015)
Demand level - moderate up	-0.03***	-0.07***	0.10***	-0.07***	-0.06***	0.13***	-0.10***	-0.01***	0.11***	-0.06**	-0.01**	0.07**	-0.06***	-0.01***	0.07***
	(0.006)	(0.012)	(0.018)	(0.013)	(0.010)	(0.021)	(0.017)	(0.003)	(0.019)	(0.025)	(0.006)	(0.031)	(0.009)	(0.004)	(0.011)
Demand level - strong up - transitory	-0.04***	-0.13***	0.17***	-0.04	-0.04	0.07	-0.15***	-0.07**	0.22***	-0.12***	-0.07*	0.19**	-0.11***	-0.22***	0.33***
	(0.005)	(0.021)	(0.025)	(0.027)	(0.030)	(0.056)	(0.035)	(0.032)	(0.066)	(0.040)	(0.042)	(0.081)	(0.009)	(0.045)	(0.051)
Demand level - strong up - long-lasting	-0.03***	-0.10***	0.13***	-0.10***	-0.13***	0.23***	-0.19***	-0.11***	0.30***	-0.07**	-0.03	0.10*	-0.08***	-0.07***	0.15***
	(0.008)	(0.029)	(0.036)	(0.014)	(0.034)	(0.046)	(0.020)	(0.027)	(0.046)	(0.035)	(0.022)	(0.056)	(0.010)	(0.021)	(0.029)
Access to finance - strong down - long-lasting	0.00	0.01	-0.01	0.10**	0.04***	-0.15***	0.07***	0.00	-0.07***	0.02	0.00	-0.03	0.03	0.00**	-0.03
	(0.012)	(0.025)	(0.037)	(0.050)	(0.008)	(0.057)	(0.023)	(0.002)	(0.021)	(0.064)	(0.011)	(0.075)	(0.034)	(0.002)	(0.033)
Access to finance - strong down - transitory	0.03*	0.06**	-0.09**	0.09	0.04***	-0.13*	0.10**	-0.00	-0.10**	0.10	0.01	-0.11	0.08	-0.01	-0.07**
	(0.017)	(0.027)	(0.044)	(0.057)	(0.014)	(0.070)	(0.046)	(0.006)	(0.041)	(0.084)	(0.007)	(0.077)	(0.056)	(0.021)	(0.036)
Access to finance - moderate down	0.02***	0.03***	-0.05***	0.06***	0.05***	-0.11***	0.00	0.00	-0.01	0.03	0.01	-0.03	-0.01	-0.00	0.01
	(0.006)	(0.013)	(0.018)	(0.019)	(0.013)	(0.031)	(0.016)	(0.002)	(0.018)	(0.036)	(0.009)	(0.045)	(0.015)	(0.004)	(0.019)
Access to finance - moderate up	0.00	0.01	-0.01	-0.03	-0.02*	0.05*	-0.01	-0.00	0.01	-0.00	-0.00	0.00	-0.00	-0.00	0.01
	(0.008)	(0.018)	(0.027)	(0.016)	(0.012)	(0.028)	(0.027)	(0.003)	(0.030)	(0.028)	(0.007)	(0.034)	(0.013)	(0.003)	(0.016)
Access to finance - strong up - transitory	0.06*	0.10**	-0.16**	-0.02	-0.02	0.04	0.02	0.00	-0.02	0.10	0.01	-0.10	0.08	-0.01	-0.07
	(0.037)	(0.041)	(0.077)	(0.062)	(0.061)	(0.123)	(0.062)	(0.004)	(0.066)	(0.076)	(0.008)	(0.069)	(0.082)	(0.030)	(0.052)
Access to finance - strong up - long-lasting	-0.02	-0.04	0.06	-0.05	-0.06	0.11	-0.04	-0.01	0.05	-0.10**	-0.06	0.16*	0.04	0.00	-0.04*
	(0.012)	(0.033)	(0.044)	(0.040)	(0.056)	(0.097)	(0.078)	(0.022)	(0.100)	(0.050)	(0.046)	(0.095)	(0.031)	(0.005)	(0.026)
Supplies - strong down - long-lasting	0.03*	0.06**	-0.09*	0.02	0.01	-0.03	0.04	0.00***	-0.04	0.09	0.01	-0.09	0.11*	-0.02	-0.09**
	(0.019)	(0.028)	(0.047)	(0.058)	(0.036)	(0.093)	(0.047)	(0.001)	(0.047)	(0.075)	(0.005)	(0.070)	(0.065)	(0.031)	(0.034)
Supplies - strong down - transitory	0.00	0.01	-0.01	-0.00	-0.00	0.00	0.08	0.00	-0.08*	-0.02	-0.01	0.03	0.00	0.00	-0.00
	(0.017)	(0.035)	(0.052)	(0.047)	(0.036)	(0.083)	(0.053)	(0.006)	(0.047)	(0.056)	(0.019)	(0.075)	(0.027)	(0.006)	(0.033)
Supplies - moderate down	0.00	0.01	-0.01	0.01	0.01	-0.02	-0.03	-0.00	0.03	0.01	0.00	-0.01	-0.04**	-0.01*	0.05**
	(0.007)	(0.015)	(0.022)	(0.015)	(0.011)	(0.026)	(0.025)	(0.003)	(0.028)	(0.025)	(0.006)	(0.031)	(0.019)	(0.005)	(0.024)
Supplies - moderate up	-0.01	-0.02	0.04	-0.01	-0.01	0.02	-0.01	-0.00	0.01	-0.01	-0.00	0.01	-0.00	-0.00	0.00
	(0.008)	(0.017)	(0.025)	(0.026)	(0.020)	(0.046)	(0.020)	(0.003)	(0.023)	(0.022)	(0.005)	(0.027)	(0.017)	(0.004)	(0.021)
Supplies - strong up - transitory	-0.03**	-0.09*	0.12*	-0.13***	-0.28***	0.41***	-0.04	-0.01	0.05	-0.07	-0.03	0.09	-0.10***	-0.16**	0.25***
	(0.014)	(0.052)	(0.065)	(0.013)	(0.059)	(0.068)	(0.084)	(0.024)	(0.108)	(0.156)	(0.095)	(0.251)	(0.014)	(0.067)	(0.079)
Supplies - strong up - long-lasting	-0.01	-0.02	0.03	0.07	0.03	-0.10	-0.06	-0.01	0.07	-0.08	-0.04	0.12	-0.06**	-0.04	0.10
	(0.019)	(0.048)	(0.067)	(0.107)	(0.032)	(0.138)	(0.062)	(0.023)	(0.085)	(0.065)	(0.046)	(0.110)	(0.027)	(0.041)	(0.067)
VARIABLES	(1) bw_d y1	(2) bw_0 y1	(3) bw_u y1	(1) fw_d y1	(2) fw_0 y1	(3) fw_u y1	(1) pe_d y1	(2) pe_0 y1	(3) pe_u y1	(1) te_d y1	(2) te_0 y1	(3) te_u y1	(1) hr_d y1	(2) hr_0 y1	(3) hr_u y1
Construction	0.02***	0.04***	-0.05***	0.03	0.02	-0.05	0.00	0.00	-0.00	0.04*	0.01**	-0.05*	-0.01	-0.01	0.02
	(0.005)	(0.011)	(0.016)	(0.016)	(0.014)	(0.030)	(0.016)	(0.002)	(0.018)	(0.020)	(0.005)	(0.025)	(0.012)	(0.005)	(0.017)
Trade	0.01**	0.03**	-0.04**	0.04*	0.03**	-0.07*	0.00	0.00	-0.00	0.06**	0.01***	-0.07**	0.01	0.00	-0.01
	(0.006)	(0.013)	(0.019)	(0.020)	(0.016)	(0.035)	(0.015)	(0.002)	(0.017)	(0.026)	(0.005)	(0.031)	(0.021)	(0.004)	(0.025)
Business Services	0.01**	0.03**	-0.04**	0.05***	0.04***	-0.09***	-0.00	-0.00	0.01	0.03*	0.01*	-0.04*	0.01	0.00	-0.01
	(0.006)	(0.012)	(0.018)	(0.017)	(0.013)	(0.030)	(0.016)	(0.002)	(0.018)	(0.019)	(0.006)	(0.025)	(0.014)	(0.003)	(0.017)
Financial Intermediation	0.00	0.01	-0.01	0.05	0.04*	-0.10	0.03	0.00	-0.03	0.12***	0.01**	-0.13***	0.03	0.00	-0.03
	(0.014)	(0.034)	(0.047)	(0.036)	(0.023)	(0.059)	(0.050)	(0.002)	(0.053)	(0.043)	(0.006)	(0.040)	(0.022)	(0.003)	(0.024)
5-19 empoyees	-0.10***	-0.12***	0.22***	-0.06	-0.03*	0.09	-0.05*	-0.01***	0.06**	-0.06	-0.02**	0.07*	-0.04	-0.00	0.04
	(0.019)	(0.016)	(0.034)	(0.038)	(0.017)	(0.055)	(0.026)	(0.002)	(0.027)	(0.037)	(0.009)	(0.045)	(0.031)	(0.004)	(0.028)
20-49 employees	-0.11***	-0.13***	0.24***	-0.03	-0.02	0.05	-0.04*	-0.00***	0.05*	-0.04	-0.01*	0.05	-0.02	0.00	0.02
	(0.019)	(0.015)	(0.033)	(0.039)	(0.017)	(0.055)	(0.026)	(0.001)	(0.027)	(0.036)	(0.007)	(0.043)	(0.032)	(0.003)	(0.029)
50-199 employees	-0.12***	-0.15***	0.26***	-0.05	-0.03**	0.09	-0.04	-0.00**	0.05	-0.03	-0.01	0.04	-0.04	-0.00	0.04
	(0.019)	(0.017)	(0.034)	(0.038)	(0.016)	(0.054)	(0.028)	(0.002)	(0.029)	(0.039)	(0.008)	(0.046)	(0.032)	(0.004)	(0.029)
200+ employees	-0.13***	-0.17***	0.29***	-0.05	-0.03	0.07	-0.02	-0.00	0.02	0.01	0.00	-0.01	-0.04	-0.00	0.04
	(0.019)	(0.018)	(0.035)	(0.040)	(0.019)	(0.058)	(0.030)	(0.001)	(0.030)	(0.040)	(0.007)	(0.047)	(0.034)	(0.005)	(0.033)
Labour cost share (%)	-0.00	-0.00	0.00	-0.00	-0.00	0.00	0.00**	0.00**	-0.00**	0.00	0.00	-0.00	-0.00	-0.00	0.00
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Permanent empl., share (%)	0.01	0.02	-0.03	0.02	0.02	-0.04	-0.06*	-0.01	0.07*	0.13***	0.03***	-0.16***	0.00	0.00	-0.01
	(0.011)	(0.023)	(0.034)	(0.041)	(0.031)	(0.072)	(0.037)	(0.005)	(0.042)	(0.044)	(0.011)	(0.053)	(0.032)	(0.008)	(0.040)
High-skilled empl., share (%)	0.02**	0.04**	-0.05**	-0.00	-0.00	0.00	0.02	0.00	-0.02	0.03	0.01	-0.04	-0.00	-0.00	0.00
	(0.008)	(0.018)	(0.027)	(0.017)	(0.013)	(0.029)	(0.027)	(0.003)	(0.030)	(0.036)	(0.009)	(0.045)	(0.018)	(0.004)	(0.022)
Existence of pay agreement (d)	-0.00	-0.01	0.01	-0.01	-0.00	0.01	0.01	0.00	-0.01	-0.00	-0.00	0.00	0.01	0.00	-0.01
	(0.005)	(0.011)	(0.017)	(0.013)	(0.010)	(0.022)	(0.018)	(0.002)	(0.020)	(0.026)	(0.006)	(0.033)	(0.010)	(0.002)	(0.012)
Tenure 5>years, share (%)	0.00	0.01	-0.01	0.03	0.02	-0.05	0.19***	0.02***	-0.21***	0.12***	0.03***	-0.15***	0.01	0.00	-0.02
	(0.010)	(0.022)	(0.031)	(0.021)	(0.016)	(0.037)	(0.036)	(0.005)	(0.040)	(0.040)	(0.011)	(0.050)	(0.018)	(0.005)	(0.023)
Moderate/strong hiring costs (d)	0.00	0.00	-0.01	-0.05***	-0.04***	0.08***	-0.01	-0.00	0.01	-0.05*	-0.01**	0.06*	-0.01	-0.00	0.02
	(0.005)	(0.011)	(0.017)	(0.014)	(0.009)	(0.023)	(0.015)	(0.002)	(0.017)	(0.027)	(0.006)	(0.032)	(0.012)	(0.003)	(0.015)
Moderate/strong firing costs (d)	-0.01	-0.02	0.03	0.02	0.02	-0.04	0.03**	0.00*	-0.03**	0.02	0.00	-0.02	-0.00	-0.00	0.00
	(0.006)	(0.013)	(0.020)	(0.015)	(0.010)	(0.025)	(0.015)	(0.002)	(0.017)	(0.018)	(0.004)	(0.022)	(0.013)	(0.003)	(0.016)
Observations	17,432	17,432	17,432	11,163	11,163	11,163	17,391	17,391	17,391	8,287	8,287	8,287	17,293	17,293	17,293

Note: Base wages (bw), flexible wages (fw), permanent employment, (pe) temporary employment (te) and hours worked (hr). _d, _0 and _u denote decrease, no change and increase, resp.
Coefficients are employment weighted average marginal effects. Specifications includes country fixed effects.
Standard errors (in parentheses) are clustered by country, sector and size.