Price, wage and employment response to shocks: evidence from the WDN survey

Price, Wage and Employment Response to Shocks: Evidence from the WDN Survey *

Giuseppe Bertola (U.Torino, EDHEC Business School, CEPR), Aurelijus Dabusinskas (Eesti Pank), Marco Hoeberichts (De Nederlandsche Bank), Mario Izquierdo (Banco de España, ECB), Claudia Kwapil (Oesterreichische Nationalbank), Jeremi Montornès (Banque de France), Daniel Radowski (Deutsche Bundesbank)

Abstract

Analysing survey data collected in the framework of the Eurosystem's Wage Dynamics Network (WDN) on patterns of firm-level adjustment to shocks, we document that the relative intensity and the character of price vs. cost and wage vs. employment adjustments in response to cost-push shocks depends in statistically significant and theoretically sensible ways on the intensity of competition in firms' product markets, on collective wage bargaining, and on other structural and institutional features of firms and of their environment.

Keywords: Wage bargaining, Labour-market institutions, Survey data, European Union

JEL code: J31, J38, P50

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1. Introduction

The distribution of shocks across prices, wages, and employment reactions is an essential element of microeconomic and macroeconomic adjustment. At microeconomic level, reactions to market-originated shocks are shaped by structural features and by institutional constraints. In the labour market, collective bargaining privileges wage stability, and employment protection legislation aims at stabilising employment. Stable wages and stable employment are beneficial for uninsured workers, but labour market rigidity constrains labour (re)allocation reducing productivity and profits (see e.g. Bertola, 1999). Administrative and survey data are analysed from relevant perspectives by Guiso et al. (2005), Leonardi and Pica (2007), Cardoso and Portela (2009), and others. At the macroeconomic level, labour market rigidity prevents wage and employment changes from absorbing the impact of cost shocks, and makes it more difficult for monetary policy to achieve price stability as contractually pre-set wages anticipate future price increases. If labour markets are heavily regulated and weak product market competition endows firms with significant price-setting power, then (in the absence of appropriate economy-wide wage-setting coordination) energy prices and other supply shocks can easily trigger wage-price inflationary spirals.

In this paper, we aim at obtaining novel insights on these important issues from the extensive firm-level information collected in the framework of the Eurosystem's Wage Dynamics Network (WDN) survey.[1] This survey (documented in the Online Appendix) is suitable for the purpose of characterising how structural and institutional features of the firms' environment shape price, employment, and wage adjustment. Its rich structure makes it possible not only to identify the persistence and commonality of hypothetical shocks, but also to relate the stated reaction strategies to self-reported and country-level features of the firm's environment.

We focus specifically on the intensity and the international character of output market competition, and on the incidence of collective-bargaining constraints on firm-level wages. We find that a significant (albeit small) proportion of the variation across countries and firms of price, wage, and employment adjustment strategies is empirically explained by structural and institutional features. Consistently with standard theoretical insights, product market competition reduces the relevance of price reactions to cost shocks, and cost adjustment is distributed across wage and employment reactions in ways that depend on the extent of firm-level wage flexibility and on the presence of temporary workers.

Section 2 reviews aspects of the survey's questions and structure that are relevant to the specific issues we address and to the interpretation of our results, and Section 3 outlines the theoretical considerations that motivate the empirical specifications. Section 4 investigates the influence of firms' characteristics on the reported relevance of price and cost adjustments. Section 5 examines the survey's evidence regarding preferred cost-adjustment strategies. In both cases, controlling for other relevant variables, the data offer robust evidence of the role of the structure of employment contracts (as regards their

[1] The WDN program, based at the European Central Bank in 2006-2009, coordinated the work of researchers from 24 European central banks. An Online Appendix documents the structure of the WDN Survey, and provides detailed information to readers interested in working on these issues and those of other papers in the same project.

permanent or temporary character, and the presence of flexible wage components) in shaping firms' responses, and confirm that when product or labour markets are less competitive, then cost shocks spill-over more strongly into price or wage increases. Section 6 concludes discussing the arguably limited quantitative relevance and structural interpretation of some of the empirical correlations, and highlighting their implications for policy and further research.

2. Data

The survey asked firms for a qualitative assessment of their adjustment strategies in reaction to hypothetical shocks (the exact wording of the questionnaire is reported in the Online Appendix). Among these, we consider cost-push shocks affecting all firms in the market: an unanticipated increase in the cost of an intermediate input (for example, an oil price increase), and an unanticipated and permanent increase in wages (for example, due to the renewal of a national contract). The extent to which such shocks are passed through to prices, wages, and employment is clearly relevant to more general and topical macroeconomic issues, such as the consequences of oil-price increases like those observed in 2007-08 (when the survey was designed), as well as in previous and later episodes.[2]

A total of 15,235 responses were obtained, from firms located in the 14 countries listed along the horizontal axis of Figure 1 and in Table A.1 in the Appendix. The summary statistics we report weigh the data so as to account for differences in sampling probabilities and non-response rates across observable characteristics of firms (see the Online Appendix for details).

The respondents were asked to consider four different adjustment strategies in response to these shocks: an increase in prices; a reduction in profit margins; a reduction in output; and a reduction in costs. Each could be assessed as "very relevant," "relevant," "of little relevance," or "not relevant." There is clearly a lot of heterogeneity across countries as regards not only the character, but also the overall intensity of adjustment. In Figure 1, the countries are sorted according to the means of the four percentages, shown by the black lines, which range from more than 75 percent in Estonia to less than 30 percent in Hungary. The bars in the figure show the percentage of firms that assign "very relevant" or "relevant" to the possible adjustment strategies. Moreover, Table 1 illustrates the average relevance of the four adjustment strategies across all countries. In response to a cost shock, approximately 70 percent of the respondents indicate that a reduction of other costs and price increases are "very relevant" or "relevant" options. Fewer indicate that a reduction in profit margins is a relevant answer, and only 23 percent say that they reduce output. In response to an input-cost shock, about two thirds of all firms increase prices. Scoring the four-point relevance scale from 4 for "very relevant", down to 1 for "not relevant", we see that reducing costs, increasing prices, and reducing profit margins are on average slightly less important after wage shocks than after other input-cost shocks.[3]

[2] Respondents were also asked about adjustment strategies in the aftermath of demand shocks. The resulting survey evidence is also highly relevant, particularly in the context of the 2008-09 recession, during which a follow-up survey was conducted. The resulting extended data set makes it possible (using methods similar to those of our paper) to study how structural and institutional features shape demand-shock reactions (Fabiani et al., 2011).

[3] One might expect the relevance of different strategies for each firm to be consistent in simple ways: for example, firms that do not adjust prices or output should adjust margins, and price increases should accompany output reductions along a stable demand curve. Simple correlations, however, do not provide clear information

For our purposes, it is most interesting to see whether and how the intended cost reduction involves a reduction of labour input. The rich structure of the WDN survey makes it possible to explore this issue. Unless firms rate 'cost reduction' as completely irrelevant, respondents were in each case asked to indicate the main channel for cost reduction, choosing a single option among the six listed in Table 2. About half of the firms choose one of the five ways to reduce labour costs; among these, three imply an employment response to a shock: in reaction to a shock, and without conditioning on any other variable, some 30 percent of the responding firms plan to implement their cost reductions by reducing the number of employees, and about 7 percent by reducing hours worked by employee. Only around 10 percent of the firms indicate that they are likely to reduce costs by cutting flexible wage components, and only about 2 percent would cut base wages, confirming a common finding in the literature (e.g. Bewley, 1999). The other half of the firms state that they would react to higher cost or wage costs by cutting other, non-labour costs. While this may simply reflect wishful thinking on the part of respondents, it may indeed be appropriate to engage in energy-saving reorganisation in the face of an oil price increase, and a wage-cost push may also induce firms to renegotiate input prices with suppliers of intermediate inputs, or to reduce administrative or advertising costs.

3. Theory

We bring to bear on these data a partial equilibrium perspective on firms' optimal employment strategies, focusing on the interaction between shocks and price, employment, and wage adjustment. We assume a "right to manage" situation, where employment and hours are chosen by firms (possibly subject to hiring and firing costs), while wages may be bargained collectively. In that setting, the relevance of price and cost reactions depends on the shape of the firm's marginal revenues and marginal productivity (hence marginal costs). In turn, these depend on the firm's market power, and on institutional constraints on wage and employment adjustment. Similar insights would also be relevant, if employment were an element of collective bargains, or in competitive frameworks where shocks (especially when they are common to the industry) are associated with wage changes along local labour supply curves.

As wages and other costs vary, firms' choices are constrained by the costs and market consequences of price adjustments. When prices are flexible, firms move along the product demand curve, and employers should choose employment so as to equate the wage to labour's marginal impact on firm's revenues. For a perfectly competitive firm with flexible prices, this is labour's marginal productivity, multiplied by the product's price. For a firm with market power, it is the marginal revenue product. Under flexible prices, margins may be adjusted, if the elasticity of demand is variable; as in Gali (1994), the resulting feedback from output quantities to prices in a multi-sector economy can generate self-fulfilling multiple dynamic equilibria. This, however, may not be the most relevant theoretical framework for the purpose of interpreting the surveyed firms' attitude towards various adjustments to cost shocks, and to assess their relevance for the cost-wage-spiral issues that motivate our research. We will instead frame our simple theoretical considerations in terms of the standard setting of modern New Keynesian macroeconomic models, where "sticky" prices change infrequently because nominal

in these respects, as each firm was allowed to consider all or none of the alternatives as more or less relevant and presumably did so in light of its own circumstances. Depending on the perceived demand elasticity, for example, output and price changes are more or less relevant in relation to each other. The controlled regressions we report below offer more interpretable results.

price variation is costly and firms can keep prices fixed in response to cost shocks because their pre-set prices are higher than marginal costs.

The survey does not offer quantitative information on the size of desired or actual price changes, which in the relevant theoretical models depend on expectations as well as on current marginal cost changes. The survey does, however, offer qualitative information as to the relevance, and perhaps the likelihood, of price adjustment as a response to shocks for each firm. If prices do not change but costs do, then margins need to be adjusted. Thus, the relative relevance of 'increase prices' and 'reduce output' should depend on the extent of price stickiness. As shown by Ball and Romer (1990), real rigidities (i.e., restraints on the variability of *relative* prices) reduce firm-level incentives to change nominal prices when doing so entails "menu" costs. While Ball and Romer focus on the equilibrium implications of demand shocks, much the same mechanism is at work in our survey's firm-level reactions to cost shocks.

In response to supply shocks that (like those mentioned in the survey questions) are common to all firms, when the output market is more competitive then price changes should be more relevant than other reactions. In the limit case of perfect competition, prices are equal to marginal costs and would necessarily change when wages or other input costs are shocked. A lower elasticity of product demand implies larger margins and, for a given cost of changing prices, makes price rigidity a more likely outcome. Conversely, high elasticity of product demand and small margins make "real" rigidity less relevant, and make it easier for wage and cost shocks to overcome the cost of price changes.

As regards to strategies other than price changes, it is particularly interesting and insightful to focus on how wage and employment reactions may depend on the structural and institutional features of the firms' business environment in which choices are made. As outlined formally in the Appendix, the relevance of employment and wage reactions depends on the elasticity of labour demand and on institutional constraints.

Both wage and employment responses are expected to be larger when labour demand is more elastic, which in turn reflects substitutability of labour with other factors of production (suggesting that empirical analysis should account for technological features) as well as the intensity of product market competition. International economic integration is a particularly plausible source of both substitutability and competition: when a firm's production and investment choice spans international borders, the elasticity of labour demand is expected to be larger (see Andersen and Skaksen, 2007, and references therein), and firms are expected to try hard to reduce costs. Whether they can do so through wage and/or employment adjustment (rather than through a catch-all 'other cost reduction' strategy) should depend on the labour intensity of their production structure.

In a dynamic environment, wages and employment need not vary along the static labour demand curve (see e.g. Bertola, 1999). Employment protection legislation can muffle employment variation in the aftermath of shocks. The ability of wages to respond to firm-level and common shocks depends on institutional features as well as on local labour market conditions, along the lines of e.g. Topel (1986), especially when labour mobility is low. Employment adjustment should be larger when wages are rigid, and smaller when turnover is more costly (Bertola and Rogerson, 1997). Thus, the wage and employment components of cost-reduction responses in our empirical specification will be allowed to

depend on firms' institutional environment in terms of both wage-bargaining institutions and employment flexibility. In this respect, the survey provides useful information as to the prevalence of temporary work and the level of wage bargaining.

As regards the cost-cutting choices of Table 2, these simple theoretical considerations suggest that wage and employment responses should be stronger when firms are subject to strong product market competition, but weaker when collective agreements reduce wage flexibility and employment protection legislation (or non-availability of temporary contracts, or technological features) reduces employment flexibility. The relevance of each reaction channel is obviously related to that of other possible reactions for each firm: a firm's propensity to adjust costs rather than prices, of course, depends on how easy it is in practice to do so. Thus, cost-related characteristics are relevant for the previous choice between price and cost adjustments. In what follows, we examine the two stages of the firms' survey replies, combining firm-level and country-level information about relevant features of the firms' environment, without modelling formally the relationship between them.[4]

4. Price and cost adjustment

We focus on the two most popular adjustment strategies in Table 1: reducing costs and increasing prices. In theory, the choice of adjustment strategy is dictated by firms' marginal revenue and cost considerations. Though these are not observed, some of the variables available in the WDN survey dataset can be used to capture certain characteristics of firms' marginal revenue and cost schedules indirectly.

We are particularly interested in whether cost reduction is a more relevant adjustment strategy than price adjustment for firms that behave as price takers rather than price makers. The variable *competition* is a dummy variable coded as unity if the firm replies that it would be "very likely" to decrease the price of its product in case the firm's main competitor reduced its price (and as zero if "likely," "not likely," "not at all," and "do not know/does not apply" was indicated by the firm).[5] The *share of foreign sales* in a firm's revenues can also proxy for the intensity of price competition, since (controlling for sector and size) firms that are more exposed to large international markets should enjoy less market power.

To account for differences in production technologies and labour intensities across firms, our specifications also include: *labour share* – the share of labour costs in total costs; the *sector* in which the firm operates (seven NACE-based sector dummies for manufacturing, energy, construction, trade, market services, financial intermediation and non-market services); and *firm size* (a set of four dummy variables indicating whether the firm's employment falls in the 5-19, 20-49, 50-199, 200+ intervals).

[4] In principle, the character of a firm's product market should determine whether costs rather than prices are adjusted, and should not be directly relevant for cost-adjustment strategies. We have considered an explicit two-stage estimation procedure, whereby the predicted probability of cost-adjustment relevance is included in the cost-adjustment specifications, to control for sample selection. In practice, however, selection of firms into the sample that identifies a main cost-reduction strategy appears to be driven by the survey's structure rather than by product-market competition indicators.

[5] We recoded answers to the slightly different question asked in the Dutch survey so as to recover analogous information.

While the choice of price adjustment as a shock-reaction strategy is shaped importantly by product market characteristics, the relevance of cost adjustment depends in theory on how easy it is to do so. This depends on rigidities and adjustment costs in the labour market. In this respect, the WDN survey dataset offers a number of variables that can be regarded as indirect measures of rigidities and adjustment costs associated with the labour input. To account for wage rigidities, our set of explanatory variables includes *collective agreement, higher level* – a dummy variable showing whether a given firm adopts a collective agreement concluded at national, regional, sectoral or occupational level, and *collective agreement, firm level* – a dummy variable indicating the presence of collective bargaining at the level of the firm.

Finally, our estimations include a set of *country-specific dummies* to account for unobserved national effects, such as those that might arise from country-specific employment protection legislation. Table A.1 in the Appendix reports basic summary statistics for the covariates; fewer than the total of 15,235 surveyed firms are included in the regressions, because many declined to answer specific questions. Irish firms are only included for cost shocks, because that country-specific questionnaire did not include wage-shock questions.

We explore the determinants of firms' choice to increase prices and/or lower costs in response to cost-push shocks by focusing on one of these adjustment strategies at a time. As already described in Section 2, firms could indicate the importance of each strategy in their packages of measures by telling us whether a given margin of adjustment is "very relevant," "relevant," "of little relevance" and "not relevant". On the basis of this information, we define the endogenous variables as dummies, which are equal to unity if the adjustment strategy in question is "very relevant" or "relevant", and zero otherwise. Thus, we model the determinants of price increase and cost-cutting decisions by estimating probit models in the form $\text{Prob}(Y=1)=\Phi(\beta' x)$ where β is a vector of coefficients, x is a vector of explanatory variables, and $\Phi(.)$ denotes the cumulative normal distribution function.

As shown in Figure 1, the sample is very heterogeneous across countries. Thus, we use regressions with country dummies. It may be of particular interest, however, to additionally assess whether slope coefficients differ across two groups of countries that may be heterogeneous across sensible and policy-relevant dimensions: the older members of the EU, which in our sample have all adopted the single currency, and the new Central and Eastern European members that have not yet entered the euro area. Thus, we report the coefficient of interactions with a Non-EA dummy that equals unity for firms located in countries that, at the time of the survey, were outside the euro area: Czech Republic, Estonia, Hungary, Lithuania, Poland. We are mainly interested in its interaction with two variables: the share of labour costs in total costs, representing an important feature of firms' production functions, and the share of foreign sales, an important feature of firms' market conditions. The latter variable's association with firms' reaction strategies may reasonably differ between euro area and non euro-area countries. Firms in non-euro area countries are exposed to potentially floating exchange rates and, in light of the countries' recent accession to the EU and less advanced economic development, may specialise in production stages where international markets are more competitive.

The regressions reported in Table 3 explain the probability that a price increase or a cost reduction is a "very relevant" or "relevant" strategy in reaction to wage and cost shocks. The coefficients measure the probability impact of a unit change of each covariate (from zero to one in the case of dummy

variables), in terms of average probit marginal effects; the size of this average (over all the sample) marginal effect and its significance do not differ substantially from those computed for a firm for which all model covariates are set at their average values. To economise on space, some of the less relevant estimates are not reported. The bottom row of the table reports the predicted probability for that firm to report that the response to a shock is "relevant" or "very relevant".

Stronger *competition* is associated with more intensive adjustment in (other) costs in the aftermath of supply shocks. A firm in a very competitive environment is 3.8 p.p. more likely to reduce costs after a cost shock and 2.9 p.p. after a wage shock. Reciprocally, price increases are less likely when competition in the product market is strong, though this effect is statistically significant only for the wage shock. Qualitatively, however, competition has the same effect on firms' adjustment to both shocks: it makes firms more likely to reduce costs, but less likely to increase prices, as suggested by our theoretical considerations in Section 3.

The *share of foreign sales* in total sales, another indicator of competitive pressure, also appears to matter for the way firms react to cost-push shocks. Specifically, we find that firms with a higher exposure to foreign product markets are more likely to respond to cost shocks by lowering other costs. In this regard, exposure to foreign markets implies a qualitatively similar effect to that of our more direct measure of price competition. Since the hypothetical wage shock is common to other firms but country-specific, it is similarly sensible to find that a higher share of foreign sales in total sales reduces the relevance of output price increases as a response to it.

Firms covered by *collective agreements at higher level* are more likely to respond to shocks by increasing prices; *collective agreements at the firm level* do not seem to have strong independent effects on price and cost adjustment. Marginal cost rigidities stemming from the presence of higher level collective agreements increase the likelihood that cost shocks and wage shocks will be passed through to product prices by 2.5 p.p. and 3.9 p.p., respectively.

A firm's production technology also affects the way it reacts to shocks. According to Table 3, a higher *labour cost share* lowers the likelihood of price adjustment after a cost shock (a 10 p.p. rise in the labour share lowers the incidence of price adjustment by about 1 p.p.). The marginal costs of firms using labour input more intensively are bound to be less sensitive to changes in the cost of intermediate inputs, reducing the need to adjust product prices in response to the input-cost shock. Since a higher labour share implies that marginal costs are more sensitive to labour costs, prices are more likely to be raised in response to a general wage increase. This is also consistent with the results obtained focusing on price determinants within the Inflation Persistence Network (see Fabiani et al., 2006).

As regards the interaction terms with dummies that identify firms located in non-euro area (and, in our sample, recent EU member) countries, a significant difference seems to be that such firms are less likely to increase prices after a supply shock when they have a high exposure to foreign markets. This may be explained by the fact that, in those countries, the firms' market environment is more competitive over and beyond what is captured by observable indicators.

The specifications of Table 3 include *country dummies*. Their estimated coefficients (not reported in the table) are sizeable and highly significant; in the case of a wage shock, the difference between the largest (Estonia) and smallest (Hungary) country effect contributes almost 60 percentage points to the probability of price adjustment: much of the variation in firms' adjustment to shocks is accounted for by national factors after controlling for a rather extensive set of firm-specific characteristics.[6]

These country-specific effects may reflect country-specific institutional characteristics. Table 4 shows how the country dummy coefficients in the four specifications of Table 3 correlate with an Employment Protection Legislation (EPL) indicator.[7] The correlation is positive and strong when the coefficients reflect the relevance of price increases as reactions to cost shocks and essentially zero when the dependent variable is the relevance of other cost reductions. Taken at face value, this indicates that price increases are more likely in the aftermath of a cost shock (such as an increase of oil prices) in countries with higher employment protection. In the wage shock scenario, however, correlations are not significantly different from zero. This evidence, of course, can only be suggestive, because only a small number of observations are available and many other institutional features, such as product market regulation, covary with EPL along the cross-country dimension.

The specifications of Table 3 also include sector and firm-size controls. We find that firms operating in the market services sector attach less relevance to adjustment strategies than manufacturing firms in the case of both input-cost and wage shocks, with a notable exception: the relevance of price increases in reaction to a permanent increase in wages is similar across services and manufacturing firms. As regards firm size, we find that larger firms are more likely to emphasise the importance of the "cutting other costs" adjustment strategy.

5. Cost-cutting strategies

To determine factors explaining the choice of the most important cost-cutting strategy (see Table 2 for the different cost-cutting strategies firms could choose from), we run a set of probit regressions relating each adjustment choice to theoretically relevant covariates. In particular, we focus on indicators of product market structure and labour market institutions. The dependent variable in the probit regression equals one if the firm indicates that the respective cost-cutting strategy is the most important one, and zero otherwise. Besides the covariates considered in Section 4, we include *share of temporary employment*, measured as the percent share of employees with a temporary contract; *share of part-time employment*, the percent share of employees that work part-time on a permanent contract, and *share of variable wages*, the percent share of the total wage bill that corresponds to bonuses and benefits that depend on individual or firm performance.

Tables 5 and 6 report the results of probit regressions relating the choice of a main cost adjustment strategy, in reaction to cost and wage shocks, to indicators of product market competition (*competition* and *share of foreign sales*), of the firm's technology (*labour share*), of the structure of the workforce

[6] In linear regressions, some 85-95 percent of the variation in the relevance scores is explained by country dummies rather than by firm-specific covariates. This may reflect differences in language and survey-taking technique, as well as the institutional features we discuss in the text.

[7] We use EPL indicators based on the standard OECD definition, as updated and extended by Tonin (2005) to new member states.

and of its remuneration (*share of temporary and part-time employment* as well as *share of variable wages*), and of wage-bargaining features *(collective agreement, firm level; collective agreement, higher level*). All specifications again include country, industry, and size dummies in order to control for institutional (and other) country-specific factors and for unobserved technological and market-structure differences across sectors and firms of different sizes.

In both Tables 5 and 6, product market competition is positively associated with the relevance of employment and wage adjustment after both types of shocks. For a given degree of wage rigidity, this is consistent with standard labour demand theory, in that, for a given labour share, a more elastic product demand function implies a more elastic labour demand and a more pressing need for firms to reduce employment. This result is similar for permanent and temporary employment. Also flexible wage adjustment is more likely in a highly competitive environment[8]. As shown in Tables 5 and 6, the main impact of competition is on the choice between labour and non-labour costs. These costs could include, for instance, advertising, marketing and other costs that in a competitive environment should be minimised even without a negative shock.[9] Firms operating in a highly competitive environment are thus less likely to reduce non-labour costs and more likely to reduce labour costs, regardless which type of labour costs.

Regarding wage-setting institutions, we find that collective agreements outside the firm, that is collective agreements signed at the national, regional, sectoral or occupational level, make an adjustment of temporary employment more likely. Imposing a wage agreement negotiated at a higher than the firm level to a firm increases the probability of laying-off temporary workers by approximately 4 p.p. Furthermore, there is a tendency for wages to be stickier when there are collective wage agreements present. Thus, firms covered by collective wage agreements appear to reduce the number of temporary employees (and not the number of permanent employees) due to wage rigidity. It should be noted that country dummies are included in our regressions, already capturing national-specific characteristics of collective bargaining institutions.

The share of temporary workers features a relatively strong association with the character of cost-cutting strategies. Firms with a high share of temporary employment are more likely to indicate layoffs of temporary employees as the preferred adjustment strategy, and less likely to reduce the number of permanent employees and flexible wages (as well as to try and decrease non-labour costs). An increase in the share of temporary workers by 10 percentage points increases the probability of cutting temporary employment by 1.4 p.p.. Thus, temporary employment acts as a buffer against employment fluctuations for permanent workers and against wage fluctuations.

Since employment protection legislation should in theory influence cost-reduction strategies, we again inspect the relationship between EPL indicators and the country dummy coefficients that in the regressions absorb these and other national characteristics. Figure 2 shows that country effects

[8] The frequency of base wage adjustment is too low to allow for a proper estimation of its determinants. The results are very similar if the very few firms that report base wage adjustment as their main cost adjustment strategy are pooled with those that choose flexible wage components.

[9] We also estimated a multinomial model, obtaining similar results. The intensity of competition appears to influence the choice between non-labour cost and labour cost adjustment more strongly than that between different labour cost adjustment strategies.

estimated in the permanent employment adjustment regressions are negatively correlated with the degree of EPL strictness for regular workers (-0.34). Thus, EPL works as intended: it protects permanent employees. In the case of temporary employment, the relationship between EPL and country effects is weaker, and positive as shown in Figure 3. While the evidence can only be suggestive, it unsurprisingly indicates that stricter employment protection for regular workers induces firms to lay off temporary workers when costs need to be reduced.

Among the other variables included in our regressions, the *labour share* deserves to be discussed briefly. We see in Tables 5 and 6 that a large labour share is positively associated with the choice of the flexible wage cost-adjustment option. Analysing another portion of the WDN survey, Babecký et al. (2009) document that non-euro area firms are more likely to have access to flexible wage adjustment mechanisms, such as bonuses, and that this and other adjustment margins are more commonly used by firms that are subject to (nominal) base wage rigidities and that tend to feature a smaller share of blue-collar workers. In our regressions, the wage rigidity implied by higher-level wage agreements implies that temporary employment bears the brunt of adjustment, while a larger share of variable wage costs tends to stabilise both temporary and permanent employment making wage adjustment the preferred reaction to all types of cost-push shocks. Interactions with non-euro area dummies are not significant as regards flexible-wage adjustment. Outside the euro area, labour intensity is associated with a significantly higher incidence of permanent employment reactions to cost-push shocks, and this may well reflect the more flexible lay-off arrangements of less heavily regulated markets.

6. Conclusions

Empirical evidence from the WDN survey highlights several theoretically sensible features of price, wage and employment reactions to changes in the economic environment for numerous European countries. Firms that report facing strong competition in the product market or export much of their production are less likely to increase prices, and more likely to reduce costs after a wage shock (stated in the survey question to be common to all firms in the industry). The presence of collective wage agreements at industry or national level makes a price increase more likely. The data also suggest that price increases are more likely where employment protection legislation is more stringent. When reducing costs, firms operating in a highly competitive environment are less likely to reduce non-labour costs and more likely to reduce labour costs. The latter is less likely to be accomplished by wage reductions when firms are subject to labour contracts signed at higher bargaining levels, which induce firms to react to cost shocks by reducing employment and especially temporary employment, in particular when permanent employees are protected from dismissal.

The quantitative magnitude of these statistically significant estimates is difficult to assess, both because they refer to the subjective “relevance” of different strategies, and because much of the variation observed remains unexplained (or is explained by country effects) after accounting for heterogeneity in directly observable firm-level characteristics. Counterfactual experiments, such as imputation to individual countries or sectors of different countries’ or sectors’ observed average levels of competition, predict rather small changes in the proportion of survey responses falling in each “relevance” category.

Arguably, however, the observed relationship between shock responses and institutional or structural variables suggests that the long phase of macroeconomic stability that accompanied European economic and monetary unification may have been fostered by stronger product market competition, within and across countries' borders, as well as by labour market deregulation. Our results suggest that these developments should have had important implications for inflation transmission mechanisms, and should have made it easier for a rule-based and credible policy framework to foster macroeconomic stability. It will be important for future research to study the evolution of these mechanisms in the aftermath of the Great Recession.

REFERENCES

Ai, Chunrong and Edward C. Norton (2003) Interaction terms in logit and probit models. Economics Letters 80, 123-129.

Andersen, Torben M. and Jan Rose Skaksen (2007) Labour Demand, Wage Mark-ups, and Product Market Integration. Journal of Economics 92:2, 103-135.

Babecký, Jan , Philip Du Caju, Theodora Kosma, Martina Lawless, Julián Messina and Tairi Rõõm (2009) Wage Costs and Alternative Margins of Adjustment: Survey Evidence from European Firms. ECB Working Paper No. 1106.

Ball, Laurence and David Romer (1990) Real Rigidities and the Non-Neutrality of Money. Review of Economic Studies 57:2, 183-203.

Bertola, Giuseppe and Richard Rogerson (1997) Institutions and labour reallocation. European Economic Review 41, 1147–71.

Bertola, Giuseppe (1999) Microeconomic Perspectives on Aggregate Labour Markets. In: Orley Ashenfelter and David Card (eds), Handbook of Labour Economics, Volume 3C, Amsterdam: North-Holland, 2985-3028.

Bewley, Truman (1999) Why Wages don't fall during a Recession. Harvard University Press. Cambridge, Massachusetts.

Cardoso, Ana Rute, and Miguel Portela (2009) Micro foundations for wage flexibility: wage insurance at the firm level. Scandinavian Journal of Economics 111:1, 29–50.

Fabiani, Silvia, Martine Druant, Ignacio Hernando, Claudia Kwapil, Bettina Landau, Claire Loupias, Fernando Martins, Thomas Mathä, Roberto Sabbatini, Harald Stahl, Ad Stokman (2006) What Firms' Surveys Tell Us about Price-Setting Behaviour in the Euro Area. International Journal of Central Banking, September, 3-47.

Fabiani, Silvia, Ana Lamo, Juliàn Messina, Tairi Rõõm (2011) Firm Adjustment During Times of Crisis. ECB Working Paper, forthcoming.

Gali, Jordi (1994) Monopolistic Competition, Business Cycles, and the Composition of Aggregate Demand. Journal of Economic Theory Vol. 63, No. 1, 73-96.

Guiso, Luigi, Luigi Pistaferri, and Fabiano Schivardi (2005) Insurance within the Firm. Journal of Political Economy 113, 1054-1087.

Leonardi, Marco and Giovanni Pica (2007) Employment Protection Legislation and Wages. IZA Discussion Paper No. 2680.

Tonin, Mirco (2005) Updated Employment Protection Legislation Indicators for Central and Eastern European Countries. Working Paper IIES.

Topel, Robert H. (1986) Local Labour Markets. Journal of Political Economy 94:3, 111-143.

Figure 1. Percentage of firms assigning "very relevant" or "relevant" to each adjustment strategy after a cost shock, by country

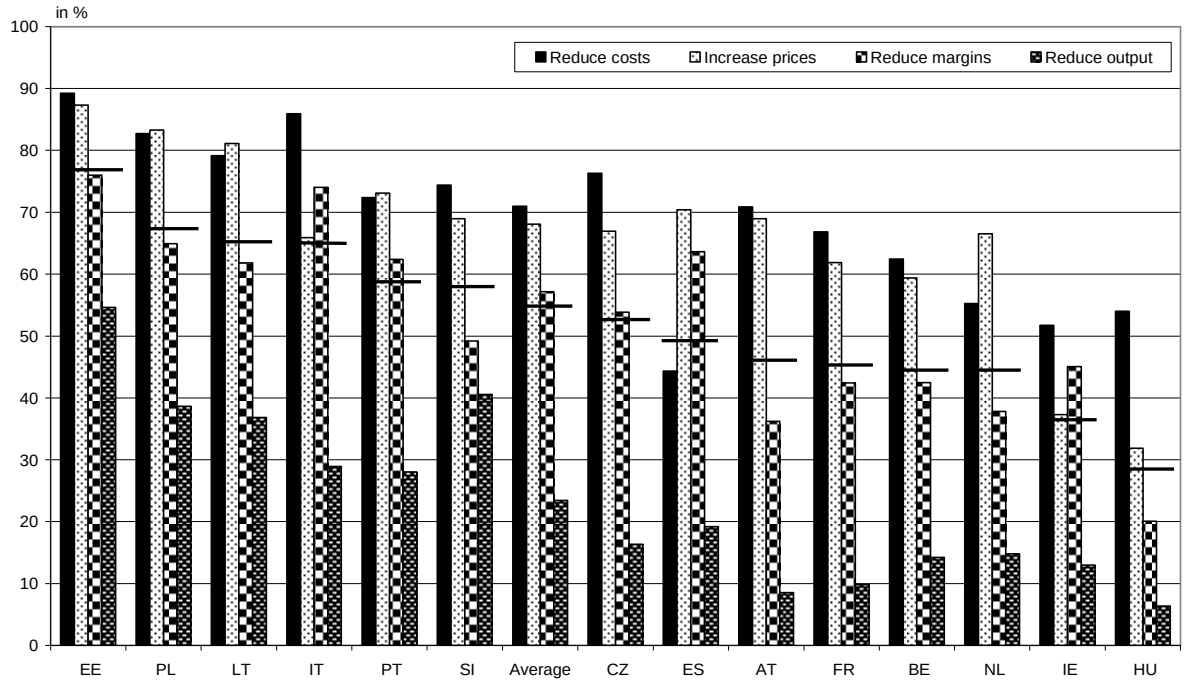

Figure 2. Correlation between EPL for permanent employment (vertical axis) and country dummy coefficients in probit regressions for "adjustment of permanent employment" as the main cost-reduction strategy after a cost shock (first column of Table 5)

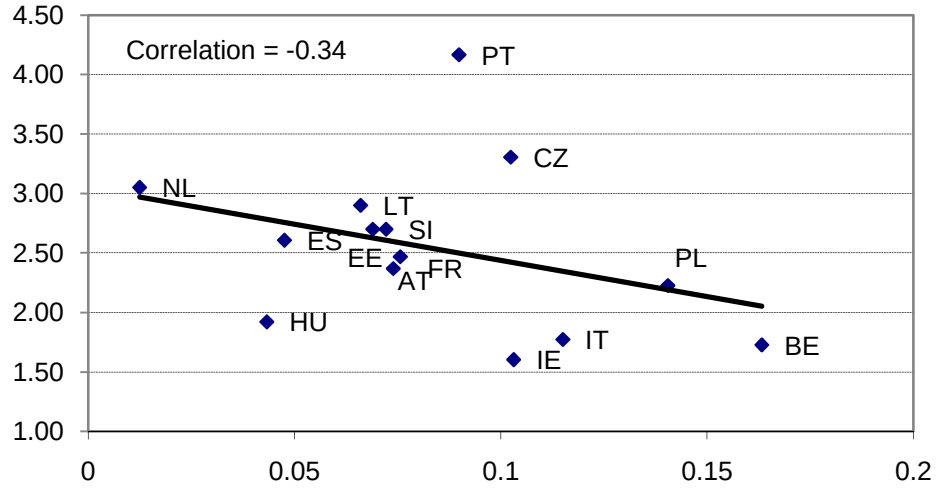

Figure 3. Correlation between EPL for permanent employment (vertical axis) and country dummy coefficients in probit regressions for "adjustment of temporary employment" as the main cost-reduction strategy after a cost shock (second column of Table 5).

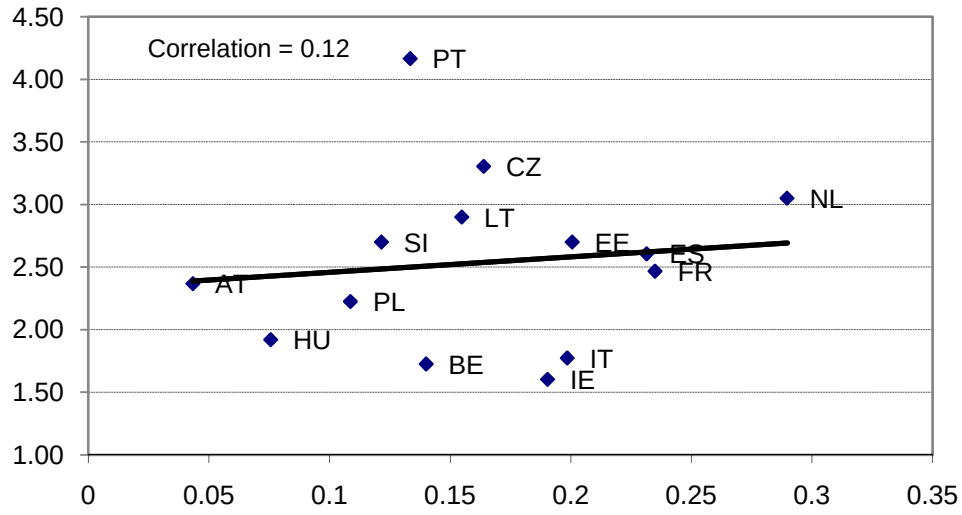

Table 1. Reactions after cost shocks and after wage shocks

Adjustment strategy	after a cost shock		after a wage shock	
	Average*	Relevant or very relevant	Average*	Relevant or very relevant
Reduce costs	2.88	70.95%	2.69	62.14%
Increase prices	2.80	68.07%	2.68	61.84%
Reduce margins	2.56	57.14%	2.49	53.26%
Reduce output	1.86	23.41%	1.88	24.25%

* Responses are scored from 1 ("not relevant") to 4 ("very relevant").

Table 2. Percentage shares of the firms' main cost-cutting strategies

Cost-cutting strategy	after a cost shock	after a wage shock
Reduce number of temporary/other employees	17.56%	19.45%
Reduce number of permanent employees	10.89%	11.39%
Reduce hours worked per employee	7.08%	7.79%
Reduce flexible wage components	9.39%	11.58%
Reduce base wages	1.64%	---
Reduce non-labour costs	53.44%	49.79%

Table 3. Adjustment of prices and (other) costs in response to cost shocks and wage shocks, probit, average marginal effects

	Cost shock		Wage shock	
	Increase price	Reduce costs	Increase price	Reduce costs
Competition (dummy)	-0.0182	0.0375***	-0.0296**	0.0292**
	(0.0119)	(0.0113)	(0.0125)	(0.0118)
Share of foreign sales	-0.0048	0.0550***	-0.0609***	0.0458**
	(0.0181)	(0.0186)	(0.0194)	(0.0193)
Labour share	-0.103***	-0.0747***	0.117***	-0.0492*
	(0.0266)	(0.0271)	(0.0294)	(0.0290)
Collective agreement, higher level (dummy)	0.0247*	0.0136	0.0390**	0.0066
	(0.0138)	(0.0139)	(0.0155)	(0.0151)
Collective agreement, firm level (dummy)	-0.0046	0.0128	-0.0217*	0.0210
	(0.0116)	(0.0119)	(0.0126)	(0.0130)
Share of foreign sales X Non-EA	-0.0632**	-0.0458	-0.0655**	-0.0453
	(0.0315)	(0.0311)	(0.0329)	(0.0308)
Labour share X Non-EA	0.0229	0.0633	0.0412	0.1140**
	(0.0507)	(0.0497)	(0.0497)	(0.050)
Observations	11123	11004	10336	10010
McFadden's Pseudo- R^2	0.088	0.080	0.097	0.149
Log-likelihood	-6572.1	-6482.3	-6309.4	-5808.3
Observed frequency	0.650	0.661	0.592	0.574
Predicted frequency	0.660	0.676	0.598	0.578

Notes: Robust standard errors in parentheses; ***, **, * denote significance at the 1%, 5% and 10% significance level, respectively. The regressions also include country, sector and firms' size effects. EA=euro area. The marginal effects of interaction terms are averages across all observations of the Ai and Norton (2003) expressions.

Table 4. Correlation between the probit coefficients of country dummies and EPL, all countries

	Cost shock	Wage shock
Increase price	0.461*	0.269
	(0.259)	(0.363)
Reduce costs	0.056	-0.208
	(0.255)	(0.274)

Notes: Bootstrap standard errors in parentheses. * denote significance at the 10% significance level according to asymptotic and bootstrap standard errors. The country effects (coefficients associated with the country dummies) are obtained from the estimations described in Table 3.

Table 5. Cost adjustment strategies after a cost shock and some relevant covariates, probit, average marginal effects

	Permanent employment	Temporary employment	Flexible wages	Hours	Non-labour cost
Competition (dummy)	0.0209**	0.0158	0.0210***	-0.0008	-0.0593***
	(0.0089)	(0.0114)	(0.0068)	(0.0071)	(0.0149)
Share of foreign sales	-0.0182	0.0156	-0.0193*	-0.0138	0.0321
	(0.0135)	(0.0166)	(0.0103)	(0.0103)	(0.0229)
Labour share	0.0279	-0.0179	0.0869***	0.0174	-0.116***
	(0.0190)	(0.0253)	(0.0152)	(0.0153)	(0.0349)
Coll. agreement higher level (dummy)	0.0116	0.0398***	-0.0145	-0.0004	-0.0217
	(0.0110)	(0.0148)	(0.0072)	(0.0095)	(0.0188)
Coll. agreement firm level (dummy)	0.0055	-0.0055	0.0001	-0.0031	-0.0014
	(0.0076)	(0.0103)	(0.0063)	(0.0064)	(0.0142)
Share of temp. employment	-0.0725***	0.135***	-0.0321**	0.0183	-0.0598*
	(0.0212)	(0.0234)	(0.0135)	(0.0147)	(0.0332)
Share of part-time empl.	0.0129	-0.0133	-0.0436**	0.0573***	0.0014
	(0.0190)	(0.0280)	(0.0156)	(0.0149)	(0.0355)
Share of variable wages	-0.0002	-0.0004*	0.0008***	-0.0001	-0.0003
	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0003)
Share of foreign sales X Non-EA	0.0272	0.0125	0.0168	0.0161	-0.0395
	(0.0208)	(0.0304)	(.0211)	(0.0215)	(0.0378)
Labour share X Non-EA	0.0894***	-0.0079	-0.0458	-0.0175	-0.0904
	(0.0440)	(0.0495)	(.0388)	(0.030)	(0.0621)
Observations	8037	8037	8037	8037	8037
Log-Likelihood	-2042.6	-3461.0	2337.9	-1689.0	-5276.1
Pseudo-R2	0.0473	0.0649	0.0705	0.0522	0.0326
Observed frequency	0.0791	0.1731	0.0945	0.0626	0.5762
Predicted frequency	0.0684	0.1552	0.0803	0.0519	0.5763

Notes: Robust standard errors in parentheses; ***, **, * denote significance at the 1%, 5% and 10% significance level, respectively. Not reported: country, sector and firms' size effects. EA abbreviates euro area. The marginal effects of interaction terms are averages across all observations of the Ai and Norton (2003) expressions.

Table 6. Cost adjustment strategies after a wage shock and some relevant covariates, probit, average marginal effects

	Permanent employment	Temporary employment	Flexible wages	Hours	Non-labour cost
Competition (dummy)	0.0275***	0.0268**	0.0232**	-0.0078	-0.0734***
	(0.0101)	(0.0125)	(0.0077)	(0.0072)	(0.0153)
Share of foreign sales	-0.0123	0.0345*	-0.0168	-0.0169	-0.0022
	(0.0151)	(0.0179)	(0.0119)	(0.0112)	(0.0244)
Labour share	0.0419*	0.0308	0.0814***	0.0018	-0.142***
	(0.0221)	(0.0271)	(0.0172)	(0.0169)	(0.0372)
Collective agreement higher level (dummy)	-0.0036	0.0352**	-0.0250**	-0.0142	-0.0012
	(0.0125)	(0.0159)	(0.0082)	(0.0109)	(0.0205)
Collective agreement firm level (dummy)	0.0120	0.0109	-0.0167*	-0.0016	-0.0078
	(0.0092)	(0.0116)	(0.0065)	(0.0072)	(0.0151)
Share of temporary employment	-0.0503**	0.137***	-0.0429**	0.0382**	-0.0884***
	(0.0220)	(0.0245)	(0.0153)	(0.0155)	(0.0338)
Share of part-time employment	0.0066	-0.0107	-0.0382	0.0620***	0.00876
	(0.0226)	(0.0308)	(0.0176)	(0.0170)	(0.0379)
Share of variable wages	-0.00058**	-0.0004	0.0012***	-0.0001	-0.0003
	(0.00023)	(0.0003)	(0.0001)	(0.0002)	(0.0003)
Share of foreign sales X non-euro area	0.0183	0.0107	0.0100	0.0049	-0.0001
	(0.0234)	(0.0330)	(0.0241)	(0.0213)	(0.0397)
Labour share X non-euro area	0.0790*	-0.0789	-0.0097	-0.0016	-0.0752
	(0.0469)	(0.0529)	(0.0440)	(0.0315)	(0.0631)
Observations	7415	7415	7415	7415	7415
Log-Likelihood	-2194.3	-3360.7	-2441.0	-1651.8	-4942.0
Pseudo-R2	0.0363	0.0742	0.0601	0.0524	0.0371
Observed frequency	0.0957	0.1926	0.1118	0.0672	0.5154
Predicted frequency	0.0866	0.1704	0.0992	0.0564	0.5149

Notes: Robust standard errors in parentheses; ***, **, * denote significance at the 1%, 5% and 10% significance level, respectively. Not reported: country, sector and firms' size effects. EA abbreviates euro area. Changes to the marginal effects of interaction terms are averages across all observations of the Ai and Norton (2003) expressions.

Appendix

Theoretical impact of shocks on wages and employment

To maximise profits in a 'right to manage' setting employers should choose employment so as to equate the wage, which they take as given, to labour's marginal impact on firm's revenues. Formally, consider a log-linear schedule

$$w_i = -\eta_i l_i + a_i$$

where w is the log of employer labour cost, l_i is employment, a indexes marginal revenue, and $\eta_i<1$ is the elasticity of the inverse labour demand schedule. Symmetrically, let ε_i denote the elasticity of wages to employment:

$$w_i = \varepsilon_i l_i + s_i \ .$$

Solving for wages and employment, we have

$$w_i = [\eta_i/(\varepsilon_i+\eta_i)]s_i + [\varepsilon_i/(\varepsilon_i+\eta_i)]a_i,$$

$$l_i = (a_i - s_i)/(\varepsilon_i+\eta_i).$$

The employment impact of the wage shocks represented by Δs in this simple framework,

$$\Delta l_i = \Delta s_i/(\varepsilon_i+\eta_i),$$

is larger when η , the elasticity of labour demand, is small. Since η is the weighted (by the cost share of labour) average of the constant-output elasticity of substitution and of the elasticity of revenues to output, it depends on the degree of decreasing returns to labour, on the elasticity of product demand, and on labour's substitutability with other factors of production, which is similar relevant to responses to changes in the prices of factors other than labour. The equilibrium wage and employment reactions to those and other labour demand shocks are

$$\Delta w_i = [\varepsilon_i/(\varepsilon_i+\eta_i)]\ \Delta a_i, \qquad \Delta l_i = \Delta a_i/(\varepsilon_i+\eta_i) = \Delta w_i/\varepsilon_i.$$

The employment response to such shocks is small when it occurs along a steeply increasing labour supply curve. Conversely, if wages do not change (possibly because they are set by binding agreements at more aggregate levels), then employment responds strongly to other cost shocks.

Table A.1. Summary statistics for control variables

	Type	Mean	Std. Dev.	Min	Max	Number of obs.
Country:						
AT (Austria)	Dummy	0.037		0	1	15235
BE (Belgium)	Dummy	0.094		0	1	15235
CZ (Czech Republic)	Dummy	0.026		0	1	15235
EE (Estonia)	Dummy	0.024		0	1	15235
ES (Spain)	Dummy	0.120		0	1	15235
FR (France)	Dummy	0.133		0	1	15235
HU (Hungary)	Dummy	0.132		0	1	15235
IE (Ireland)	Dummy	0.065		0	1	15235
IT (Italy)	Dummy	0.063		0	1	15235
LT (Lithuania)	Dummy	0.023		0	1	15235
NL (Netherlands)	Dummy	0.070		0	1	15235
PL (Poland)	Dummy	0.076		0	1	15235
PT (Portugal)	Dummy	0.094		0	1	15235
SI (Slovenia)	Dummy	0.044		0	1	15235
Sector:						
Manufacturing	Dummy	0.399		0	1	15171
Energy	Dummy	0.012		0	1	15171
Construction	Dummy	0.076		0	1	15171
Trade	Dummy	0.204		0	1	15171
Market services	Dummy	0.272		0	1	15171
Financial intermediaries	Dummy	0.024		0	1	15171
Non-market services	Dummy	0.013		0	1	15171
Employment size:						
5-19	Dummy	0.260		0	1	14972
20-49	Dummy	0.224		0	1	14972
50-199	Dummy	0.304		0	1	14972
200+	Dummy	0.212		0	1	14972
Competition	Dummy	0.164		0	1	14139
Share of foreign sales	Fraction	0.193	0.308	0	1	13810
Labour share	Fraction	0.339	0.201	0.001	1	13615
Collective agreement, higher level	Dummy	0.597		0	1	15099
Collective agreement, firm level	Dummy	0.243		0	1	15026
EPL for permanent workers	Index, 0-5	2.442	0.734	1.603	4.167	13860
Share of part-time employment	Fraction	0.094	0.180	0	1	15021
Share of temporary employment	Fraction	0.094	0.184	0	1	14991
Share of variable wages	Fraction	0.120	0.191	0	1	13277