

# **Eurosystem Wage Dynamic Network**

## ***How are firms' wages and prices linked: survey evidence in Europe***

by

Martine Druant, Silvia Fabiani, Gabor Kezdi, Ana Lamo,  
Fernando Martins, Roberto Sabbatini\*

**Preliminary and incomplete**

**[This draft: 20 June 2008]**

---

\* Affiliation: National Bank of Belgium (Martine Druant), Bank of Italy (Silvia Fabiani and Roberto Sabbatini), Central European University and Magyar Nemzeti Bank (Gabor Kezdi), ECB (Ana Lamo), Bank of Portugal (Fernando Martins). Corresponding author: [silvia.fabiani@bancaditalia.it](mailto:silvia.fabiani@bancaditalia.it). This paper has been prepared in the context of the Eurosystem Wage Dynamic Network (WDN) research project. We are very grateful to Giuseppe Bertola, Juan Jimeno, Julian Messina, Paolo Sestito and Frank Smets for their useful comments, to all members of the WDN survey group for their fruitful cooperation and to Rebekka Christopoulou for her remarkable data assistance. The opinions expressed in the papers are those of the authors and do not necessarily reflect the views of the institutions they belong to.

## Introduction

The paper addresses the issue of the frequency and timing of changes in wages and prices across firms, sectors and countries in the EU. It provides important micro-founded evidence for models of wage and price staggering that have become very popular in New Keynesian DSGE models. The important role of labour markets in generating price rigidity in structural models is discussed for instance in Altissimo *et al.* (2006). By incorporating real wage rigidities, i.e. the slow adjustment of real wages to the underlying market conditions in the context of New Keynesian Philips Curve framework, these models seem to fit better the data.

This paper uses a new and unique cross-country dataset - unprecedented by international standards in terms of geographical and sectoral coverage - based on an ad-hoc survey on wage and pricing policies at the firm level. The survey was developed within the framework of the Wage Dynamics Network (WDN), a research network grouping 23 central banks in the EU and coordinated by the European Central Bank. It was carried out by 17 national central banks (Austria, Belgium, Czech Republic, Estonia, France, Germany, Greece, Hungary, Italy, Ireland, Lithuania, Luxembourg, the Netherlands, Poland, Portugal, Slovenia and Spain) between the end of 2007 and the first half of 2008, on the basis of a harmonised questionnaire that aimed at uncovering specific features of firm's price and wage setting policies and their relationships. Overall, more than 17,000 firms were interviewed, belonging to different size classes and operating in different sectors of the economy.

The uniqueness of this survey is at least twofold. First, its country coverage. Given the large heterogeneity of labour markets across European countries, the harmonised questionnaire allows to widen our understanding of the effects of different labour market institutions and policies in price and wage setting practices. Second, the scope and richness of the information collected. In addition to firm characteristics such as sector, market structure, degree of competition, labour force structure and institutional features, the survey collects information on both price and wage setting and adjustments.

The use of surveys to investigate firm's pricing policies was pioneered by the seminal work of Blinder (1991) and Blinder *et al.* (1998). Their approach has led to similar analyses in other countries and was recently adopted within the Eurosystem Inflation Persistence Network (IPN) (for the results, see Fabiani *et al.*, 2007). The survey on which this paper is based can be somehow viewed as the "natural" follow-up to some of the results on pricing decisions in the euro area revealed by the IPN (Altissimo *et al.*, 2006; Fabiani *et al.*, 2007). Indeed one of the most interesting finding of studies based on micro quantitative and survey data (see Dhyne *et al.*, 2007, Vermeulen, *et al.*, 2007, and Fabiani *et al.*, 2006) is the substantial heterogeneity in the degree of price stickiness across products and sectors that could reflect, among other factors, the variability of input costs and the cost structure at the firm and sectoral level. This evidence, albeit anecdotic, suggests that the observed price stickiness mostly reflects wage inertial behaviour and hence put firms' wage setting policies at the heart of our interests.

In the existing literature, surveys focused on wage setting are mostly aimed at disentangling the existence and the reasons of downward wage rigidity; seminal works in this field are those by Blinder (1990), Agell and Lundborg (2003), Campbell and Kamlani (1997) and Wolfgang and Pfeiffer (2006). This paper, and more generally the studies based on the WDN survey, somehow enrich this research approach and complement previous IPN results by focusing explicitly on how firms set and change prices and wages and on the relationship between wage and pricing policies and adjustments.

In particular, this study aims at providing answers to the following questions:

(i) how often are prices and base wages changed? Are adjustments synchronized or not and do they tend to take place in specific months of the year?

(ii) Are there significant differences across sectors and countries regarding the frequency and timing of wage and price changes and their relationship? If such differences are indeed present, how do they eventually relate to institutional and structural features such as the intensity of competition, the relevance of international trade or the labour intensity of production, as suggested by the IPN results?

More generally, the analysis of price and wage dynamics simultaneously could also shed some light on the impact of recent changes in labour market institutions on wage and labour cost dynamics. Specifically, it could give some indications about the sources behind the substantial degree of wage moderation observed in a number of European countries, which in turn could be potentially useful in terms of implications for monetary policy and structural reform.

The structure of the paper is the following. Section 1 briefly present the data collected by the WDN survey. Section 2, 3 and 4 carry out some descriptive analysis on how often firms adjust their price and wages and the relationship between wage and price. Section 5 looks at the same questions as the previous ones by mean of regressions analysis that uses the richness of firm-level information to assess the main features of price and wage setting strategies and of their possible relationship. Some conclusions are summarized in Section 6.

## **1 The data**

The data used for this paper is a sub-set of the harmonised sample of the WDN survey. The survey covers 17 European countries, 12 from the euro area and five of the new EU member states. Although the national surveys were organized by each national central bank, the questionnaire and the target population of firms was very similar across countries. A “core questionnaire” was developed in a co-coordinated fashion and individual country surveys made very few modifications to the structure of this set of common questions; the national questionnaires could also include other questions aimed at analysing specific issues particularly relevant for each economy. The country-level data were harmonised into a common dataset by the WDN staff.

The sub-set of it on which this paper is based does not contain Germany (due to data confidentiality reasons which will be overcome in the revised draft of the paper), Lithuania and Luxemburg (where the surveys had not been completed yet). It also excludes very small firms and those operating in the energy sector. Broadly speaking, it contains firms employing more than five employees in manufacturing, construction and services (trade, business services and financial intermediation). Appendix 1 discusses some more details on the survey methodology and presents the most important information on the individual country samples.

Sampling probabilities and non-response patterns vary across countries as well as by sector and firm size within countries. All analyses need to handle this problem in one way or another. In this paper, the descriptive analysis uses appropriate weights, while the regressions (binary and ordered probability models) condition on country, sectors and firm size. The weights used in this paper are the employment-adjusted weights produced by the WDN staff and available in the harmonised dataset. Employment-adjusted weights attached to each observation (firm) in the sample show how many employees that observation represents in the population. They are defined as the sum of all employees in the population in a sampling category (by country, sector, firm size category, perhaps region) divided by the number of observations (firms) in that category. They can also be thought of as the product of three fractions: the intended sampling probability, the response rate, and employees per firm. Employment-adjusted weights add up to total employment in the population the sample represents.

Table 1 – Sample composition by country

Country	Number of firms	%
AT	548	3.7
BE	1,420	9.7
CZ	399	2.7
EE	366	2.5
ES	1,769	12.1
FR	2,015	13.7
GR	402	2.7
HU	1,799	12.3
IE	975	6.6
IT	953	6.5
NL	1,068	7.3
PL	896	6.1
PT	1,425	9.7
SI	650	4.4
<b>Total</b>	<b>14,685</b>	<b>100</b>

Table 2 – Sample composition by sector and size

(a) Number of observations

	5-19	20-49	50-199	>200	Total
Number of firms:					
Manufacturing	839	1,228	2,221	1,756	6,044
Construction	370	297	323	113	1,103
Trade	1,118	700	759	358	2,935
Business services	1,365	1,061	1,086	764	4,276
Financial services	105	34	77	111	327
<b>Total</b>	<b>3,797</b>	<b>3,320</b>	<b>4,466</b>	<b>3,102</b>	<b>14,685</b>
Employees ( <i>thousands</i> ):					
Manufacturing	2,161	4,115	4,912	7,646	18,835
Construction	805	561	565	314	2,245
Trade	2,815	2,402	1,848	2,355	9,419
Business services	2,474	2,546	2,875	6,775	14,670
Financial services	148	78	246	506	978
<b>Total</b>	<b>8,404</b>	<b>9,702</b>	<b>10,446</b>	<b>17,596</b>	<b>46,148</b>

(b) Percentages

	5-19	20-49	50-199	>200	Total
Number of firms:					
Manufacturing	5.7	8.4	15.1	12.0	41.2
Construction	2.5	2.0	2.2	0.8	7.5
Trade	7.6	4.8	5.2	2.4	20.0
Business services	9.3	7.2	7.4	5.2	29.1
Financial services	0.7	0.2	0.5	0.8	2.2
<b>Total</b>	<b>25.9</b>	<b>22.6</b>	<b>30.4</b>	<b>21.1</b>	<b>100.0</b>
Employees:					
Manufacturing	4.7	8.9	10.6	16.6	40.8
Construction	1.7	1.2	1.2	0.7	4.9
Trade	6.1	5.2	4.0	5.1	20.4
Business services	5.4	5.5	6.2	14.7	31.8
Financial services	0.3	0.2	0.5	1.1	2.1
<b>Total</b>	<b>18.2</b>	<b>21.0</b>	<b>22.6</b>	<b>38.1</b>	<b>100.0</b>

Tables 1 and 2 present the number of observations and the distributions by country, sector and firm size. Table 2 also shows the distribution based on the number of employees represented by the sample. The total sample size is a little below 15,000, representing more than 46 million employees. By design, the sample is relatively balanced across firm size categories, and its sectoral distribution closely follows the distribution of employment.

## 2 Evidence on price-setting

### 2.1 Frequency of price changes: some descriptive evidence

We start our investigation focusing on firms' pricing policies, namely on the frequency of price changes. Other pieces of information available from the survey, for example regarding how firms set their prices, will also be briefly considered, in particular to assess their consistency with IPN results, that were based on a similar approach but on a much smaller sample of firms and countries and on information collected around four years ago.

The survey asked firms about the frequency of price changes for the firm's main product (see Appendix 2, question 31). This variable is a categorical one that takes ordered values (1=daily, 2=weekly, 3=monthly, 4=quarterly, 5=half-yearly/twice a year, 6=once a year, 7= less frequently than once a year, 8= other/ never/ there is not a defined pattern). When analyzing the answers, we aggregate the first three and the fourth and fifth answers into two categories, respectively (1=daily-monthly; 2=quarterly-half-yearly/ twice a year).

Table 3 shows that, in the whole sample, about half of the firms change their prices once a year or less frequently. Even though there are no major differences between euro area and non-euro area countries when considered as a group, the Netherlands and Poland seem to be the countries where prices change more frequently whereas France and Greece are those with the lowest share of firms adjusting more frequently than yearly. Needless to say that these results are very sensitive to the sample selection, in particular in terms of sectors and firms' sizes.

It is worth remarking that a low frequency of price changes does not necessarily mean that prices are sticky. As argued in Altissimo *et al.* (2006) price stickiness corresponds to a low responsiveness of prices to fundamentals; hence, if there is no change in costs relevant to the firm or in demand, there is no reason for a firm to adjust its prices.

Table 3 - Frequency of price changes by country  
(percentages)

	daily to monthly	quarterly to half yearly	yearly	less frequently	no pattern
Total	9.9	14.0	41.9	6.7	27.1
Euro Area	10.4	13.2	42.3	5.8	27.7
Austria	5.9	12.1	37.7	5.3	38.8
Belgium	7.1	16.2	39.8	7.8	28.5
France	5.3	14.0	48.1	5.3	27.2
Greece	3.8	16.7	41.8	8.0	29.7
Ireland	13.1	13.4	34.7	9.8	28.6
Italy	7.9	12.8	33.5	6.4	39.4
Netherlands	37.5	15.7	38.9	7.8	0.0
Portugal	7.3	11.7	43.4	2.7	34.9
Slovenia	6.6	16.8	39.1	6.6	24.5
Spain	8.5	8.3	50.3	3.2	29.5
Non-Euro Area	8.1	16.4	40.5	9.3	25.0
Czech Republic	10.1	13.2	38.0	7.3	31.1
Estonia	4.1	18.9	30.3	8.2	38.0
Hungary	5.0	11.1	47.7	7.1	28.1
Poland	15.4	28.0	31.1	15.2	10.4

Unweighted figures, rescaled excluding non-responses.

Table 4 - Frequency of price changes by sector  
(percentages)

	daily to monthly	quarterly to half yearly	yearly	less frequently	no pattern
Total	9.9	14.0	41.9	6.7	27.1
Manufacturing	6.0	13.7	45.4	6.8	27.7
Construction	10.4	14.6	29.2	5.0	40.2
Trade	20.2	19.3	31.8	3.7	24.6
Business services	6.9	10.4	49.0	8.7	24.2
Financial services	25.6	14.9	17.2	8.4	31.7

Unweighted figures, rescaled excluding non-responses.

The analysis by sector reveals indeed that firms in manufacturing and business services change their prices much less frequently than those in trade and financial intermediation, which is the only sector where the yearly frequency is not the modal one (Table 4). Construction is the sector with the highest fraction of firms reporting no regular time-dependent pattern in price revisions. When interpreting the results concerning financial services, a note of caution regards on the one hand, the concept of price, which might be difficult to capture for respondents, and on the other the fact that in most countries interviews were carried out in a period of exceptional turbulence on international financial markets.

As regards differences across firms' size, very small companies, i.e. those with less than 20 employees, are apparently the ones that change prices more frequently, with 13 percent of them adjusting at least once a month (Table 5). The other classes show no major difference.

Table 5 - Frequency of price changes by firms' size  
(percentages)

	daily to monthly	quarterly to half yearly	yearly	less frequently	no pattern
Total	9.9	14.0	41.9	6.7	27.1
from 5 to 19 employees	12.7	14.6	38.5	9.0	24.4
from 20 to 49 employees	7.9	14.0	42.1	7.7	27.9
from 50 to 199 employees	9.0	13.5	43.6	5.5	28.1
more than 200 employees	9.9	13.8	43.3	4.4	28.1

Unweighted figures, rescaled excluding non-responses.

There are number of empirical papers linking price stickiness and the degree of competition. Álvarez and Hernando (2007) analyze the relationship between price flexibility and competition, focusing on euro area manufacturing and services industries. They conclude inter alia that price setting strategies of the most competitive firms give them greater room of manoeuvre to react to shocks. In addition, Carlton (1986) and Hall et al. (2000) find that more competitive firms tend to adjust prices faster than firms facing less elastic demand. Geroski (1992) shows that price reaction to shocks is faster in more competitive industries.

In line with this evidence, the results presented in Tables 6 and 7 indicate that larger competition induces higher price flexibility, in terms of frequency of price changes, on the part of firms. Results based on one of the survey questions asked about product-market competition in the following way (see Appendix 2, question 30): "Suppose that the main competitor for your firm's main product decreases its prices; how likely is your firm to react by decreasing its own price?". Firms that answered "very likely" or "likely" are classified as being subject to strong competition, while those that answered "not likely" or "not at all" are classified as facing weak competition.

Table 6 - Frequency of price changes and degree of competition  
(percentages)

	daily to monthly	quarterly to half yearly	yearly	less frequently	no pattern
Total	7.7	13.7	42.2	6.5	29.3
Weak	4.2	10.9	46.4	7.8	29.9
Strong	10.4	15.9	39.0	5.4	28.9

Unweighted figures, rescaled excluding non-responses.

Table 7 – Regression: frequency of price changes and competition  
(OLS estimates)

Dependent (dummy) variable: <i>Prices are changed once per year or less often</i>	Coef.	Std. Err.	t	P>t
degree of competition	-0.10	0.01	-100.78	0.00
constant	0.54	0.01	790.65	0.00

Finally, also consistently with the anecdotic IPN findings, there is a negative relationship between the share of labour input on total costs (see Appendix 2, question 40) and the frequency of price adjustment (Tables 8 and 9). However, the impact of the labour share does not seem to be linear as firms experiencing very low labour shares also adjust their prices infrequently.

This relationship will be investigated more thoroughly at the micro-level within a multivariate framework in section 5.

Table 8 - Frequency of price changes by labour share  
(percentages)

	daily to monthly	quarterly to half yearly	yearly	less frequently	no pattern
Total	9.9	14.0	42.4	6.7	26.4
from 0 to 19 percent	12.6	16.7	37.4	4.7	28.1
from 20 to 39 percent	7.3	14.1	44.2	6.8	27.0
from 40 to 80 percent	10.7	12.3	43.8	8.0	24.5
more than 80 percent	11.6	7.5	47.2	8.0	24.4

Unweighted figures, rescaled excluding non-responses.

Table 9 – Regression: labour share and frequency of price changes  
(OLS estimates)

Dependent (dummy) variable: <i>Prices are changed once per year or less often</i>	Coef.	Std. Err.	t	P>t
labour share	0.62	0.08	80.02	0.00
labour share^2	-0.52	0.09	-50.78	0.00
constant	0.36	0.01	260.21	0.00

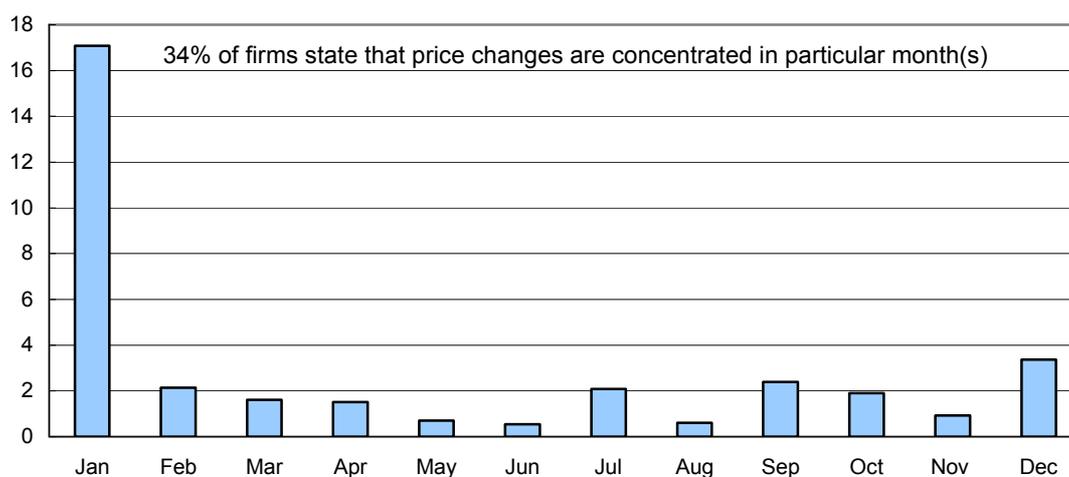
## 2.2 Timing of price changes

Apart from the typical frequency of price adjustment, other features of price setting at the firm level were investigated in the survey.<sup>1</sup>

In the literature, firms' pricing strategies are modelled either as a time-dependent process, where the timing of price adjustment is exogenously given and does not depend on the state of the economy, or as a state-dependent process. Which of the two modelling approaches reflects better firms' actual behaviour and the degree of synchronisation of price revisions have important implications for monetary policy makers.

With a view on obtaining empirical evidence on these issues, firms were asked to specify whether their price changes take place with no predefined pattern or are concentrated in particular month(s) (see Appendix 2, question 32). This latter option was chosen by about 34 per cent of the sample. This result is very consistent with IPN evidence, where around one-third of firms reported to follow mainly time-dependent rules. Looking at the month in which adjustments typically take place, there appears to be a considerable degree of synchronisation among firms, as half of those reporting the presence of some time regularity indicate January as the month in which prices are typically changed (Figure 1).

Figure 1: Timing of price changes  
(percentage of firms reporting to change their price in a particular month)



Weighted figures (weights based on employment), rescaled excluding non-responses.

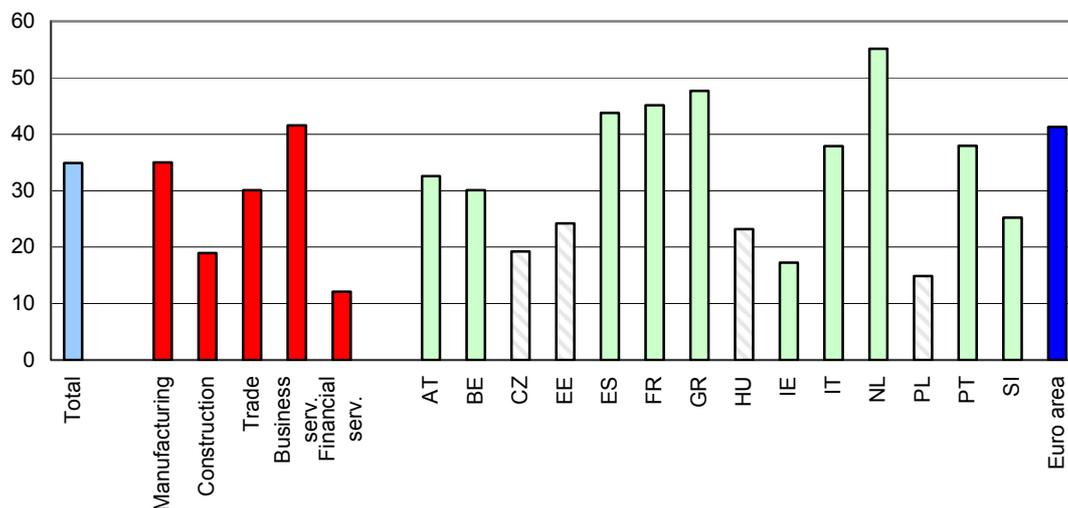
The concentration of price adjustments in particular months is less common in financial intermediation, consistently with a higher frequency of adjustment found in this sector; on the other hand, it is more widespread in business services (Figure 2). In all sectors, January is the month in which the largest part of price changes occurs.

Some variation can also be observed across countries (Figure 2). The fraction of "time-dependent" firms ranges from a minimum in Poland (15 percent) and a maximum in the Netherlands (55 percent). It exceeds 40 percent in Spain, France and Greece as well. In all countries, most price changes occur in January, although a relatively high fraction of firms in the

<sup>1</sup> This also allows to verify the robustness of previous IPN findings to an enlarge sample of countries and firms considered in the survey and to a different economic situation.

Netherlands and Poland choose also December. In Estonia and Slovenia some scattering among months is observed.

Figure 2: Timing of price changes across sectors and countries  
(percentage of firms reporting to change their price in a particular month)



Weighted figures (weights based on employment), rescaled excluding non-responses.

### 3 Evidence on wage-setting

#### 3.1 The frequency of wage changes: some descriptive evidence

The survey investigated the process of wage setting at the firm level through three separate questions about the frequency of wage changes: those due to factors unrelated to tenure and/or inflation, those due to tenure and those due to inflation. The exact wording of the question is the following: “How frequently is the base wage of an employee belonging to the main occupational group in your firm typically changed in your firm?” (See Appendix 2, question 9). Respondents could choose from the following five options: a) more than once a year; b) once a year; c) once every two years; d) less frequently than once every two years; e) never / don’t know.

For analyzing the answers, we aggregated the third and fourth categories into a single one, which we labelled as “less frequently than once a year”. We also created a synthetic variable for the frequency of wage changes for any of the listed three reasons considered, which is defined as the highest frequency of wage change at the firm level independently of the reason behind it. Figure 3 shows the (weighted) distribution of the answers.

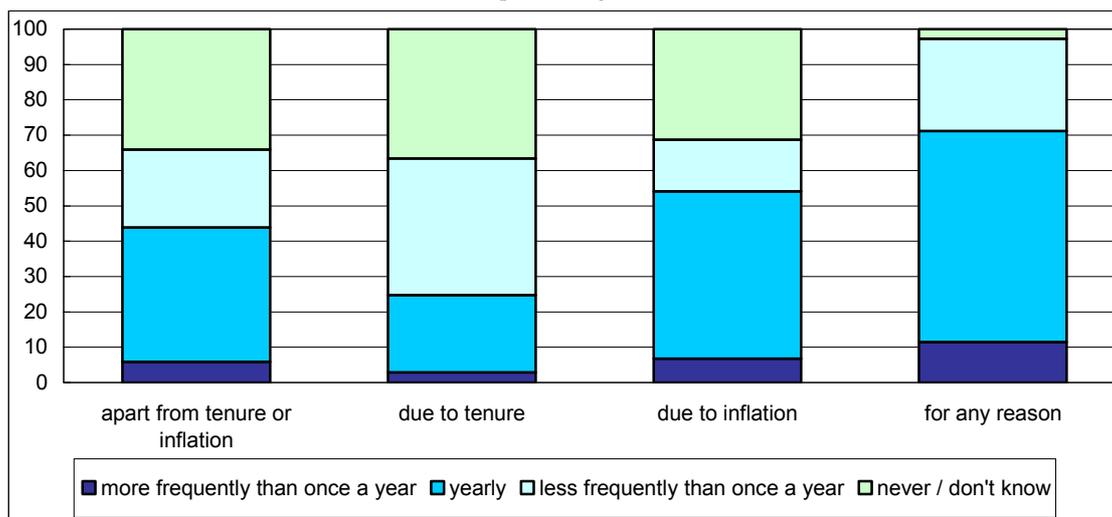
As shown in the figure, around 60 percent of all firms change their base wage once a year for one reason or another; 12 percent of them do it more often and 26 percent more rarely. The fraction of firms with never / don’t know frequency (i.e. those that answered never/don’t know to all three questions) is negligible. In the sample as a whole, the frequency of wage changes due to inflation is the highest, while that due to tenure is the lowest.

There is little variation across sectors, with construction being the only sector to exhibit some differences (Figure 4). Wage changes are least frequent in services, more frequent in manufacturing and most frequent in construction. Even in construction, though, 60 percent of the firms reported

wage changes at the yearly frequency and only 24 percent reported higher frequency. At the same time, there is substantial cross-country variation in the answers (Figure 5).

Greek and Slovene firms seem to change the base wage most frequently, followed by Belgium, France and Estonia, while Italian firms seem to change wages the least frequently, followed by Hungary and Portugal. Apart from Italy, though, the modal frequency is one year in all countries.

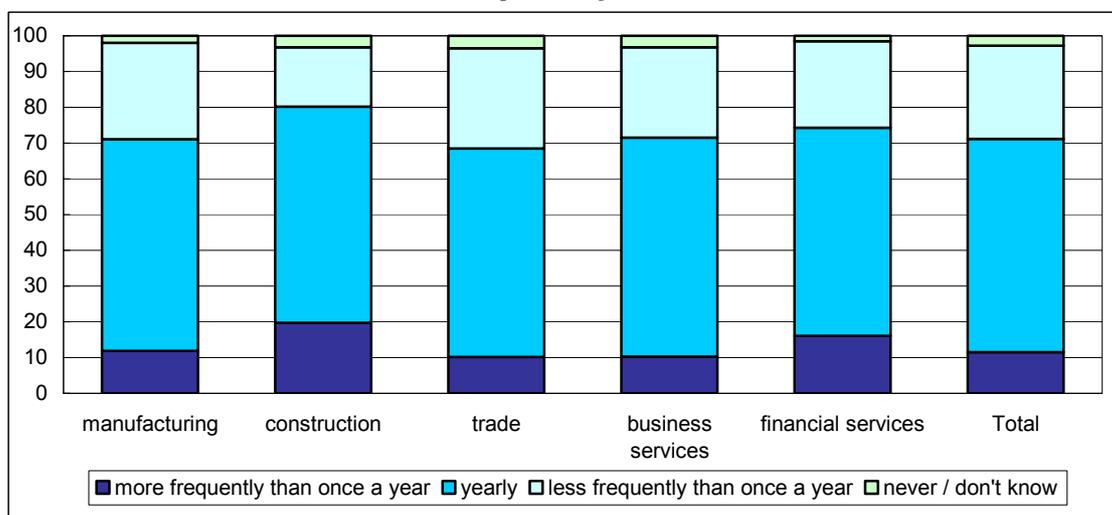
Figure 3 - Frequency of wage changes  
(percentages)



Figures weighted by employment weight, rescaled excluding non-responses.

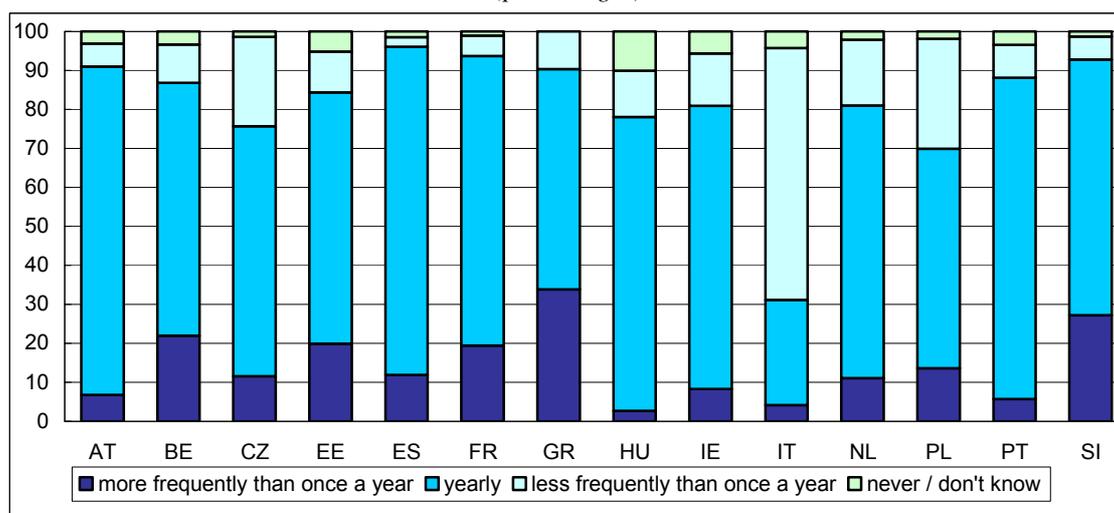
While there is considerable heterogeneity across countries, the results reported in Table 10 show very little difference between firms in euro-area and non-euro area EU member countries.

Figure 4 - Frequency of wage changes (for any reason) by sector  
(percentages)



Figures weighted by employment weight, rescaled excluding non-responses.

Figure 5 - Frequency of wage changes (for any reason) by country  
(percentages)



Figures weighted by employment weight, rescaled excluding non-responses.

Table 10 - Frequency of wage changes for any reasons, by euro-area membership  
(percentages)

	more frequently than once a year	yearly	less frequently than once a year	never / don't know	Total
Non-euro area	12.0	60.6	24.5	2.9	100.0
Euro area	11.3	59.4	26.6	2.7	100.0
Total	11.5	59.7	26.1	2.7	100.0

Weighted figures (employment-adjusted weights), rescaled excluding non-responses.

### 3.2 The role of competition, labour intensity and collective bargaining

Apart from specific features related to sectors, size and country, firms' wage policies could depend also on the economic and institutional environment in which they operate.

As a first step, we consider the intensity of the competitive pressures faced by the firm. Table 11 shows that firms that are subject to more intense competition are associated with a higher frequency of wage changes.<sup>2</sup> Consistent results, though slightly weaker, are obtained by capturing the degree of product-market competition on the basis of the firm's main price-setting strategy; specifically, firms are considered to operate in a highly competitive environment if they report that the price is set following the main competitors (see Appendix 2, question 28).

Table 11 - Frequency of wage changes for any reasons, by degree of product market competition  
(percentages)

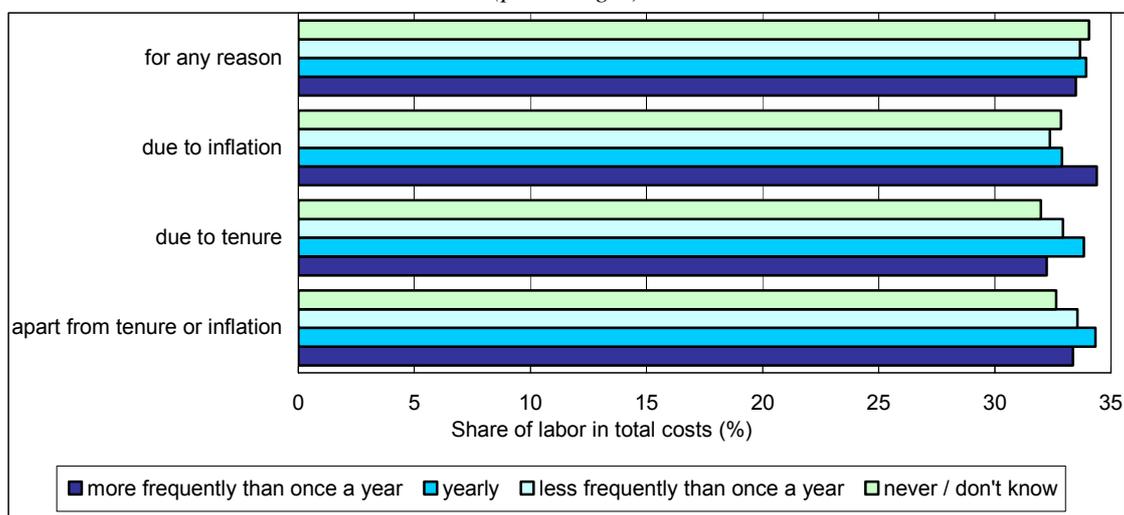
	more frequently than once a year	yearly	less frequently than once a year	never / don't know	Total
low competition	9.5	57.8	29.3	3.4	100
high competition	12.5	59.0	26.1	2.4	100
Total	11.2	58.4	27.5	2.8	100

Weighted figures (employment-adjusted weights), rescaled excluding non-responses.

<sup>2</sup> Our measure of competition is based on answers to question 30, that measures the likelihood that a price reduction by competitors triggers a similar reaction in the firm (see Appendix 2).

As a second step, we consider the relationship between the frequency of wage changes and the share of labour costs at the firm level. Figure 6 shows that the frequency of wage changes for any reason does not appear to be systematically related to labour intensity.

Figure 6. Share of labour in total costs and frequency of wage changes  
(percentages)



Weighted figures (employment-adjusted weights), rescaled excluding non-responses.

Finally, we look at the possible influence that collective agreements signed at the national, sectoral or other level outside and above the firm have on the duration of wages. Table 12 shows the frequency of wage changes (for any reason) for firms that apply collective pay agreements negotiated and signed outside the firm and those that do not.

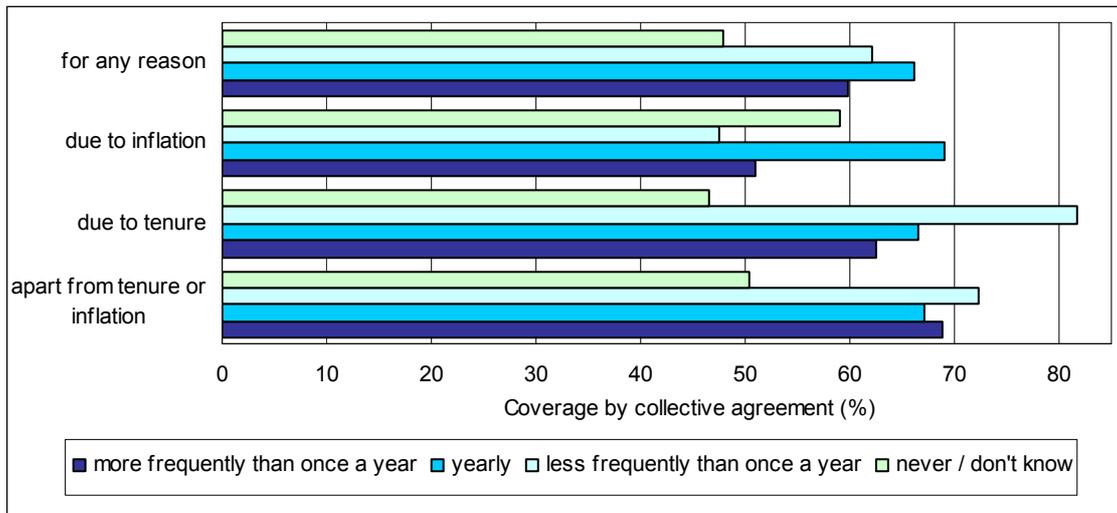
Table 12 - Frequency of wage changes for any reasons and collective agreements negotiated outside the firm  
(percentages)

	more frequently than once a year	yearly	less frequently than once a year	never / don't know	Total
No collective agr.	12.2	63.2	21.8	2.8	100
Collective agr.	11.1	57.5	28.7	2.8	100
Total	11.4	59.3	26.5	2.8	100

Weighted figures (employment-adjusted weights), rescaled excluding non-responses.

Table 12 implies that firms applying collective agreements signed at national or sectoral level change wages less frequently. This relationship is weakly confirmed by looking at the wage change frequency and the fraction of the firms' workers covered by collective pay agreements (Figure 7). Yearly wage-adjuster firms seem to have the highest coverage, and more frequent adjusters seem to have the lowest (not counting the very few firms with never/don't know answer). The relationship is most pronounced in terms of wage changes due to tenure.

Figure 7. Frequency of wage changes and coverage of collective agreements  
(percentages)



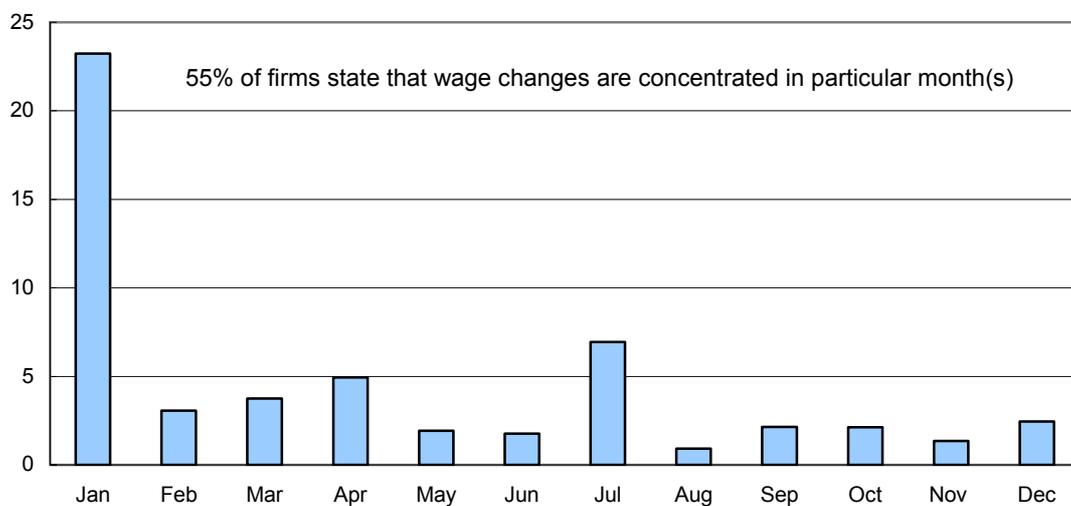
Weighted figures (employment-adjusted weights), rescaled excluding non-responses.

### 3.3 Timing of wage changes

**When do firms typically change wages?** Just like for price changes, firms were asked some details concerning the timing of the wage-adjustment process (see Appendix 2, question 10). They had to specify whether or not wage changes are concentrated in any particular month(s). If this was the case, they were asked to indicate the month(s) in which this typically happens.

More than half of firms (55 percent) stated that wage changes are concentrated in particular month(s) (Figure 8). A considerable degree of synchronisation among firms is observed, as almost half of them carry out the wage change in January. Another, although smaller, peak occurs in July (7 percent). The other months represent shares around or below 5 percent.

Figure 8. Timing of wage changes  
(percentage of firms reporting to change wages in a particular month)

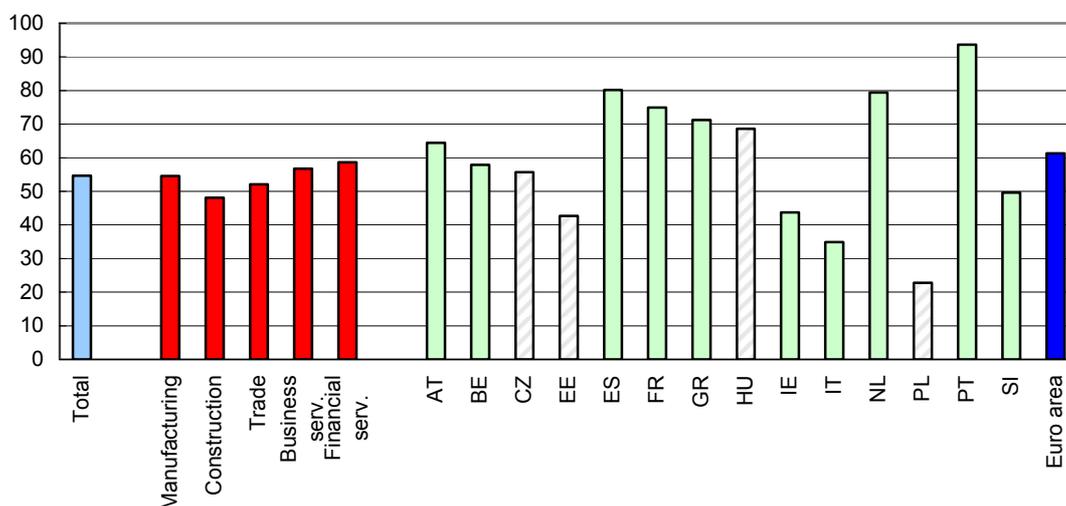


Weighted figures (weights based on employment), rescaled excluding non-responses.

The pattern of concentration of wage changes in particular month(s) is very similar across sectors. It is below average in construction and trade. In all sectors, January is the month in which the largest part of wage changes occurs; July also has some importance in manufacturing and business services. Wage changes are more scattered among different months in financial intermediation.

As to countries, the concentration of wage changes is practised least in Poland (23 percent of firms) and most in the Portugal (94 percent). The share of time-dependent wage rules also exceeds 70 percent in Spain, France, Greece and the Netherlands. In all countries, most wage changes occur in January, except for France (July) and Slovenia (August). July is also important in Belgium, and Greece. Besides, in some countries, another specific month is indicated by a relatively large share of firms. The monthly pattern could be linked to the use of wage indexation mechanisms in some countries.

Figure 9: Timing of wage changes across sectors and countries  
(percentage of firms reporting to change wages in a particular month)



Weighted figures (weights based on employment), rescaled excluding non-responses.

## 4 The link between wage and price changes: some descriptive analysis

After having examined separately the main characteristics of price and wage change at the firm level, we now turn to the relationship between the two. The main issues we are interested in is whether wage and price adjustment decisions are synchronized or not, to explore the causal link between the two and identify empirical regularities that characterise firms where such a link is stronger. The first and second aspect of this question are dealt with in this section, the third aspect will be discussed in Section 5.

### 4.1 Synchronization between wage and price changes

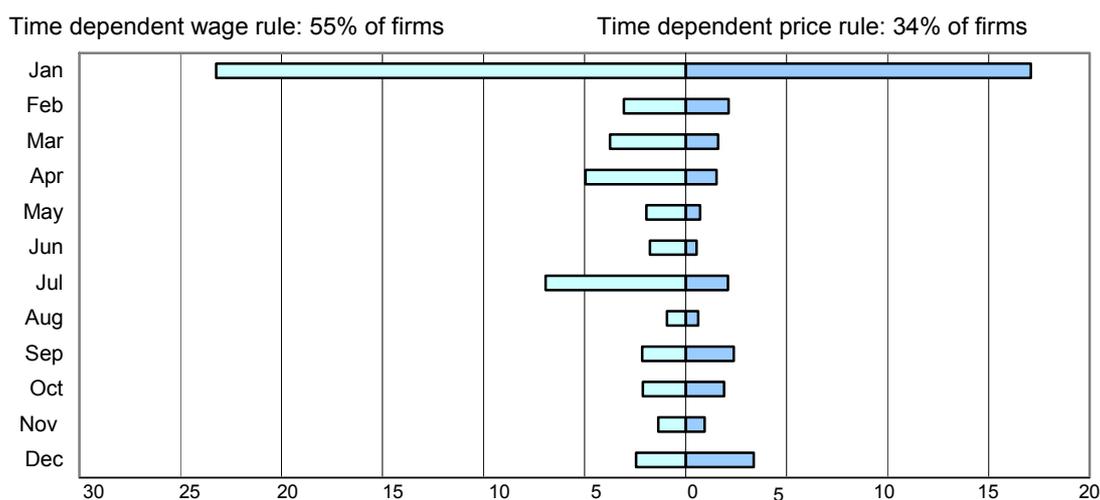
Several survey questions investigate whether wage and price changes are synchronized and explore the causal relationship between the two. Combining the answers to question 10 and question 32 (see Appendix 2), allows to have a closer look at synchronization. As mentioned before, in these questions, firms had to specify whether or not wage and price changes are concentrated in

any particular month(s). If this was the case, they were asked to indicate the month(s) in which this typically happens. Results are presented in Figure 10.

While 55 percent of firms stated that wage changes are concentrated in particular months, only 34 percent do so for price changes. This could be related to the use of wage indexation mechanisms in some countries, or to the presence of institutional arrangements within the firm itself or at the national or sectoral level, in the form of collective bargaining agreements. In both cases, a peak is observed in January. July is also a month in which a relatively large fraction of wage changes occur, but not price changes.

While all sectors show a similar behaviour with respect to the fact that the wage changes are more concentrated than price adaptations, this pattern is much more pronounced in financial intermediation: 59 percent of firms state that wage changes typically happen at a specific time of the year, while only 12 percent for prices. Financial intermediation is of course a very particular sector with respect to price setting. In business services, however, wage changes are concentrated as on average (57 percent of firms), but price change time-dependence is considerably above average (41 percent).

Figure 10: Timing of wage and price changes  
(percentage of firms reporting to change prices and wages in a particular month)



Weighted figures (weights based on employment), rescaled excluding non-responses.

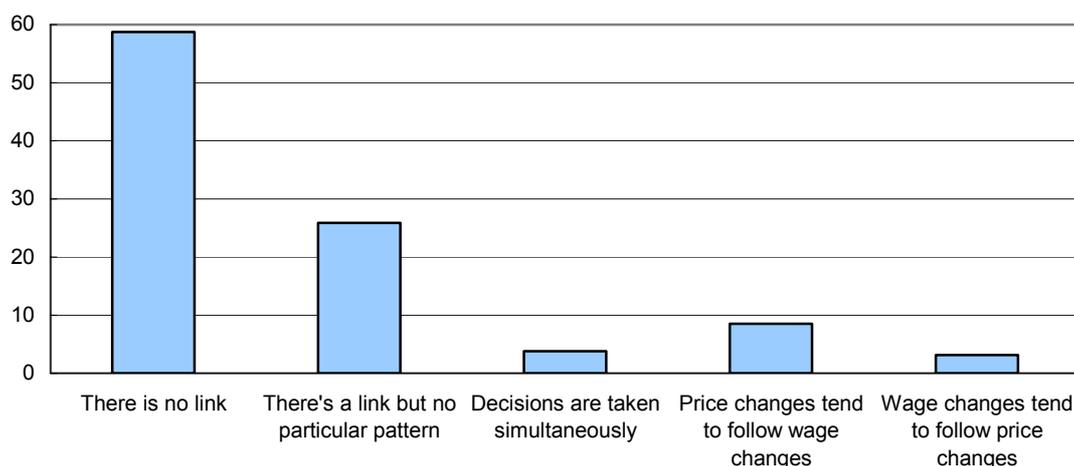
More pronounced differences between the time pattern of wage and price changes are observed across countries, but for all of them - except Italy - wage changes are more concentrated than price changes. The lowest concentration of both wage and price changes is observed in Poland, the highest in the Netherlands.

In order to assess the causal link between wage and price revisions, firms were asked how the timing of price changes relates to that of wage changes (see Appendix 2, question 33). The intensity, as well as the direction of the relationship between the two firms' strategies are summarized in Figure 11.

According to 59 percent of the firms in the overall sample, no link exists between the timing of price and wage changes; 26 percent of them indicate that there is some link but no particular pattern, while the remaining 15 percent states that a strong link exists. As to the direction of the relationship: decisions are taken simultaneously for 4 percent of the firms, prices follow wages in 8 percent of the cases and wages follow prices in the remaining 3 percent. The patterns with respect to intensity and direction of the relationship are very similar across sectors and across countries.

The large share of firms stating that decisions concerning wage and price changes are unrelated in time seems quite puzzling considering the high concentration (in January) of wage and price revisions emerged at the aggregate level. In Section 5, this issue will be analysed in more detail using a micro-based empirical approach, aimed at highlighting the factors that might strengthen or weaken this relationship.

Figure 11: The relationship between wage and price changes at the firm level  
(percentages)

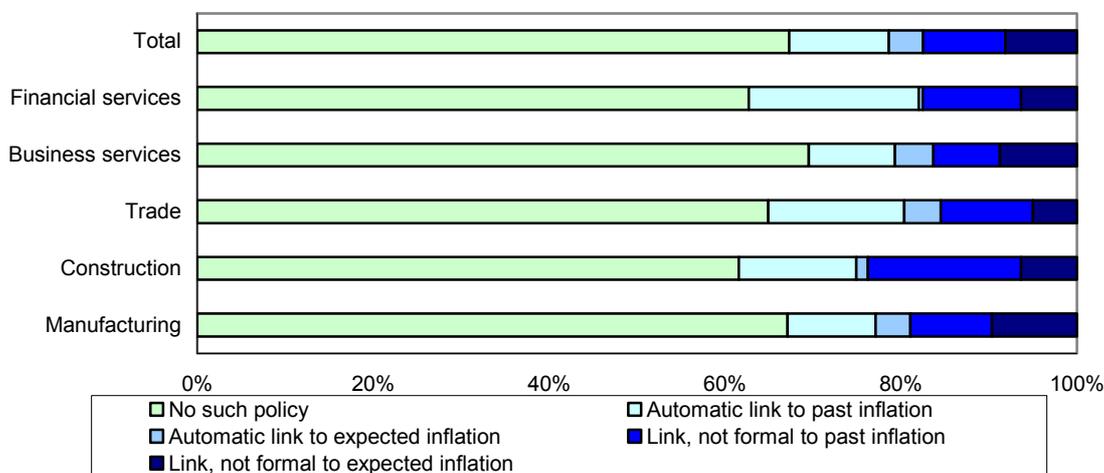


Weighted figures (weights based on employment), rescaled excluding non-responses.

#### 4.2 The role of indexation

The speed and extent to which wages react to price changes is very likely to be influenced by the prevailing indexation mechanism. Two questions on this topic were included in the questionnaire (see Appendix 2, questions 6 and 7). In the first, firms were asked whether or not they have a policy that adapts changes in base wages to inflation. If so, they had to report whether the adjustment is automatic or not, subject to a formal rule, if it refers to past or expected inflation.

Figure 12: Adjustment of base wages to inflation  
(percentages)



Weighted figures (weights based on employment), rescaled excluding non-responses.

Two-thirds of firms have no internal policy that adapts base wages to inflation. Of the remaining 33 percent that do have such a policy, nearly half adopt an automatic indexation mechanism, mostly based on past inflation. The other half takes inflation into account without applying any formal rule (9 percent referring to past inflation and 8 percent to expected inflation).

As Figure 12 shows, there is some variability across sectors: firm's policies linking base wages to inflation are less common in business services and more widespread in financial intermediation and construction. Mostly, these rules are not formal and tend to be backward looking, i.e. take into account past inflation.

A description of the relevance of indexation mechanisms at the firm level across countries (Table 13) shows that the adaptation of wages to inflation is a slightly less widespread practice in the euro area (31 percent of firms), than in the total of countries covered by the survey (33 percent). It is very common in Belgium (100 percent) and Spain (70 percent); in these two countries automatic indexation mechanisms are prevalent. Dutch and Italian firms, on the other hand, do not (are almost not) adapt wages to inflation. In all other 10 countries, policies of adjusting wages to inflation are used to some extent, mostly without any formal rule. Expected inflation seems to be more important than past inflation for wage setting in France and Portugal only.

Table 13 - Policy of adjusting base wages to inflation: country overview  
(percentages, unless otherwise stated)

	Total	Automatic link to past inflation	Automatic link to expected inflation	No formal rule, past inflation taken into account	No formal rule, expected inflation taken into account
AT	24 (VL)	9	1	10	3
BE	100 (H)	100	0	0	0
CZ	60 (None)	6	3	27	24
EE	54 (None)	2	1	29	21
ES	70 (H)	38	16	11	5
FR	33 (VL)	1	5	5	21
GR	47 (None)	16	6	13	12
HU	33 (None)	7	4	15	6
IE	29 (None)	2	1	15	10
IT	6 (VL)	1	1	3	2
NL	0 (None)	0	0	0	0
PL	31 (VL)	5	2	17	6
PT	51 (None)	3	6	13	29
SI	60 (L)	20	3	32	5
Euro area	31	13	4	6	7

Weighted figures (weights based on employment), re-scaled excluding non-responses. Between brackets: percentage of workers covered by wage indexations clauses: VL=very low <0-25%>; L=low <26-50%>; M=moderate <51-75%>; H=high <76-100%> (Source: Du Caju et al., 2008).

The picture that arises from the results of the survey on wage formation can be complemented by information from information on wage bargaining institutions collected through a questionnaire filled in by NCB experts (Du Caju et al., 2008). This separate source provides, among others, a measure of coverage of formal wage indexation mechanisms at the national and sectoral level (see Appendix 2 for a description of the questions).<sup>3</sup> According to this measure, in only seven out of the fourteen countries examined here workers are to some extent covered by formal wage indexation

<sup>3</sup> The questionnaire on wage bargaining institutions extends its analysis, using a broader definition on adapting wages to inflation, however, without providing for a quantitative measure. It asks to consider some broad categories of factors entering collective wage negotiations and to provide details on the way that these are taken into account. These categories were: prices, labour productivity, competitiveness and changes in taxation or social contributions. Prices came out to be the most important determinant in most countries, a result being in line with the conclusions from the wage and price setting survey.

clauses, coverage being particularly high in Belgium and Spain, low in Slovenia and very low in Austria, France, Italy and Poland.

This evidence is not incoherent with the fact that in our survey firms in twelve countries report having policies that adapt wages to inflation. In fact, such policies do not necessarily imply the existence of a formal rule, as price developments may be just one of the factors entering wage negotiations at the firm level, even if no institutional indexation mechanism is present. This is so for the Czech Republic, Estonia, Greece, Hungary, Ireland and Portugal. Indeed, the vast majority of firms in these countries indicate that no formal rule is applied.

## 5 A firm level analysis of price and wage policies in a multivariate framework

The descriptive analysis presented in the previous sections shows some interesting regularities and relations between the frequency with which firms change prices and wages and features such as the degree of competition, labour intensity, the level and importance of collective bargaining in the firm, and compares it by countries, sectors and firm size.

Here we go a step further and estimate, within a multivariate framework, the determinants of the pattern of price and wage changes at the firm level, accounting for differences that could be country, sector or size specific and taking into account the possible interaction between price and wage policies. We examine a number of additional features that could potentially affect firms' strategies. Some of them reflect the institutional setup, like the degree of wage indexation, others the economic and technological environment, such as foreign exposure in terms of trade and some characteristics and composition of the labour force (share of white collars, of high skill workers, of permanent jobs, etc.). In particular, we consider the following factors (in brackets we report the name of the variable; see Appendix 3 for an overview):

- a set of dummy variables for the firm's economic sector of activity (*sector*: manufacturing, construction, trade, business services, financial services), its size in terms of employees (*size*: 5-19, 20-49, 50-199, >199), the country it belongs to (*country*); These dummies also help to account for unobserved characteristics of the firm that might impact on the relationship between price and wage changes but are not captured by the other explanatory variables;
- a set of variables capturing features of the firm's strategies, that are partly related to the market structure in which the firm operates. The first variable reflects the degree of competition perceived by the firm. It is based on answers to question 30 (see Appendix 2), that measures the likelihood that a price reduction by competitors triggers a similar reaction in the firm (*perceived\_competition*). This question, however, was not asked in the Netherlands and using it forces us to exclude the Netherlands from the regressions. To avoid this, as an alternative measure of product market competition, we use a dummy based on question 28 (see Appendix 2) that takes value 1 if the firm, when asked about its price setting policy, reports that its own prices are mostly based on the ones set by its competitors (*price\_follows\_competitors*). The third (*export\_share*), also aimed at capturing the degree of competitive pressures faced by the firm, is its international exposure, proxied by the share of exports on total sales (see Appendix 2, question 27);
- a set of variables based on the composition of the work force (see Appendix 2, questions 1 and 34). First, we proxy the relative strength of the workforce in shaping wage policies at the firm level with the predominant duration of the employment relationship between the firm and its employees, temporary or permanent (*share\_permanent*). Second, we consider a higher fraction of high skilled employees (*high\_skill*) and a higher share of white collars

(*white\_collar*) as proxies for more technological advanced firms. Finally, we include a variable that reflects the flexibility of the firm's cost structure, captured by the share of labour costs on total costs (*labour\_cost\_share*). Evidence from the IPN suggested indeed that firms in sectors characterized by a higher labour share tend to adjust prices less frequently;

- a set of covariates that refer to firm specific and institutionally driven characteristics related to wage negotiations. They include a dummy for firms that have a policy adapting salaries to past or expected inflation (*indexation*) (see Appendix 2, questions 6 and 7), two dummies capturing the existence of a collective pay agreement signed either outside (*coll\_agr\_out*) or at the firm level (*coll\_agr\_firm*), and a variable indicating the percentage of the firm's employees covered by the collective agreement (*coverage*) (see Appendix 2, questions 2,3 and 4);
- a final group of variables intends to take into account the possible interaction between price and wage setting. It includes dummies for firms that change prices or wages with infra-annual frequency (*pfreq\_high*, *wfreq\_high*). Other features of the price setting process are captured by a dummy for firms that follow a time-dependent rule when changing prices (*time\_dependent\_pricing*) based on questions 31 and 32 (see Appendix 2) and one for those that claim there is a link between price and wage setting timing (*wage\_price\_link*), based on question 33.

**Which firms are likely to change prices more often?** The first empirical exercise aims at highlighting the factors that influence the frequency of price changes at the firm level. The dependent variable is a categorical one that takes ordered values. It consists of 5 categories: 1=daily-monthly; 2=quarterly-half-yearly/twice a year; 3=once a year; 4=less frequently than once a year; 5= never/don't know/other. We drop category 5, as for this one we do not have information on the effective frequency of price changes, and estimate an ordered probit with the sample of firms that have explicitly indicated that they have a pattern when changing prices, hence excluding about 25 percent of the initial sample. The order of the categorical variable is increasing with the degree of price stickiness; it moves from more to less frequent changes in prices. Table 14 shows the results of our estimation, where the columns refer to different specifications that include or not some of the covariates described above.

Starting with cross-sectoral differences, firms operating in trade and financial intermediation (with a significant negative coefficient) change prices more often than those in manufacturing, while business services firms do it slightly less frequently. Interestingly, the difference between services and manufacturing becomes not significant once we control for the share of labour costs in total costs (compare column (1) versus (2) in Table 14).

In contrast with the variable "sector", we do not find evidence of a country-specific pattern relating price changes, although country dummies are jointly significant in the regression.

Firms' size matters: prices tend to be adjusted more frequently in larger firms, as those with more than 50 employees turn out to have a negative and significant coefficient when compared with smaller firms. The latter have less than 20 employees and represent the omitted category in the regression.

Confirming the descriptive analysis presented in the preceding sections and previous IPN results, our regressions show that firms with a larger share of labour cost are more likely to change prices less frequently. We also tried to allow for a non-linear relationship by, first, introducing the variable squared and, second, by constructing categorical dummies for different bracket of labour cost share [20, 40, 80, 100]. The results did not always support non-linearity.

Table 14 – Factors affecting the frequency of price changes  
(ordered probit estimate)

	(1)	(2)	(3)	(4)	(5)	(6)
construction	-0.318 [6.29]**	-0.345 [6.32]**	-0.238 [2.76]**	-0.205 [2.37]*	-0.201 [2.26]*	-0.297 [3.76]**
trade	-0.665 [20.31]**	-0.672 [19.40]**	-0.814 [15.74]**	-0.794 [15.32]**	-0.798 [15.04]**	-0.714 [14.56]**
business services	0.094 [3.47]**	0.031 [1.06]	-0.08 [1.92]	-0.079 [1.89]	-0.084 [1.99]*	-0.021 [0.54]
financial services	-0.584 [5.41]**	-0.642 [5.46]**	-0.918 [5.20]**	-0.835 [4.57]**	-0.908 [4.86]**	-0.664 [4.35]**
20-49	-0.015 [0.45]	-0.023 [0.67]	-0.048 [0.97]	-0.044 [0.88]	-0.04 [0.78]	-0.008 [0.18]
50-199	-0.131 [4.06]**	-0.132 [3.89]**	-0.146 [3.02]**	-0.144 [2.94]**	-0.142 [2.84]**	-0.08 [1.76]
>200	-0.235 [6.60]**	-0.217 [5.82]**	-0.183 [3.36]**	-0.182 [3.34]**	-0.171 [3.06]**	-0.129 [2.51]*
labor_cost_share		0.442 [6.98]**	0.655 [2.17]*	0.457 [5.10]**	0.436 [4.69]**	1.074 [3.82]**
white_collar			0.002 [2.67]**	0.002 [2.77]**	0.002 [2.63]**	0.001 [1.88]
high_skill			0.001 [2.77]**	0.001 [2.66]**	0.001 [2.37]*	0.001 [2.67]**
share_permanent			0.001 [1.54]	0.001 [1.60]	0.001 [1.58]	0.001 [1.37]
coll_agr_firm			-0.038 [0.82]	-0.035 [0.74]	-0.033 [0.70]	-0.064 [1.45]
coll_agr_out			0.035 [0.33]	0.029 [0.27]	0.063 [0.57]	-0.044 [0.56]
coverage			0.002 [0.04]	0.004 [0.08]	-0.013 [0.24]	-0.015 [0.31]
indexation			-0.033 [1.00]	-0.044 [1.32]	-0.038 [1.11]	-0.037 [1.10]
export_share			-0.178 [3.12]**	-0.163 [2.85]**	-0.165 [2.83]**	-0.145 [2.64]**
price_follows_competitors						-0.091 [2.79]**
time_dependent_pricing				0.211 [6.58]**	0.2 [6.06]**	0.246 [7.82]**
wfreq_high					-0.177 [3.72]**	-0.176 [4.00]**
wage_price_link					0.052 [1.25]	0.051 [1.33]
labor_cost_share^2			-0.217 [0.61]			-0.878 [2.67]**
perceived_competition			-0.312 [9.73]**	-0.294 [9.11]**	-0.288 [8.75]**	
Observations	10286	9376	5367	5324	5167	5758
Joint significance of country coefficients ( $X^2$ ):	249.0**	222.6**	25.6**	41.0**	40.0**	165.7**

Robust z statistics in brackets (\* significant at 5%; \*\* significant at 1%). See Appendix 3 for the definition of the explanatory variables.

The degree of product market competition faced by firms also influences the frequency of price changes. According to our results, firms operating in a more competitive environment are

likely to change prices more often, this result holds for both the variables we adopted for measuring competition. We also find that openness to foreign markets has some influence on the frequency of price changes, the coefficient of the variable being negative and significant, hence indicating that firms with larger export share change prices more frequently.

Regarding the composition and characteristics of the labour force, a higher frequency of price changes is significantly associated to a lower fraction of white-collar and of high-skill employees.

Institutional features affecting the functioning of the labour market and wage setting policies, such as the presence of a collective agreement and its coverage among the firm's employees, and the relevance of indexation of wages to inflation at the firm level do not have a significant influence on the frequency of price changes once we control for all the covariates above.

Finally, as expected and often claimed in the literature, firms that follow a time-dependent pricing rule tend to adjust prices less frequently while those that change wages often do also change prices often.

**Why do some firms adjust wages more frequently than others?** Having ascertained which are the main factors underlying the timing of price adjustment, we now focus on the frequency of wage changes. We estimate an ordered probit as our dependent variable, described in section 3.1, takes values from 1 to 4, where 1=basic wage changes more frequently than yearly; 2=yearly; 3=less frequently than yearly and 4=never/don't know. As in the exercise presented above, we drop the category "never/don't know" which in this case hardly amounts to 3 percent of the sample. The value categories are increasing in the degree of stickiness, from more to less frequent changes in wages.

We consider as "main regression" results those referring to the frequency of wage changes due to any reason as defined in section 3.1 (eventually pointing out differences with the results from ordered probit that have as dependent variable changes separately due to inflation, tenure, or other reasons, also defined in section 3.1).

As shown in Table 15, the most robust result regarding cross-sectoral differences is that wages in services firms are stickier than in manufacturing ones, i.e. adjust less frequently. Construction and trade firms change wages respectively more (construction) and less (trade) frequently, but in both cases the coefficient becomes not significant once we introduce other covariates in the regression.

Wages in larger firms are likely to vary more often than in small ones: firms with more than 50 employees turn out to have a negative and significant coefficient when compared with small firms with less than 20 employees, which is the omitted category in the regression.

Country specific factors are significant. The omitted country is Estonia, whose labour market is one of the most flexible of the EU. Although we do not show individual coefficients in the Table for sake of simplicity, many of the country dummies have a positive and significant coefficient, meaning that wages adjust somewhat less frequently than in Estonia, with the only exception of Greece and Slovenia.

Differently from the case of price changes, the share of labour costs, the intensity of product market competition and the foreign exposure of the firm do not affect the frequency of wage changes.

Turning to the features of the labour force and job specific characteristics, there is a negative relationship between the share of white-collar workers and the frequency of wage changes, while the proportion of permanent and high skill workers is statistically not significant.

Table 15 – Factors affecting the frequency of wage changes  
(ordered probit estimates)

	(1)	(2)	(3)	(4)	(5)	(6)
construction	-0.332 [6.96]**	-0.318 [6.18]**	-0.055 [0.76]	-0.074 [1.01]	-0.074 [0.99]	-0.194 [2.56]*
trade	0.075 [2.49]*	0.087 [2.75]**	0.09 [1.98]*	0.082 [1.78]	0.116 [2.41]*	0.075 [1.63]
business services	0.121 [4.74]**	0.135 [4.81]**	0.119 [2.96]**	0.121 [3.02]**	0.123 [2.98]**	0.088 [2.25]*
financial services	0.103 [1.54]	0.129 [1.76]	0.105 [1.07]	0.097 [0.95]	0.109 [1.04]	0.143 [1.55]
20-49	-0.051 [1.59]	-0.056 [1.66]	-0.07 [1.45]	-0.076 [1.58]	-0.077 [1.57]	-0.112 [2.45]*
50-199	-0.177 [5.80]**	-0.176 [5.50]**	-0.207 [4.53]**	-0.212 [4.63]**	-0.209 [4.44]**	-0.224 [5.11]**
>200	-0.323 [9.95]**	-0.315 [9.21]**	-0.321 [6.30]**	-0.328 [6.41]**	-0.33 [6.25]**	-0.352 [7.15]**
labor_cost_share		-0.016 [0.26]	0.496 [1.76]	-0.002 [0.03]	0.036 [0.41]	0.003 [0.03]
white_collar			0.001 [2.23]*	0.001 [1.95]	0.001 [1.47]	0.001 [1.89]
high_skill			0.001 [1.17]	0.001 [1.16]	0.001 [1.48]	0 [0.91]
share_permanent			0 [0.16]	0 [0.29]	0 [0.45]	0 [0.38]
collAgr_firm			-0.133 [2.83]**	-0.132 [2.79]**	-0.146 [2.97]**	-0.157 [3.50]**
collAgr_out			-0.118 [1.16]	-0.105 [1.02]	-0.083 [0.75]	-0.047 [0.58]
coverage			0.147 [2.72]**	0.145 [2.68]**	0.148 [2.67]**	0.129 [2.53]*
indexation			-0.41 [13.08]**	-0.402 [12.73]**	-0.401 [12.37]**	-0.378 [11.88]**
export_share			0.044 [0.86]	0.046 [0.89]	0.038 [0.71]	0.013 [0.25]
price_follows_competitors						-0.041 [1.30]
time_dependent_pricing				-0.113 [3.63]**	-0.103 [3.15]**	-0.09 [2.87]**
pfreq_high					-0.174 [4.32]**	-0.176 [4.71]**
wage_price_link					-0.104 [2.37]*	-0.112 [2.68]**
labor_cost_share^2			-0.623 [1.86]			
perceived_competition			-0.019 [0.65]	-0.027 [0.90]	-0.014 [0.46]	
Observations	13881	12549	7323	7248	6934	7422
Joint significance of country coefficients ( $X^2$ ):	1341.9**	1175.8**	374.4**	368.1**	330.9**	352.7**

Robust z statistics in brackets (\* significant at 5%; \*\* significant at 1%). See Appendix 3 for the definition of the explanatory variables.

While they were not significant in the case of price changes, variables reflecting the institutional environment do matter, as expected, for the frequency at which wages are adjusted. First, if there is some form of indexation of salaries to (past or expected) inflation, wages change more frequently. Second, the higher the percentage of employees covered by any kind of collective pay agreement the less frequent are wage adjustments. Third, firms with dominant collective

agreement at the firm level (are more likely to) change wages more frequently than those that apply collective wage agreements defined outside the firm (at the national, sectoral or other level).

Finally, price setting policies have a significant impact: firms that change prices often, those that follow a time-dependent pricing rule and those that declare an explicit relationship between the timing of wage changes and that of price changes are more likely to adjust wages more often.

Estimations performed considering as dependent variable the frequency of wage changes due to (i) reasons different from inflation and tenure (ii) inflation (iii) tenure give broadly similar results (results are not shown here but are available upon request). The sign of the coefficients remains unchanged; collective agreement at the firm level and sectoral dummies become statistically non significant, while the share of high skilled workers becomes significant. In the case of wage changes due to inflation, as expected the indexation variable becomes the most relevant one, but still most of the covariates that are significant in the main regression remain significant.

**What determines the existence of a relationship between price and wage changes and its intensity?** To answer this question, we first focus on the existence and intensity of the link, as stated by firms, between wage and price setting. We estimate an ordered probit model where the dependent variable is based on the answers to question 33 (see Appendix 2 for details) and takes value 1 if the two variables are unrelated, 2 if the firm states the existence of some link between them and 3 in presence of a strong link.

The results presented in Table 16 indicate that the relationship between price and wage changes is stronger for construction and (marginally) services firms compared to manufacturers, whereas it is weaker for firms in trade and financial intermediation. It is also weaker for large firms (with more than 200 employees) compared to smaller ones. These results hold also accounting for the incidence of labour on total costs, which turns out to significantly and positively affect the probability of a stronger link between price and wage changes. In addition, the link between price and wage change decisions is more intense when competitive pressures are weak, when there is no firm-level collective bargaining and, finally, when the firm's technology is less flexible, as captured by a lower share of white collars on total employees.

**An all-encompassing perspective on price and wage setting.** Many of the features of firms' pricing and wage policies analysed so far are not independent of each other. In order to account for this possible correlations we estimate, within a SURE regression approach, linear probability models of high price change frequency, high wage change frequency, the adoption by the firm of a time-dependent pricing rule, the existence of a link between price and wage changes at the firm level and the direction of such a link. By adopting a SURE approach, we can allow and test for correlation across the equations residuals and also test for coefficients restrictions across the various equations.

The dependent variables are all dummies. They take value 1: in equation (1) if the firm changes prices more often than once a year; in (2) if wages are adjusted at least with a yearly frequency; in (3) if the firm reports to adjust prices following a time-dependent rule; in (4) if there is a strong link at the firm level between price and wage changes; in (5) if such a link goes from wages to prices. The most interesting results of our empirical exercise (presented in Tables 17 and 18) can be summarised as follows.

First, the residuals of the five equations appear to be significantly correlated, hence validating the use of a SURE approach (Table 18). It is interesting to note that the residuals of the equation of price and wage changes synchronisation are positively correlated with those of the equation of high wage change frequency and negatively with those of the equation of high price change frequency.

Table 16 - Intensity of the relationship between price and wage changes  
(ordered probit estimates)

	Link between price and wage changes
construction	0.21 [3.21]**
trade	-0.328 [7.11]**
business services	0.06 [1.56]
financial services	-0.742 [6.00]**
20-49	-0.033 [0.77]
50-199	-0.064 [1.53]
>200	-0.157 [3.22]**
white_collar	-0.003 [5.63]**
high_skill	0.001 [2.64]**
share_permanent	0.0005 [0.59]
labor_cost_share	1.038 [13.28]**
price_follows_competitors	-0.098 [3.19]**
coll_agr_firm	-0.107 [2.57]*
coll_agr_out	0.159 [2.22]*
coverage	-0.082 [1.75]
indexation	0.036 [1.13]
export_share	-0.266 [5.08]**
wfr_year	0.139 [3.10]**
Observations	7602
Joint significance of country coefficients ( $\chi^2$ ):	197.5**

Robust z statistics in brackets (\* significant at 5%; \*\* significant at 1%). See Appendix 3 for the definition of the explanatory variables.

Second, the results concerning the estimation of equations (1) and (2), i.e. the factors affecting the high frequency of price and wage changes on the part of the firm, are in line with those contained in Tables 14 and 15, based on ordered probit regressions.<sup>4</sup>

Third, if time-dependent pricing rules are broadly less flexible than state-dependent ones, the results presented in column (3) confirm that price flexibility, captured by an alternative measure to the frequency of price changes, is higher in the construction, trade and financial services sectors and lower in business services as compared to manufacturing. Even controlling for these sectoral differences, the share of labour on total costs, insiders' power as captured by the fraction of

<sup>4</sup> Similar regressions, based on simple probit models, are presented in Tables 4.1 and 4.2 in Appendix 4. The results broadly confirm those obtained in the SURE estimation.

permanent employees and the presence of indexation mechanisms are negatively related to the probability of adopting a state-dependent (more flexible) pricing rule. Conversely, the existence of firm-level collective bargaining agreements and the incidence of white collars on total workforce, which we interpret as capturing the sophistication of technology, enhance the degree of flexibility with which the firm sets and adjusts its prices.

Table 17 – Price and wage setting  
(SURE estimates)

	(1)	(2)	(3)	(4)	(5)
	High price change frequency	High wage change frequency	Time-dependent pricing	Link between wage and price changes	Price changes follow wage changes
construction	0.053 [2.36]*	0.036 [2.06]*	-0.074 [2.85]**	0.072 [2.78]**	0.072 [4.79]**
trade	0.151 [14.64]**	-0.004 [0.37]	-0.033 [1.96]*	-0.122 [7.14]**	-0.034 [3.44]**
business services	0.001 [0.08]	0.003 [0.26]	0.055 [3.71]**	0.004 [0.29]	0.019 [2.24]*
financial services	0.138 [5.72]**	0.023 [0.84]	-0.156 [3.93]**	-0.205 [5.13]**	-0.077 [3.34]**
20-49	-0.004 [0.31]	0.033 [2.92]**	0.002 [0.13]	-0.008 [0.45]	-0.002 [0.19]
50-199	-0.004 [0.29]	0.05 [4.62]**	0.021 [1.33]	-0.019 [1.19]	-0.001 [0.07]
>200	0.01 [0.62]	0.078 [6.21]**	0.026 [1.40]	-0.062 [3.36]**	-0.007 [0.61]
labor_cost_share	-0.076 [2.93]**	-0.003 [0.14]	0.059 [1.99]*	0.235 [11.30]**	0.121 [10.05]**
high_skill	-0.0003 [1.83]	-0.0001 [0.43]	-0.0002 [0.93]	0.001 [2.82]**	-0.0002 [0.24]
white_collar	-0.0004 [1.94]	-0.0001 [1.02]	-0.0004 [2.06]*	-0.001 [5.03]**	-0.0003 [2.59]**
share_permanent	-0.001 [2.48]*	-0.0001 [0.25]	0.001 [2.29]*	-0.0001 [0.45]	0.0003 [1.66]
price_follows_competitors	0.037 [3.64]**	0.012 [1.45]	0.001 [0.06]	-0.026 [2.21]*	-0.026 [3.82]**
coll_agr_out	0.02 [0.84]	-0.046 [2.47]*	-0.013 [0.48]	0.046 [1.67]	0.035 [2.19]*
coll_agr_firm	0.016 [1.14]	0.038 [3.37]**	-0.041 [2.48]*	-0.033 [2.00]*	-0.037 [3.84]**
coverage	0.014 [0.88]	-0.004 [0.28]	0.033 [1.76]	-0.036 [1.95]	0.007 [0.67]
indexation	0.033 [3.06]**	0.099 [11.72]**	0.038 [3.07]**	0.015 [1.23]	0.008 [1.06]
export_share	0.081 [4.70]**	0.017 [1.26]	0.035 [1.80]	-0.091 [4.63]**	-0.032 [2.84]**
Constant	0.19 [6.68]**	0.54 [24.69]**	0.09 [2.81]**	0.36 [11.26]**	0.01 [0.33]
Observations	7406	7406	7406	7406	7406

Joint significance of country coefficients ( $X^2$ ): 2162.3\*\*

Robust z statistics in brackets (\* significant at 5%; \*\* significant at 1%). See Appendix 3 for the definition of the explanatory variables.

Fourth, the results presented in column (4), concerning the determinants of a strong link between price and wage changes at the firm level, confirm the main findings emerged from the ordered probit model estimated in Table 16.

Table 18 – Correlation matrix of residuals  
(*SURE estimates*)

	High price change frequency	High wage change frequency	Time-dependent pricing	Link between wage and price changes	Price changes follow wage changes
High price change frequency	1				
High wage change frequency	0.0289	1			
Time-dependent pricing	-0.0647	0.0594	1		
Link between wage and price changes	-0.0665	0.0268	0.1429	1	
Price changes follow wage changes	-0.0174	0.0173	0.0955	0.359	1

Breusch-Pagan test of independence:  $\chi^2(10) = 1279.092$ , Pr = 0.0000

Fifth, very similar results are obtained if we isolate only those firms that claim that price revisions tend to follow wage changes, shown in column (5). The main difference with respect to the previous estimation is the finding that this adjusting mechanism is significantly more likely in firms in the business services sector.

Finally, we did run some restriction tests regarding the coefficients of the equation of the frequency of price change and the ones of the equation of the frequency of wage change. The hypothesis that all the coefficients in the two equations are equal is strongly rejected, as expected. More interestingly, the tests also reject the hypothesis that the labour cost share coefficient is equal across the two equations, pointing to its significance only as concerns price change frequency. The same result holds also for the variables capturing the degree of competitive pressures faced by firms, i.e. the export share and the influence of competitors on price setting. Conversely, the adoption of a collective wage agreement signed at the national or sectoral level hinders only wage flexibility and has no effect on price behaviour. The presence of collective bargaining at the firm level is instead a relevant element of flexibility, both for prices and for wages.

## 6 Summary and conclusions

This paper provides a wide range of new information of firms' price and wage setting policies by relying on a dataset of firm-level (mostly) qualitative data collected through harmonised surveys conducted in 17 European countries.

The most interesting findings can be summarised and grouped around two broad issues: i) the frequency of price and wage changes and ii) the link between the two.

**Frequency of price and wage changes.** Confirming previous IPN results, we find that about half of the firms change their prices once a year or less frequently. As expected, wages are somewhat stickier: around 75 percent of firms change them once a year or less frequently.

Consistently with these findings, a multivariate regression exercise based on individual data shows that the incidence of labour costs on firms' total costs is indeed one of the main factors behind the observed differences in the frequency of price changes across sectors and in particular the higher stickiness in business services. Together with a lower labour cost share, a higher responsiveness of prices is associated with the intensity of competitive pressures and the flexibility of technology. Firms that do not typically follow a time-dependent price adjustment mechanism are also those that change prices more frequently.

While no major heterogeneity can be found across countries in the patterns of price changes, larger cross-country differences emerge regarding wage setting practices and in particular the frequency of wage changes, where institutional features are found to play a major role. In particular, firms tend to change wages more frequently in presence of mechanisms (formal or informal) linking wages to (past or expected) inflation and of firm-level collective wage negotiations. The application of national or sectoral collective agreements tends to operate in the opposite direction, enhancing the duration of wages.

**The link between wage and price changes.** According to the information collected by our survey, around one-third of the firms typically adjust their price in specific months; the share rises to more than half with regard to wage adjustments. Both tend to concentrate mostly in January. This apparent synchronisation compares to a fraction of around 40 percent of firms that, when asked directly, acknowledge the existence of a relationship between the timing of price and wage changes within their company; such a relationship is strong for less than half of them.

The results, still preliminary, of a firm-level regression analysis that allows to control for a number of important factors that may affect wage and pricing policies, and their link, shows that sectoral and country-specific characteristics, institutional features as well as the economic environment in which firms operate affect significantly the intensity of the relationship between price and wage changes. In particular, this relationship is weaker:

- in trade and financial intermediation;
- in large firms;
- in firms with a lower share of labour on total costs;
- where competitive pressures are strong;
- when firm-level collective agreements are applied;
- in presence of a more flexible technology.

## Appendix 1 – The survey

The WDN-survey project involved all euro area countries except Cyprus, Finland and Malta, as well as Estonia, the Czech Republic, Hungary, Lithuania and Poland (in total, 17 countries). The group opted for a decentralised approach in which each National Central Bank was responsible for carrying out the national survey. However, strong coordination within the WDN guaranteed that the national questionnaires, at least with respect to a subset of clearly pre-defined “core questions”, were almost fully harmonized.

The paper is based on results for all countries except Lithuania, Luxembourg and Germany, which were not available yet at the time of completing the paper and will be taken on board in the revised draft.

The available national surveys were carried out between the second half of 2007 and the first quarter of 2008. Their main characteristics are summarised in Table A1. In most cases the survey was outsourced to an external company, which collected the answers from firms mainly by traditional mail or the internet. Operational instructions were added to the questionnaire, in particular regarding (i) the person who preferably was required to fill in the questionnaire (the CEO or the Human Resource Manager), (ii) the business unit answers should refer to (the firm and not the establishment), and (iii) the reference period (period covered by the latest 12-month profit and loss account, or, for a few questions, the end of the reference period). All NCB's pre-tested the questionnaire on a pilot sample.

The branches of activity underlying the samples vary across countries; for the purpose of the common empirical analysis, firms have been grouped in 6 sectors: manufacturing, trade, business services, construction, energy and financial intermediation; as shown in Table A1, all national samples cover the first three sectors (except Germany, where trade is not covered); in many surveys construction, energy and financial intermediation were also considered, whereas non-market services were included only in the French sample. Because of the poor coverage in terms of number of interviewed firms, the energy sector was excluded from the cross-country analysis.

Concerning firm size, the sample was split up into four classes: 5 to 19 employees, 20 to 49 employees, 50 to 199 employees and 200 employees and more. Since very small firms (with less than 5 employees) were covered in Germany, Luxembourg and Poland only, they were excluded from the harmonised analysis of the results.

The sample size was quite different across countries, ranging from 1,000 in Ireland to 6,500 in France. In terms of response rate, three broad groups can be identified: Austria, Greece and Lithuania with a response rate below 20 percent; a large group of countries with response rates between 20 and 50 percent; and Hungary, Ireland, the Netherlands, Poland and Spain with above 50 percent. Overall, more than 17,000 firms were surveyed.

**Table A1 – The main characteristics of the national surveys**

Country	Sectoral coverage	Firms' size	Sample size	Number of respondents ( <i>response rate</i> )	Ad hoc survey?	Geographical breakdown	Who carried out the survey	How was the survey carried out	
Austria	Manufacturing Energy Construction Trade Bus. services Fin. intermed.	≥ 5	~ 3,500	557 (16%)	Ad hoc	No	External Company (WIFO)	Traditional mail and Internet	
Belgium	Manufacturing Energy Construction Trade Bus. services Fin. intermed.	≥ 5	~ 4,100	1,431 (35%)	Ad hoc on the business survey sample	No	NBB	Traditional mail	
Czech Rep.	Manufacturing Construction Trade Bus. services	≥ 20	1,591	399 (25%)	Ad hoc	No	CNB branches	Internet	
Estonia	Manufacturing Construction Trade Bus. services	≥ 5	~ 1,400	366 (26%)	Ad hoc	Yes (Tallinn–non-Tallinn)	External company	Internet	
France	Manufacturing Trade Bus. services Non-market serv.	≥20 industry ≥ 5 services	~ 6,550	2,029 (31%)	Ad hoc	Yes	Local branches	Phone, mail, and face to face	
Germany	Manufacturing Bus. services	All (56 firms with <5)	4,600	1,832 (40%)	Attached to IFO business survey	East-West	IFO	Traditional mail	
Greece	Manufacturing Trade Bus. services	≥ 5	5,000	429 (9%)	Ad hoc	All regions	External company	Traditional mail	
Hungary	Manufacturing Energy Construction Trade Bus. services Fin. intermed.	≥ 5	3,785	2,006 (53%)	Ad hoc	All regions, stratified by NUTS1 regions	External company	Face-to-face interview	
Ireland	Manufacturing Energy Construction Trade Bus. services Fin. intermed.	≥ 5	~ 4,000	985 (25%)	Ad hoc	No	External company	Traditional mail, phone	
Italy	Manufacturing Trade Bus. services Fin. intermed.	≥ 20	~ 4,000	953 (24%)	Ad hoc	Yes	External company	Internet	
Lithuania	Manufacturing Energy Construction Trade Bus. services Fin. intermed.	≥5	2,810	500 (18%)	Ad hoc	No	External company	Phone, mail, face-to-face	
Luxembourg	Manufacturing Energy Construction Trade Bus. services Fin. intermed.	≥1	>7,000	survey not finished yet	Ad hoc	No	BCL	Email	
Netherlands	Manufacturing Construction Trade Bus. services Fin. intermed.		≥ 5	2,116	1,068 (50%)	Ad hoc	No	External company	Internet
Poland	Manufacturing Energy Construction Trade Bus. services Fin. intermed.		All	~1,600	1,161 (73%)	Ad hoc + attached to the labour market	All regions	National Bank of Poland (branches)	Traditional mail

	survey							
Portugal	Manufacturing Energy Construction Trade Bus. services Fin. intermed.	≥ 10	~5,000	1,436 (29%)	Ad hoc	No	Banco de Portugal	Traditional mail and internet
Slovenia	Manufacturing Energy Construction Trade Bus. services Fin. intermed.	≥ 5	~ 3,000	658 (22%)	Ad-hoc	No	Banka Slovenije	Traditional mail and internet
Spain	Manufacturing Energy Trade Bus. services	≥ 5	3,000	1,835 (61%)	Ad-hoc	No	External company	Mail, phone, fax or internet

## Appendix 2 – The questions used from the WDN-survey

All countries included in their national questionnaires a subset of almost fully harmonised "core questions". Although the translation in national languages could lead to small differences, the high degree of harmonization of the content of the questions allows a meaningful comparison of results across countries.

As for prices, firms are asked to refer answers to their “main product (or service)”, defined as the one that generated the highest turnover in the reference period. Similarly, in most questions on wage setting respondents are asked to focus on the “main occupational group”, defined in terms of the highest number of employees with the same characteristics.

This paper relies mainly on following core questions:

6 – Does your firm have a policy that adapts changes in base wages to inflation ?												
No	<input type="checkbox"/>											
Yes	<input type="checkbox"/>											
7 – If “yes” in question 6, please select the options that best reflects the policy followed:												
Wage changes are <u>automatically linked</u> to:												
- past inflation	<input type="checkbox"/>											
- expected inflation	<input type="checkbox"/>											
Although there is no formal rule, wage changes <u>take into account</u> :												
- past inflation	<input type="checkbox"/>											
- expected inflation	<input type="checkbox"/>											
9 – How frequently is the base wage of an employee belonging to the main occupational group in your firm (as defined in question 1) typically changed in your firm? <i>Please tick an option for each of the three types of wage changes listed below.</i>												
	<i>more than once a year</i>	<i>once a year</i>	<i>once every two years</i>	<i>less frequently than once every two years</i>	<i>never / don't know</i>							
Wage changes apart from tenure and/or inflation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>							
Wage changes due to tenure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>							
Wage changes due to inflation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>							
10 – Under normal circumstances, are base wage changes concentrated in any particular month / months?												
No	<input type="checkbox"/>											
Yes:	Jan. <input type="checkbox"/>	Feb. <input type="checkbox"/>	Mar. <input type="checkbox"/>	Apr. <input type="checkbox"/>	May <input type="checkbox"/>	June <input type="checkbox"/>	July <input type="checkbox"/>	Aug. <input type="checkbox"/>	Sept. <input type="checkbox"/>	Oct. <input type="checkbox"/>	Nov. <input type="checkbox"/>	Dec. <input type="checkbox"/>
31 – Under normal circumstances, how often is the price of the firm's main product typically changed? <i>Please choose a single option, the one that best describes the situation in your firm</i>												
More than once a year:												
- daily	<input type="checkbox"/>											
- weekly	<input type="checkbox"/>											
- monthly	<input type="checkbox"/>											
- quarterly	<input type="checkbox"/>											
- half-yearly	<input type="checkbox"/>											
Once a year	<input type="checkbox"/>											
Once every two years	<input type="checkbox"/>											
Less frequently than once every two years	<input type="checkbox"/>											
Never	<input type="checkbox"/>											
There is not a defined pattern	<input type="checkbox"/>											
32 – Under normal circumstances, are these price changes concentrated in any particular month / months?												
No	<input type="checkbox"/>											
Yes:	Jan. <input type="checkbox"/>	Feb. <input type="checkbox"/>	Mar. <input type="checkbox"/>	Apr. <input type="checkbox"/>	May <input type="checkbox"/>	June <input type="checkbox"/>	July <input type="checkbox"/>	Aug. <input type="checkbox"/>	Sept. <input type="checkbox"/>	Oct. <input type="checkbox"/>	Nov. <input type="checkbox"/>	Dec. <input type="checkbox"/>
33 – How does the timing of these price changes relate to that of wage changes? <i>Please choose a single option</i>												
There is no link between the two												
<input type="checkbox"/>												
There is a link but no particular pattern												
<input type="checkbox"/>												
Decisions are taken simultaneously												
<input type="checkbox"/>												
Price changes tend to follow wage changes												
<input type="checkbox"/>												
Wage changes tend to follow price changes												
<input type="checkbox"/>												
Don't know												
<input type="checkbox"/>												

Additionally, the following core questions were used to construct control variables:

<b>1 – How were your firm's employees distributed across the following occupational groups at the end of the reference period ?</b>		
Low skilled blue collar/Production	_____%	
High skilled blue collar/Technical	_____%	
Low skilled white collar/Clerical	_____%	
High skilled white collar/Professional	_____%	
Other	_____%	
TOTAL (= 100%)	100 %	
<b>2 – Does your firm apply a collective pay agreement bargained and signed outside the firm (at the national, regional, sectoral or occupational level) ?</b>		
No, such an agreement does not exist	<input type="checkbox"/>	
No, we opt out	<input type="checkbox"/>	
Yes, we apply such an agreement	<input type="checkbox"/>	
<b>3 – Notwithstanding your answer to question 2, does your firm apply a collective pay agreement signed at the firm level ?</b>		
Yes	<input type="checkbox"/>	
No	<input type="checkbox"/>	
<b>4 – If "yes" in questions 2 or 3, what percentage of your firm's employees are covered by a collective pay agreement (at any level) ?</b>		
_____ %		
<b>27 – What share of the revenue generated by your firm's main product in the reference period was due to sales in:</b>		
Domestic market	_____%	
Foreign markets	_____%	
Total (= 100%)	100 %	
<b>28 – How is the price of your firm's main product set in its main market ? <i>Please choose a single option.</i></b>		
There is no autonomous price setting policy because:		
- the price is regulated, or is set by a parent company / group	<input type="checkbox"/>	
- the price is set by the main customer(s)	<input type="checkbox"/>	
The price is set following the main competitors	<input type="checkbox"/>	
The price is set fully according to costs and a completely self-determined profit margin	<input type="checkbox"/>	
Other (please specify) _____	<input type="checkbox"/>	
<b>30 – Suppose that the main competitor for your firm's main product decreases its prices; how likely is your firm to react by decreasing its own price? <i>Please choose a single option.</i></b>		
Very likely	<input type="checkbox"/>	
Likely	<input type="checkbox"/>	
Not likely	<input type="checkbox"/>	
Not at all	<input type="checkbox"/>	
It doesn't apply	<input type="checkbox"/>	
<b>34 – How many workers (including employees and other types of workers) did your firm have at the end of the reference period?</b>		
Number of employees: _____		
of which:		
<b>(fill in one of the two columns, as you prefer: levels or %)</b>	Percentages	Number
permanent full-time	_____ %	_____
permanent part-time	_____ %	_____
temporary	_____ %	_____
TOTAL (= 100%)	100 %	
Number of other types of workers (e.g. people employed by agencies, freelance, consultants, apprenticeships, students, other casual workers, etc.)		Number _____
<b>40 – What percentage of your firm's total costs were due to labour costs in the reference period ?</b>		
_____ %		

A second piece of information is based on an additional survey on wage bargaining institutions at the country level (Du Caju *et al.*, 2008). In particular, within the WDN information on national institutions was collected using a standardised questionnaire answered by national

experts from the central banks of each of the countries considered, namely 22 countries of the European Union, plus the US and Japan. The information refers to two data points (1995 and 2006), four sectors (agriculture, industry, market services and non-market services) and the total economy.

More specifically, this information is collected through the following questions:

4. Coordination of wage bargaining Please indicate with an X in the grid below the level(s) at which wage bargaining coordination takes place in your country. <i>Please respond for each column in turn.</i>					
<i>Most recent information</i>	Agriculture etc. (NACE A-B)	Industry (NACE C-F)	Market Services (NACE G-K)	Non-Market Services (NACE L-P)	Total (NACE A-P)
State imposed 1 pay indexation (also see qs. 5)					
State imposed 2 statutory minimum wage (also see qs. 6)					
Inter-associational by national or cross-sectoral agreements					
Intra-associational within peak employers' and trade union organisations					
Pattern bargaining coordination by a sectoral trend-setter					
Other (please specify)					
Which one (or more) of the above levels is (are) the dominant?					

9. Indexation mechanisms (also see/use information/updated information in Annex 1 to this questionnaire) For the questions requiring percentages please provide figures as percentages in numbers or, if not available, by choosing from the following ranges: Very Low <0-25%> Low <26-50%> Moderate <51-75%> High <76-100%> <i>Please respond for each column in turn, underlining Yes or No where indicated.</i>					
<i>Most recent information</i>	Agriculture etc. (NACE A-B)	Industry (NACE C-F)	Market Services (NACE G-K)	Nonmark. Serv. (NACE L-P)	Total (NACE A-P)
Percentage of workers covered by automatic/direct indexation mechanisms					
Type of indexation none/automatic/only in minimum wages/part of negotiations/combo (please provide details)					
Which price index is used for reference?					
Does indexation refer to its past, expected or targeted annual rate of increase?					
Average duration of agreements					
If relevant, under what circumstances does renegotiation take place?					
If there is a retroactive element to wage indexation in your country, please provide details of the relevant process.					

### Appendix 3 - List of variables used in the regression analysis

Variable name	Description	Computation
<i>sectoral dummies</i>	Control variables for the economic sector. Dummy variables (=1 if the sector is the one indicated, 0 otherwise).	Based on sampling information: manufacturing construction trade business services financial services
<i>country dummies</i>	Control variables for the country. Dummy variables (=1 if the country is the one indicated, 0 otherwise).	AT BE CZ EE ES FR GR HU IE IT NL PL PT SI
<i>size dummies</i>	Control variables for the firm size. Dummy variables (=1 if the size is the one indicated, 0 otherwise).	5_19 = between 5 and 19 employees 20_49 = between 20 and 49 employees 50_199 = between 50 and 199 employees >200 = more than 199 employees
<i>price_follows_competitors</i>	Variable capturing competitive pressures.	Based on answers to question 28. It takes values: 1 = if selected in question 28 option "The price is set following the main competitors" 0 = otherwise
<i>export_share</i>	Variable capturing competitive pressures.	Based on answers to question 27. Percentage of the revenue generated by the firm's main product in the reference period due to sales in the foreign market
<i>perceived_competition</i>	Variable capturing competitive pressures.	Based on answers to question 30, which asks the firm to report how likely it is to decrease its own price if its main competitor did the same. It takes values 1 if "very likely" or "likely", and 0 otherwise.
<i>indexation</i>	Variable capturing the degree of indexation of wages to inflation.	Based on answers to question 6. It takes values: 1 = if respondents selected in question 6 the option "yes, the firm has a policy that adapts changes in base wages to inflation" 0 = otherwise
<i>white_collar</i>	Variable capturing features of the firm's labour force.	Based on answers to question 1 regarding the distribution of employees across occupational groups at the end of the reference period. The variable is the sum of "1_c" (low-skilled, white collar) and "1_d" (high-skilled, white collar).
<i>share_permanent</i>	Variable capturing features of the firm's labour force.	Based on answers to question 34 regarding the distribution of workers at the end of the reference period. The variable is the sum of "34_b" (percentage of permanent full-time) and "34_c" (percentage of permanent part-time)
<i>high_skill</i>	Variable capturing features of the firm's labour force.	Based on answers to question 1 regarding the distribution of employees across occupational groups at the end of the reference period. The variable is the sum of "1_b" (high-skilled, blue collar) and "1_d" (high-skilled, white collar).
<i>coverage</i>	Variable capturing institutional framework and industrial relationships.	Based on answers to question 4. If the firm applies a collective pay agreement signed either outside the

		firm (question 2) or at the firm level (question 3), percentage of firms' employees covered by this type of contract.
<i>coll_agr_firm</i>	Variable capturing institutional framework and industrial relationships.	Whether the firm applies a collective agreement bargained and signed at the firm level Based on answers to question 3. It takes values: 1 = if yes 0 = if no.
<i>coll_agr_out</i>	Variable capturing institutional framework and industrial relationships.	Whether the firm applies a collective agreement bargained and signed outside the firm (at the national, regional, sectoral or occupational level). Based on answers to question 2. It takes values: 1 = if yes 0 = if no.
<i>labor_cost_share</i>	Incidence of labour on the firm's cost structure.	Based on answers to question 40. Percentage of total costs that were due to labour costs in reference period.
<i>wfr_year</i>	Frequency of wage adjustment.	Based on answers 9_a, 9_b, 9_c. More specifically: a) first we take min(9_a, 9_b, 9_c) b) then we define "more" if wages change more frequent than yearly; "yearly" if wages are adjusted once a year; "less" if wages are adjusted less than once a year. wfr_year takes value 1 if "more" or "yearly" and 0 otherwise.
<i>link</i>	Ordered variable indicating the Intensity of the link between price and wage changes.	Based on answers to question 33. It takes values: 1=no link (question 33, option 1) 2=some link (question 33, option 2) 3= strong link between price and wages (question 33, options 3-4-5)
<i>wage_price_link</i>	Dummy indicating a strong link between price and wage changes	Based on answers to question 33. It takes values: 1= strong link between price and wages (question 33, options 3-4) 0=otherwise
<i>linkdir</i>	If there is some link between price and wage changes, what is its direction	Focusing on firms assuming values 1 or 2 to the variable <i>link</i> , it is based on answers to question 33.

## Appendix 4 - Probit regressions

Table 4.1 – What determines a high frequency of price changes  
(*probit estimates*)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
construction	0.028 [1.88]	0.032 [2.03]*	-0.013 [0.58]	-0.02 [0.84]	-0.02 [0.84]	0.046 [1.93]	0.045 [1.91]
trade	0.19 [17.53]**	0.194 [16.89]**	0.231 [13.69]**	0.226 [13.16]**	0.226 [13.16]**	0.228 [13.29]**	0.227 [13.21]**
business services	-0.038 [4.13]**	-0.022 [2.17]*	0.023 [1.65]	0.024 [1.73]	0.024 [1.73]	0.003 [0.24]	0.003 [0.23]
financial services	0.13 [4.94]**	0.167 [5.72]**	0.227 [5.14]**	0.21 [4.64]**	0.21 [4.64]**	0.2 [4.99]**	0.199 [4.98]**
20-49	0 [0.00]	0 [0.03]	0.006 [0.43]	0 [0.01]	0 [0.01]	-0.007 [0.45]	-0.007 [0.46]
50-199	0.019 [1.82]	0.016 [1.46]	0.014 [0.96]	0.007 [0.48]	0.007 [0.48]	-0.005 [0.36]	-0.006 [0.38]
>200	0.048 [4.11]**	0.042 [3.48]**	0.02 [1.21]	0.013 [0.79]	0.013 [0.79]	0.011 [0.62]	0.01 [0.59]
labor_cost_share		-0.136 [6.70]**	0.028 [0.32]	-0.083 [3.03]**	-0.083 [3.03]**	-0.074 [2.72]**	-0.149 [1.65]
white_collar			-0.001 [3.19]**	-0.001 [3.40]**	-0.001 [3.40]**	0 [2.51]*	0 [2.56]*
high_skill			0 [1.62]	0 [1.27]	0 [1.27]	0 [1.37]	0 [1.37]
share_permanent			0 [1.60]	0 [1.63]	0 [1.63]	-0.001 [1.99]*	-0.001 [1.95]
coll_agr_firm			0.004 [0.27]	0.003 [0.18]	0.003 [0.18]	0.011 [0.74]	0.011 [0.74]
coll_agr_out			0.011 [0.37]	0.007 [0.23]	0.007 [0.23]	0.01 [0.42]	0.011 [0.47]
coverage			0.002 [0.10]	0.008 [0.45]	0.008 [0.45]	0.014 [0.83]	0.014 [0.82]
indexation			0.031 [2.99]**	0.03 [2.86]**	0.03 [2.86]**	0.036 [3.10]**	0.036 [3.11]**
export_share			0.089 [5.16]**	0.083 [4.75]**	0.083 [4.75]**	0.081 [4.45]**	0.081 [4.45]**
price_follows_competitors						0.039 [3.55]**	0.038 [3.54]**
time_dependent_pricing				-0.017 [1.61]	-0.017 [1.61]	-0.052 [4.74]**	-0.052 [4.73]**
wfreq_high				0.064 [4.16]**	0.064 [4.16]**	0.071 [4.55]**	0.071 [4.54]**
wage_price_link				-0.044 [3.02]**	-0.044 [3.02]**	-0.044 [3.09]**	-0.044 [3.11]**
labor_cost_share^2			-0.173 [1.60]				0.094 [0.89]
perceived_competition			0.094 [9.62]**	0.088 [8.86]**	0.088 [8.86]**		
Observations	14215	12836	7430	7114	7114	7605	7605
Joint significance of country coefficients ( $X^2$ ):	672.4**	601.7**	144.7**	135.9**	135.9**	433.7**	431.5**

Robust z statistics in brackets (\* significant at 5%; \*\* significant at 1%). See Appendix 3 for the definition of the explanatory variables.

Table 4.2 – What determines a high frequency of wage changes  
(*probit estimates*)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
construction	0.098 [8.40]**	0.095 [7.57]**	-0.001 [0.08]	0.001 [0.05]	0.005 [0.30]	0.036 [2.14]*	0.035 [2.09]*
trade	-0.018 [2.36]*	-0.022 [2.80]**	-0.019 [1.82]	-0.017 [1.57]	-0.024 [2.20]*	-0.018 [1.70]	-0.02 [1.85]
business services	-0.034 [5.27]**	-0.039 [5.47]**	-0.024 [2.54]*	-0.023 [2.44]*	-0.025 [2.60]**	-0.028 [3.00]**	-0.029 [3.06]**
financial intermediation	-0.041 [2.48]*	-0.047 [2.67]**	-0.073 [2.63]**	-0.073 [2.53]*	-0.073 [2.57]*	-0.075 [3.06]**	-0.075 [3.06]**
20-49	-0.006 [0.75]	-0.007 [0.86]	0.012 [1.02]	0.012 [1.03]	0.012 [0.97]	0.011 [0.95]	0.011 [0.93]
50-199	0.018 [2.42]*	0.019 [2.40]*	0.039 [3.51]**	0.041 [3.64]**	0.042 [3.64]**	0.038 [3.52]**	0.037 [3.45]**
>200	0.046 [5.27]**	0.047 [5.10]**	0.066 [4.90]**	0.071 [5.13]**	0.071 [5.03]**	0.062 [4.67]**	0.061 [4.57]**
labor_cost_share		0.014 [0.94]	-0.127 [1.94]	0.012 [0.59]	0.012 [0.55]	0.013 [0.63]	-0.111 [1.70]
white_collar			0 [1.97]*	0 [1.72]	0 [1.69]	0 [2.42]*	0 [2.53]*
high_skill			0 [0.37]	0 [0.40]	0 [0.26]	0 [0.49]	0 [0.48]
share_permanent			0 [0.63]	0 [0.50]	0 [0.23]	0 [0.19]	0 [0.09]
coll_agr_firm			0.016 [1.60]	0.015 [1.46]	0.016 [1.48]	0.014 [1.43]	0.015 [1.45]
coll_agr_out			0.021 [1.05]	0.018 [0.91]	0.009 [0.41]	0.044 [2.75]**	0.046 [2.85]**
coverage			-0.039 [3.68]**	-0.038 [3.54]**	-0.037 [3.40]**	-0.028 [2.59]**	-0.028 [2.65]**
indexation			0.051 [6.63]**	0.05 [6.42]**	0.048 [6.09]**	0.05 [6.05]**	0.05 [6.07]**
export_share			-0.021 [1.69]	-0.02 [1.62]	-0.018 [1.42]	-0.016 [1.22]	-0.015 [1.21]
price_follows_competitors						0.003 [0.43]	0.003 [0.40]
time_dependent_pricing				0.006 [0.75]	0.004 [0.51]	-0.001 [0.08]	-0.001 [0.08]
pfreq_high					0.039 [4.23]**	0.041 [4.66]**	0.041 [4.66]**
wage_price_link					0.007 [0.65]	0.013 [1.28]	0.012 [1.20]
labor_cost_share^2			0.176 [2.30]*				0.153 [2.02]*
perceived_competition			0.005 [0.69]	0.006 [0.84]	0.003 [0.35]		
Observations	14363	12931	7516	7440	7114	7605	7605
Joint significance of country coefficients ( $X^2$ ):	716.2**	608.6**	281.9**	271.8**	239.3**	224.9**	227.1**

## References

- Agell, J. and P. Lundborg (2003), "Survey evidence on wage rigidity and unemployment: Sweden in the 1990s", *Scandinavian Journal of Economics*, 105, 15-29.
- Altissimo F, M. Ehrmann and F. Smets (2006) "Inflation and price-setting behaviour in the euro area", ECB Occasional paper No. 46.
- Álvarez, L.J., and I. Hernando (2007), "Competition and price adjustment in the euro area", in Fabiani, S., Loupias, C., Martins, F. and R. Sabbatini (eds.), "Pricing decisions in the euro area. How firms set prices and why", Oxford University Press.
- Ascari, G. (2003), "Price/Wage Staggering and Persistence: A Unifying Framework" *Journal of Economic Surveys*, 17, pp 511-540.
- Blinder, A.S. (1991), "Why are prices sticky? Preliminary results from an interview study", *American Economic review* 81, pp. 89-100.
- Blinder, A.S., Canetti, E.R.D., Lebow, D.E. and Rudd, J.B. (1998), "Asking about prices: a new approach to understanding price stickiness", Russel Sage Foundation, New York.
- Blinder, A.S. and D.H. Choi (1990), "A shred of evidence on theories of wage stickiness", *Quarterly Journal of Economics*, No. 4, pp. 1003-1015.
- Campbell, C..M. and K. S. Kamlani (1997). "The Reasons for Wage Rigidity: Evidence from a Survey of Firms", *Quarterly Journal of Economics*, Vol.112, No.3, pp.759-789.
- Carlton, D.W. (1986), "The theory and facts about how markets clear: is industrial organization valuable for understanding macroeconomics?", in Schmalensee, R. And R.D. Willg (eds.), "Hand book of industrial organization", North Holland.
- Dhyne, E., Alvarez, L.J., Le Bihan, H., Veronese, G., Dias, D., Hoffmann, J., Jonker, N., Lunnemann, P., Rumler, F. And J. Vilmunen (2007), "Price setting in the euro area: some stylised facts from consumer price data", *Journal of Economic Perspectives*.
- Du Caju, P., Gautier, E., Momferatou, D. and M. Ward-Warmedinger (2008), "Institutional features of wage bargaining in 22 EU countries, the US and Japan", forthcoming in ECB Working Paper Series.
- Franz, W. and F. Pfeiffer (2006). "Reasons for Wage Rigidity in Germany", *LABOUR*, Vol.20, No.2, pp.255-284
- Fabiani, S, M. Druant, I. Hernando, C. Kwapil, B.Landau, C. Loupias, F. Martins, T. Mathae, R. Sabbatini, H. Stahl, and A. Stokman (2006), "What Firms' Surveys Tell Us about Price-Setting Behavior in the Euro Area", *International Journal of Central Banking* September 2006.
- Fabiani, S., Loupias, C., Martins, F. And R. Sabbatini (2007), "Pricing decisions in the euro area. How firms set prices and why", Oxford University Press.
- Hall, S., Walsh, M. and T. Yates (2000), "Are UK companies' prices sticky?", *Oxford Economic papers* 52, pp. 425-446.
- Taylor J.B. (1999), "Staggered price and wage setting in macroeconomics", in Taylor, J.B. and M. Woodford "Handbook of macroeconomics", North-Holland.
- Vermeulen, P., Dias, D, Dossche, M., Hernando, I., Sabbatini, R., Sevestre, P. and H. Stahl (2007), "Price setting in the euro area: some stylised facts from individual producer price data", ECB Working Paper Series.