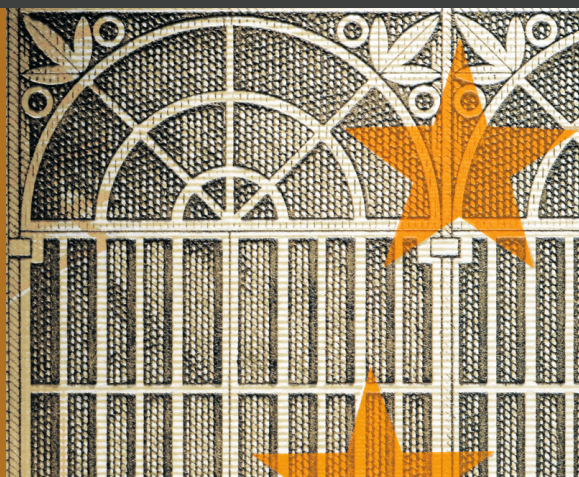


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Please address correspondence to
Banco de Portugal, Economics and Research Department
Av. Almirante Reis 71, 1150-012 Lisboa, Portugal
Tel.: 351 21 313 0000, email: estudos@bportugal.pt



Banco de Portugal
EUROSYSTEM

BANCO DE PORTUGAL

Av. Almirante Reis, 71

1150-012 Lisboa

www.bportugal.pt

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Survey evidence on price and wage rigidities in Portugal*

Fernando Martins[†]

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Abstract

This paper exploits the information collected from a survey conducted on a sample of Portuguese firms to study the patterns of firms' price and wage adjustments and the extent of nominal price and wage rigidities. The evidence shows that the frequency of price changes varies substantially across sectors and depends on a number of factors such as the intensity of competition, the share of labour costs and firms' price reviewing behaviour. The results also show that wages are more flexible in those firms where the fraction of permanent and high-skilled workers is lower and where the share of flexible pay components is higher.

JEL classification codes: D21, E30, J31.

Key Words: wage rigidity, price rigidity, clustering, survey data.

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[†]Banco de Portugal (Research Department), ISEG (Technical University of Lisbon) and Universidade Lusíada de Lisboa. Address for correspondence: Banco de Portugal, Research Department, Av. Almirante Reis, 71, 1150-012 Lisboa. E-mail address: fmartins@bportugal.pt

1 Introduction

The definition of economic policies in general and monetary policy in particular requires a deeper knowledge of the characteristics and determining factors underlying price and wage dynamics. For a member of a monetary union like Portugal, where the exchange rate instrument is no longer available to bring about adjustments, price and wage flexibility is a fundamental requirement for ensuring an adequate adjustment to shocks. This has been a topic of intense debate in Portugal, in particular at the current juncture when, following a large GDP contraction in the period 2009-2013, the unemployment rate has reached the two-digit psychological threshold for the first time in many years and is fast-approaching an unthinkable level of 20 percent.

Against this background, the memorandum of understanding signed between the Portuguese authorities and the *Troika* (the International Monetary Fund, the European Commission and the European Central Bank) in May 2011 elected the reform of the labour market as one of the key ingredients of the overall adjustment programme. Measures included in the programme were designed in order to tackle all the main policy-induced distortions that were identified: i) an extreme level of employment protection; ii) a wage setting system governed by strong multi-year increases in the minimum wage and sectoral collective wage agreements traditionally extended without regard to the competitive position of nonaffiliated firms; and iii) the most generous unemployment benefit system in Europe, in terms of replacement ratios but particularly with respect to duration.

The issue of nominal wage rigidity was not clear addressed in the programme but it is important to mention that many studies place the Portuguese labour market among the most rigid countries in Europe (see, Behr and Pötter (2010), Messina et al. (2010), Holden and Wulfsberg (2008), Dickens et al. (2007) and Knoppik and Beissinger (2009)). Such rigidity stems above all from the fact that labour legislation forbids nominal wage cuts. According to the Portuguese law, a firm cannot reduce contracted wages, including other regular and periodic monetary or non-monetary pay components, unless this is permitted by collective agreements. Also, collective negotiations are usually conducted at the industry or occupation level, and collective agreements stipulate minimum working conditions, like the monthly minimum wage for each category of workers, overtime pay and the normal duration of work. Such

collective bargaining covers a large part of the workforce resulting both from the presence of labour unions and the existence of mechanisms of contract extension, i.e., the Government normally uses extension mechanisms to broaden the coverage of the collective bargaining agreement to workers not covered by unions. This largely regulated institutional framework, as well as the existence of a compulsory minimum wage, which establishes a wage floor for many workers, introduces strong additional rigidity in the wage-setting process.

The Portuguese labour market is also seen as displaying a high level of employment rigidity among European economies mainly due to legislation that protects employees with permanent contracts against individual dismissal (see Venn (2009)). Nevertheless, the typical Portuguese firm appears to have more control over employment than it has over contracted wages, namely because it has the possibility of resorting to collective dismissals and temporary contracts or finding ways to get around individual dismissals regulation by negotiating voluntary quits.

It is within this context that this paper details the findings of a survey carried out on a sample of Portuguese firms in late 2008. The main aim of the paper is to identify some relevant characteristics about the dynamics of prices and wages in Portugal. In particular, it focuses on the nature, extent and sources of nominal rigidities. Based on new firm-level survey data, it addresses the following issues: How often are prices and wages adjusted in Portugal? Is the adjustment staggered or does it tend to be clustered in specific periods? Are there significant differences across sectors in the frequency and timing of wage and price changes? How do the differences in the frequency of price changes relate to structural features of product markets or to firm-specific characteristics? What are the factors that explain differences in firms' ability to adjust their base wages in response to shocks? Besides the innovative features of the dataset used, the main strength of the paper is the richness of the facts reported. Many of them are consistent with previous findings about wage and price setting though others are completely new.

One of the main advantages of using surveys is their flexibility. There is the possibility of questioning firms directly on a number of points related to the way they set prices or wages, such as the main obstacles to freezing or cutting wages, the most important determinants of wages or the way they react to significant changes either in demand or in production costs. This is the type of information that cannot be obtained from quantitative databases. However, surveys that are not conducted

directly with the firms may well throw up a number of problems. These relate both to the low response rate normally obtained and to the possibility of ill-judged interpretation of the questions raised. Apart from this, the responses may be coloured by other factors, such as the way questions are formulated or the economic outlook in which they occur.

The remaining of the paper is structured in the following way. Section 2 presents the theoretical background of the paper. The main characteristics of the database are described in Section 3. Section 4 presents some descriptive evidence about the dynamics of price and wage setting decisions as well as the link between the two. Section 5 investigates within the context of a multivariate model the factors that may have an impact on the frequency of price changes. Section 6 tries to find the factors that explain differences in firms in terms of their ability to adjust their base wages by providing a measure of nominal wage flexibility that is particularly suitable given the characteristics of the Portuguese labour market. Finally, section 7 summarises the main findings of the paper.

2 The theory behind the facts

In recent years, a substantial amount of theoretical research devoted to improve the microeconomic foundations of macroeconomic behavior has shown that nominal rigidities are key in determining the effects of different shocks on the economy. This research has made clear that a thorough understanding of the extent and causes of the sluggish adjustment of nominal variables is crucial to the design and conduct of monetary policy. Such understanding strengthens the conceptual foundation of general equilibrium models, providing policy makers with a useful framework for interpreting, through a realistic calibration, the evolution of the macroeconomy.

In the New Keynesian DSGE models with nominal rigidities, which are widely used for monetary policy analysis (see, among others, Carlton (1986), Woodford (2003), Gali et al. (2003) and Smets and Wouters (2003)), the sluggish response of prices and wages to shocks depends on several factors. One of those factors is the type of mechanism that generates nominal rigidities, i.e. the type of contract that is used to set prices or wages. The models of Calvo (1983) and Taylor (1980) are the most common frameworks to introduce nominal rigidity in DSGE models. According to the former, price (or wage) setters face a constant probability of adjustment;

Taylor's model, instead, explicitly specifies the duration of contracts in a fixed non-stochastic manner (time-dependent adjustment). De Walque et al. (2010) show that the response of prices and wages to a monetary policy shock is larger under Taylor contracts, whereas inflation and nominal wages respond more persistently in the Calvo random duration models (in line with Knell and Stiglbauer (2012)).

Another important factor affecting the way prices and wages respond to shocks is the degree of clustering of their changes. Olivei and Tenreyro (2010) show that the response of inflation to changes in official interest rates is likely to be faster and larger when these changes take place at the moment when most workers are renegotiating their wages. The analysis carried out in this paper sheds some light on the extent to which of the two adjustment mechanisms is closer to actual firms' behavior, insofar as the information collected in the survey enables to discriminate between staggering and clustering of price and wage changes.

The evidence presented in this paper also allows to assess empirically some of the predictions of several price and wage setting models. In particular, the paper investigates the relative importance of most of determinants of the frequency of price changes identified in the literature, such as the degree of product market competition, the cost structure or firms' size. In addition, an econometric model is formulated with the specific purpose of identifying the characteristics that explain why base wages in some firms tend to be more flexible than they are in other firms. These characteristics include the wage bargaining institutional setup, the composition and characteristics of the workforce and the wage structure.

The functioning of product markets is crucial in sticky price models. Under perfect competition all firms earn zero profits in equilibrium, and prices adjust continuously in response to marginal costs. In contrast, in an environment of monopolistic competition, prices incorporate a positive markup that depends on the elasticity of demand and on the strategic behavior of competitors. In such a framework, firms do not adjust prices continuously. On the empirical side, 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) and Alvarez and Hernando (2007) for the euro area show that price reaction to shocks is faster in more competitive sectors, whereas Druant et al. (2012) show that prices are more flexible when competitive pressures in product markets are strong and when labour costs account for a lower fraction of firms' total costs.

As to the wage setting, the institutions governing wage formation and in particular the degree of centralization of bargaining, its coverage and the extent of indexation are often mentioned as important determinants of the dynamics of wages, affecting the extent and speed with which they adjust to economic shocks. In particular, deregulated and/or decentralized wage bargaining enhances wage flexibility, whereas indexation to inflation, though possibly leading to more frequent adjustment, is a source of rigidity. Results based on micro data confirm that wages negotiated at the firm level tend to be more flexible, to the extent that they give firms greater margins for reacting to economic fluctuations. In addition, several labor market theoretical models provide predictions on the relative degree of wage rigidity across categories of workers. According to these models (among the most popular, Shapiro and Stiglitz (1984), Akerlof and Yellen (1990), Stiglitz (1974), Weiss (1980)) wages are more rigid for highly skilled/white-collar workers and for those with high tenure and/or a permanent contract. This outcome finds some support in empirical studies (Campbell and Kamlani (1997), Caju et al. (2007), Babecký et al. (2010)).

3 The database

The results presented in this paper are based on the information collected from a survey carried out by the Banco de Portugal in the second half of 2008 on a sample of firms covering manufacturing, energy, construction, retail and wholesale trade, transport and communications, education, health, financial services and other business services. The final sample included 1,872 firms accounting for around 35 per cent of total employment in Portugal. Table 1 presents the distribution of these firms by sector and firm size in terms of the number of employees. The questionnaire (the relevant questions for this paper are shown in the Appendix) contained 39 questions grouped in 4 sections: i) General information; ii) Wage setting; iii) Wage rigidity; and iv) Wage and price setting.

Table 1: Sample composition by sector and firm size

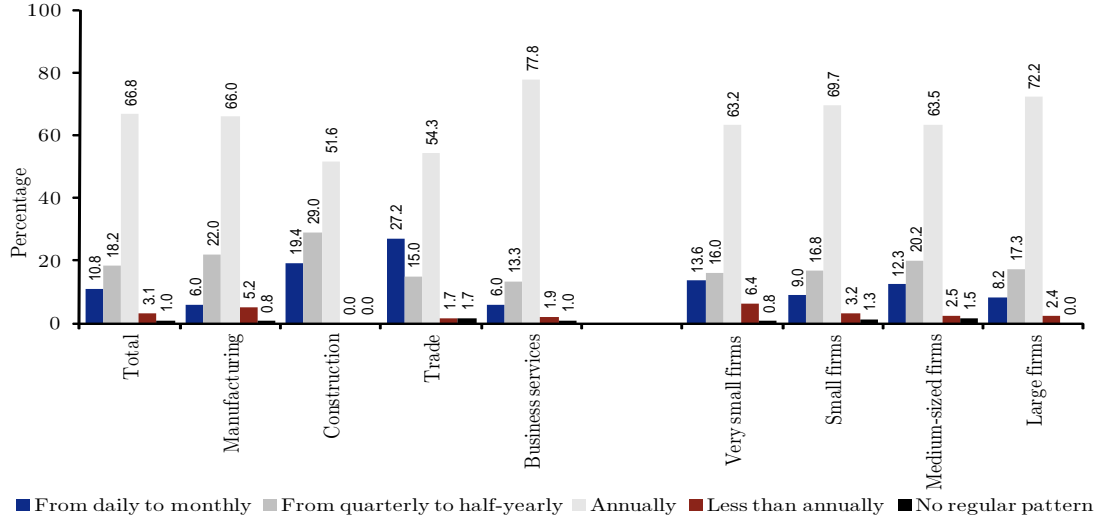
	Size classes (number of employees)				Total
	10-19	20-49	50-199	>199	
	Percentage of firms				
Manufacturing	3.9	6.7	16.9	9.0	36.5
Energy	0.1	0.1	0.5	0.4	1.1
Construction	2.7	3.9	4.8	2.1	13.5
Trade	4.5	3.2	7.3	2.4	17.4
Business services	4.3	4.0	12.3	11.0	31.6
Total	15.4	17.8	41.8	24.9	100.0
	Percentage of employees				
Manufacturing	0.2	1.0	9.1	17.0	27.3
Energy	0.0	0.0	0.3	2.5	2.8
Construction	0.2	0.5	2.5	4.1	7.3
Trade	0.3	0.5	4.0	4.8	9.5
Business services	0.3	0.6	6.7	45.6	53.1
Total	0.9	2.5	22.6	74.0	100.0

4 Descriptive evidence on price and wage changes: frequency, clustering and synchronisation

The speed and magnitude of the adjustment in the economy reflects to a large extent the degree of price and wage rigidities. Regarding the degree of price rigidity, previous studies conducted on the basis of micro quantitative and survey data revealed a considerable degree of price stickiness, measured by the frequency of price changes, both in Portugal and in the euro area as a whole, in particular when compared with the United States (see Fabiani et al. (2007) and Martins (2010) for survey evidence and Vermeulen et al. (2012) and Dias et al. (2008) for micro quantitative evidence). The information collected in the survey shows that around 70 per cent of firms do not change prices more than once a year; with this percentage being particularly high in the case of business services (Figure 1). The comparable figures for the euro area and the US are, respectively, 66 and 50 percent (see Fabiani et al. (2006) and Blinder et al. (1998)).

The approach used in the analysis of price change frequency was different from the procedure for wage change frequency. Whereas for price changes firms were asked directly about their typical frequency of change, in the case of wages the frequency of change was split according to its main determinant: changes that caused by moves in inflation, changes related to tenure and changes related to other factors. One

Figure 1: Frequency of price changes
(as a percentage of total firms in the sample)



composite measure was calculated for the three motivations, defined as the highest frequency of wage change for each firm, irrespective of the specific determining factor. Results show that the wages of most workers (85 percent) are changed only once per year (Figure 2). So, not surprisingly, the frequency of wage changes is much lower than the frequency of price changes.

As to the degree of clustering of price changes, in 37 per cent of the firms price changes are concentrated in specific months of the year, with 64 per cent of these firms adjusting their prices in January (Figure 3). Results show that the degree of concentration of wage changes is considerably higher than that of prices, with 81 per cent of firms changing wages in specific months of the year. January is the month with the largest number of changes. The fact that most decisions on wages are made in January is probably institutional by nature, both at sectoral level and at firm level, a reflection of collective labour conventions.

The survey also included a question with the purpose of assessing the link between the timing of firms' price and wage setting decisions. The intensity and direction of this connection is illustrated in Figure 4. The results suggest that there is some degree of synchronisation between the timing of price and wage changes, with around 50 per cent of firms recognising that a connection does exist. However,

Figure 2: Frequency of wage changes
(as a percentage of total firms in the sample)

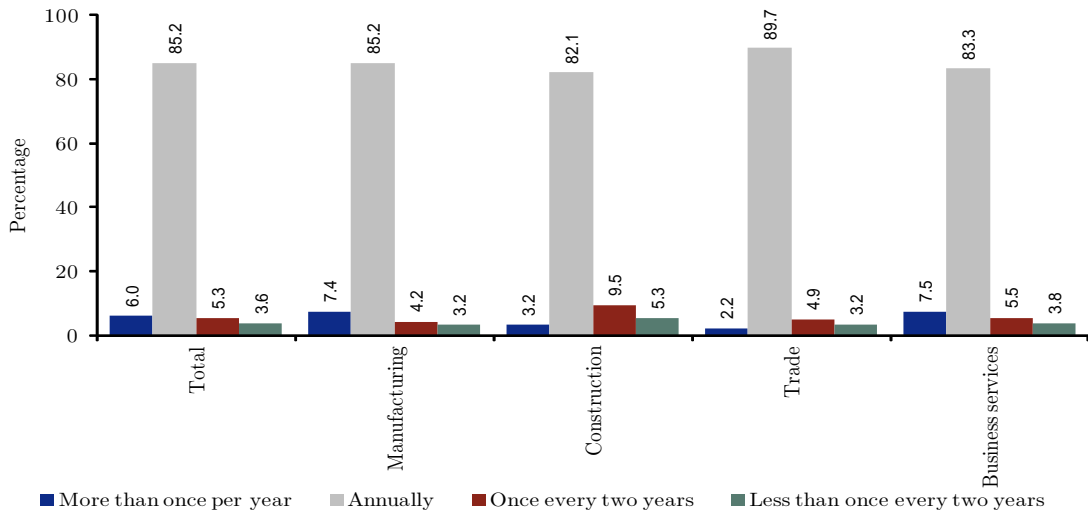
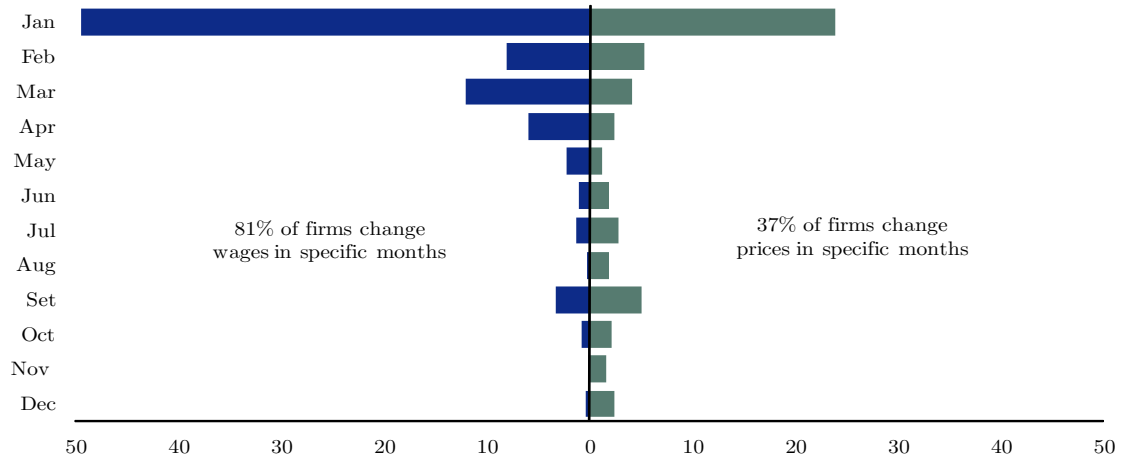
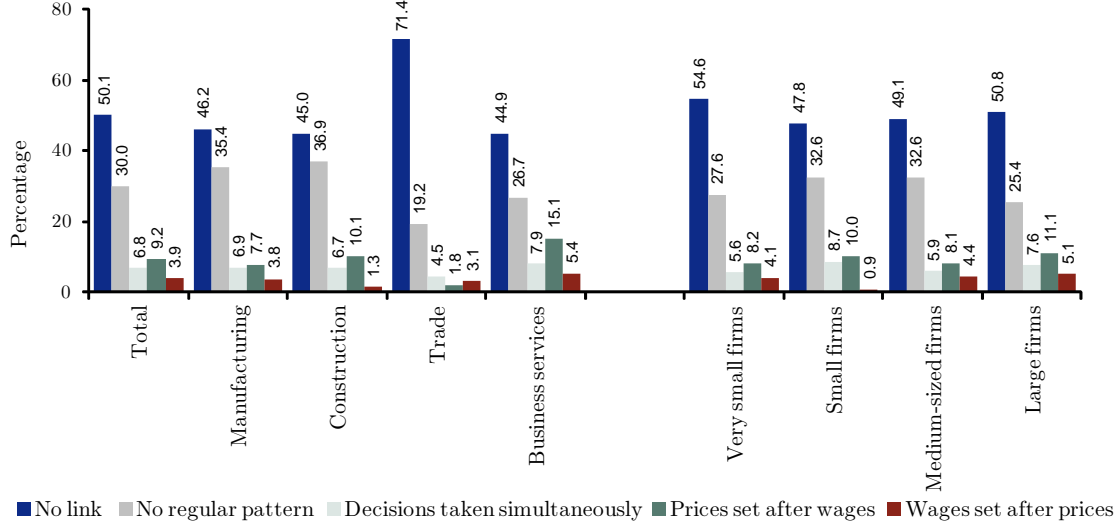


Figure 3: Clustering of price and wage setting decisions
(as a percentage of total firms in the sample)



Values computed as a share of all firms with valid responses. The sum of percentages exceed the proportion of firms that change wages or prices in specific months as they could choose more than one month.

Figure 4: Synchronisation between price and wage setting decisions
(as a percentage of total firms in the sample)



only 20 per cent admit that the link is strong: in 7 per cent the decisions are taken at the same time, in 9 per cent changes in prices are taken only after wages are set, and in 4 per cent changes in wages occur only after prices are set. In contrast, in around half of the firms there does not seem to be any link between the timing of both decisions.

5 A deeper look into the factors that explain the differences in the frequencies of price changes

Guided to a large extent by the theoretical background presented in section 2, this section focuses on the main determinants of the frequency of price changes. I do so by estimating a model for the frequency of price changes within a multivariate framework that accounts for the interaction of a number of firm-level characteristics such the degree of market competition, the time pattern of price reviews or the importance of labour costs. To that end, a categorical variable was created by collapsing firms' answers to the question on the frequency of changes. In particular, in the questionnaire firms were asked about the frequency of price changes for their main product. They could have selected one of the following categories: "daily",

"weekly", "fortnightly", "monthly", "quarterly", "twice a year", "once a year", "every two years", "less than once every two years" and "no predefined pattern". For the sake of simplicity and tractability, I collapsed the answers into four categories (1 - "daily to monthly", 2 - "quarterly to half-yearly", 3 - "yearly" and 4 - "less frequently than yearly"). Those firms that selected the "no pattern" option were not considered in the regressions.¹

The next step was to estimate an ordered probit model where the dependent variable is the four-category variable defined above. The model controlled for features of the firms' such as the sector of activity (manufacturing, construction, trade and business services)² or the size (in terms of employees: 5-19, 20-49, 50-199, more than 199). In an attempt to test some of the predictions of pricing models, a number of covariates were included (a list of all the covariates included in this model and in the model presented in the next section is shown in an appendix).

Degree of product market competition - Measuring the degree of competition and disentangling a situation of perfect competition and price taking agents from one of imperfect or monopolistic competition is not straightforward and becomes particularly difficult in the context of survey data. Two proxies for the intensity of competitive pressures faced by firms were constructed. The first captures the relevance of competitors' pricing strategies (*Market competition*). Firms were asked about the likelihood of a decrease in the price of their main product as a reaction to a price cut by their main competitors. Firms were considered to operate in a competitive environment if they reported a high or very high likelihood.³ Following Bertola et al. (2012), the intensity of external competitive pressures was proxied with a variable that captures the exposure of the firm on foreign markets, measured by the share of exports on total sales (*Share of exports*).

Pricing behaviour - In order to analyse the impact on the frequency of price

¹The same approach could have been used to analyse the frequency of wage changes. However, since the typical Portuguese firm change the wages of its workers once per year (85.2 percent of the firms in the sample), this would imply too little variability in the dependent variable. In addition, inferring the degree of wage rigidity from the frequency of wage changes could be misleading as the timing of these changes are set in collective wage agreements. For reasons that become clearer in the next section, I analyse the issue of wage rigidity using a different approach.

²The final sample included a very small number of firms from energy. For this reason, these firms were included in the manufacturing sector.

³The measure presents some shortcomings. It may not be a good measure of competition in certain cases, for example, when prices are set at the marginal cost and firms compete exclusively à la Bertrand.

changes stemming from firms' different practices of price setting, two variables were included in the model: the degree of firms' price setting autonomy and the time pattern of price reviews. Firms' degree of price setting autonomy is a feature that can potentially affect the frequency of price changes. This dummy variable (*Pricing autonomy*) takes the value 1 if firms can set prices their prices autonomously, and 0, if the price is regulated or mostly defined by the main competitors or customers. As to the pattern of price reviews, in the literature, there are traditionally two approaches for modelling price reviewing behaviour: time-dependent rules and state-dependent rules. Under the former, prices are reviewed at discrete time intervals, which can be fixed as in Taylor (1980) or stochastic as in the Calvo's setting (Calvo (1983)). The main point is that firms review their prices periodically and independently of economic conditions. As opposed to time-dependent rules, in state-dependent rules the timing of price reviews is endogenous, which means that firms decide to review their prices only when there is a sufficiently large shift in market conditions. To test the relative importance of both rules in the frequency of price changes, the model included a dummy variable (*state dependent*) which takes the value 1 if firms reported to change their prices without any defined frequency, being reviewed in reaction to market conditions, and 0 otherwise. The results reported in Figure ?? show that more than 50 percent of the firms follow state-dependent price reviewing rules.⁴

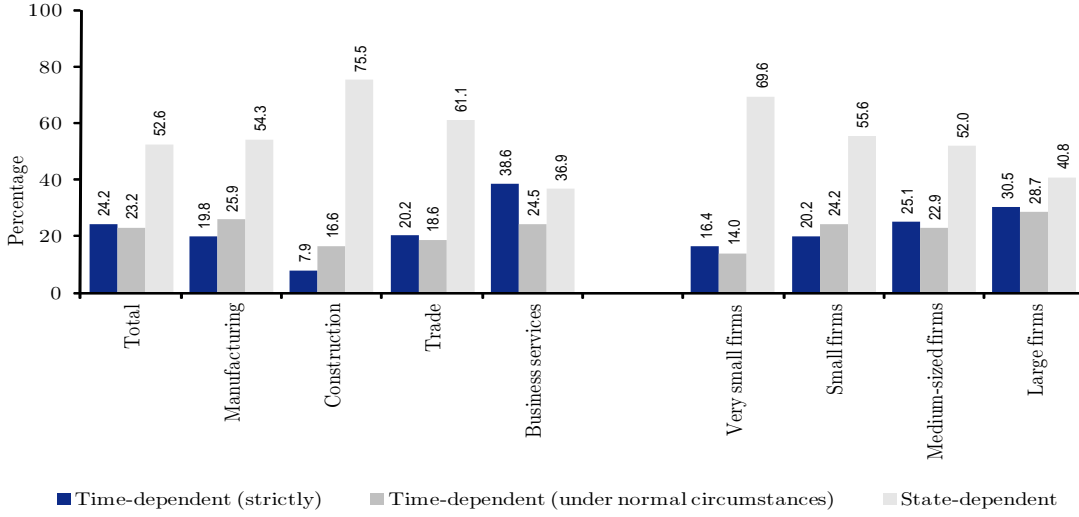
Labour cost share - Recent micro-level data evidence (see Fabiani et al. (2007), Martins (2010) and Altissimo et al. (2006)) shows that sectors with higher labour cost shares are typically characterized by lower frequencies of price changes, which is frequently suggested as being a sign of wage rigidity. Against this background, it was included a variable that aims at measuring the importance of labour cost in price setting (*Labour cost share*). This variable takes the value 1 for those firms where the labour cost share exceeds the median labour cost share in the sample (24 percent) and 0 otherwise.

Table 2 summarizes the main estimation results. In particular, it shows the results of the estimated model as well as the probability estimates for the more extreme rigidity category (less frequently than once a year).⁵ The results confirm

⁴The questionnaire also included a hybrid option in order to consider those situations where firms in general review their prices at a specific time frequency, but in response to particular events they can also conduct additional reviews.

⁵ It is well-known (see, for instance, Winkelmann and Boes (2009)) that in models for ordered

Figure 5: Price reviewing strategies: time vs state dependent
(as a percentage of total firms in the sample)



the presence of cross-sectional differences between firms. Compared to firms in manufacturing (the reference category), all the remaining sectors revealed lower probability of leaving prices unchanged for more than one year. The estimates also show that prices are changed less frequently in very small firms.

As to the structure of the product market, the results indicate that firms operating in more competitive environments change their prices more frequently. A similar result is also found for the regressor measuring the degree of exposure to foreign markets, although in this case the coefficient is not statistically significant. As to the degree of price setting autonomy, this does not seem to have a bearing on the frequency of price changes. The results also indicate that firms adopting state dependent price reviewing rules tend to change their prices more frequently - a result that was largely expected given that, in the presence of shocks, this type of firms are expected to exhibit a lower degree of price rigidity. Turning to the role played

data the signs of the partial effects of the covariates are unambiguous only for the first and last category ($\hat{y}_{i,j} = 1$ and $\hat{y}_{i,j} = 4$, in our case). For the intermediate categories, it is possible to see how a covariate changes the probability of a firm being in a given category, but that is not informative about whether that variable has a positive or negative impact on the value of the underlying latent variable. I focus on the category $\hat{y}_{i,j} = 4$ (i.e., prices changes less frequently than yearly), as it is more meaningful than the category $\hat{y}_{i,j} = 1$ (i.e., prices change at least once per month).

Table 2: Price rigidity
Ordered probit estimates

Regressors	Estimated coefficients from the ordered probit regression	Probability estimates for the more extreme rigidity category (less than once a year)
<i>Pricing behaviour:</i>		
State dependent	-0.2411** (0.1006)	-0.0195** (0.0079)
Pricing autonomy	-0.1403 (0.1041)	-0.0114 (0.0087)
<i>Market competition:</i>		
Share of exports	-0.1229 (0.1014)	-0.0099 (0.0081)
Market competition	-0.4367*** (0.1005)	-0.0353*** (0.0090)
<i>Cost structure:</i>		
Labour cost share	0.3980*** (0.0978)	0.0322*** (0.0090)
<i>Sectors and sizes:</i>		
Large firms (≥ 199)	-0.2303* (0.1323)	-0.0186* (0.0110)
Medium-sized firms (50-199)	-0.2841** (0.1205)	-0.0230** (0.0102)
Small firms (20-49)	-0.2432 (0.1803)	-0.0197 (0.0147)
Construction	-0.6457*** (0.1684)	-0.0522*** (0.0156)
Trade	-0.6221*** (0.1442)	-0.0503*** (0.0131)
Business services	-0.2405** (0.1109)	-0.0195** (0.0094)

Number of observations: 794 Wald $\chi^2(15)=154.62$ (p=0.000)
Log pseudo-likelihood: -697.50 McFadden's Pseudo $R^2=0.1059$
Robust standard errors are in parentheses; ***, **, * denote significance at 1, 5 and 10 percent level, respectively.

by firms' cost structure, the results confirm that the higher the share of labour costs the lower the frequency of price of price changes.

6 Assessing nominal wage rigidity: an alternative approach

6.1 Measuring downward nominal wage rigidity

The concept of nominal wage rigidity is frequently associated with the legal or contractual constraints which hinder firms from reducing the wages of their workers. The empirical literature on the factors that explain the importance of downward

nominal and/or real wage rigidity is quite extensive. The models in this field typically regress a measure of downward nominal or real wage rigidity, computed at the firm, sectoral or country level, on a number of variables the theory suggests as potentially important to explain such differences (see, among others, Dickens et al. (2007), Holden and Wulfsberg (2008), Caju et al. (2009), Messina et al. (2010) and Babecký et al. (2010)). Information on wage freezes has been used as a measure of the degree of downward nominal wage rigidity in a number of papers. However, as pointed out by Dias et al. (2013), wage freezes can only be seen as a measure of downward nominal wage rigidity if the analysis is restricted to the population of firms where wages have been frozen or cut. Given the fact that labour legislation in Portugal strictly forbids nominal wage cuts, in the event of a common negative shock, wage freezes identify those firms where base wages exhibit the lowest degree of downward rigidity. So, given the idiosyncrasy of the Portuguese labour market, the model presented in this section takes the share of base-wage freezes as a measure of downward wage flexibility.

The dependent variable in the model (*Wage flexibility*) is based on firms' answers to the following question (Q20): "*Over the last five years, has the base wage of some workers in your firm ever been frozen?*". The dependent dummy variable takes the value 1 for firms answering positively to this question (most flexible firms).⁶ Obviously, this variable can only be considered as a measure of wage flexibility for those firms that are hit by some type of shock and have the desire to have their wages cut. For this reason, the sample is restricted to those firms where downward nominal wage rigidity is seen as an active restriction. The survey included a question which is particularly useful for the purpose at hand. In particular, firms were asked the following question (Q8): "*If there were no legal or contractual constraints, would you consider the possibility of changing the average base wage in your firm last year differently?*". Firms answering affirmatively to this question had two options: i) an increase in the base wage but in an amount lower than the one reported before; ii) a cut in the base wage. For estimation purposes, I only consider firms that chose this last option. In addition, given that this question takes only into account one single year, the restricted sample for estimation purposes also included those firms that reported that "reduce base wages" would be their preferred channel to

⁶Radowski and Bonin (2008) also use the frequency of wage freezes for wage flexibility in Germany.

achieve a reduction in their labour costs in the event of an unanticipated slowdown in the demand of the main product or an unanticipated increase in the cost of an important intermediate input (Q25 and Q27). These are those firms that would desire to cut down their base wages following a negative shock but for some reason (not necessarily legal) were unable to do it. This reduces the initial sample to 343 firms, whereas the final sample retained for estimation purposes, that excludes the firms that did not answered to the questions which are used as regressors, declines to 312 firms.

6.2 The determinants of downward nominal wage rigidity

In order to identify the determinants of nominal wage flexibility, I estimate a probit model where the choice of the exogenous regressors is guided by the literature on downward wage rigidity summarised in section 2. The model controls for features of the firms' such as the sector of activity (manufacturing, construction, trade and business services) or the firms' size (in terms of employees: 5-19, 20-49, 50-199, more than 199). In an attempt to test some of the predictions of wage setting models, a number of covariates were included. These variables are described below.

Wage setting institutional setup - Based on the information provided by firms on whether they apply a collective wage agreement bargained and signed at a more centralized (sectoral/industry) level and/or an agreement bargained at the firm level, a dummy variable (*Firm-level agreement*) was constructed that is equal to 1 if the firm applies a firm-level collective agreement. The adoption of a less centralized level of wage setting is expected to induce higher wage flexibility.

Characteristics of the workforce - The relative easiness of adjustment of firms' labor force also depends on its composition and on the nature of the relationship between employers and employees. These aspects are taken into account through two indicators drawn from the survey. The first is a dummy (*Permanent workers*) that takes the value 1 for those firms where the share of permanent workers is equal or greater than the sample median (85 percent); the second is also a dummy (*High-skilled workers*) that takes the value 1 for those firms where the share of high-skilled workers is equal or greater than the sample median (74 percent).

Margins of labour cost adjustment - The availability (and flexibility) of alternative margins of labour cost adjustment other than base wages provides firms with additional room to adjust their labour costs. Since firms are primarily con-

cerned with total compensation per employee, these alternative labour cost adjustment strategies are crucial to evaluate the overall degree of labour cost flexibility and its implications. Lebow et al. (2003), Dwyer (2003) and Oyer (2005) look at the role played by benefits in reducing nominal wage rigidity. Dias et al. (2013) provide evidence that firms with more flexible base wages are less likely to reduce employment, and that such effect may be significantly strengthened by the availability of alternative margins of labour-cost adjustment that firms can use in bad times. The questionnaire included a question that attempted to capture the importance of these margins. In particular, firms were asked if they had ever used other strategies to reduce their labour costs. The dummy *Use of flexible components* is equal to 1 for firms that chose at least one of the following three options: "Reduction or elimination of bonus payments and other monetary benefits", "Reduction or elimination of non-monetary benefits" or "Slowdown or freeze the rate at which promotions are filled". An additional dummy (*Share of flexible components*) was included to measure the extent to which firms with a higher share of the flexible pay components in total labour costs are also those with a lower degree of wage rigidity.

Table 3 summarizes the results from the probit model. In particular, it displays the estimated coefficients as well the average marginal effects of each of the covariates on the probability of a base-wage freeze after an unanticipated slowdown in demand or an unanticipated increase in the cost of an important intermediate input. The results show that the degree of wage flexibility does not differ substantially across sectors in contrast with the evidence found for price rigidity. The same does not hold for the size variable: the degree of wage rigidity seems to increase with the size of the firms. The results also show that the existence of firm-level collective bargaining is positively relative to a higher flexibility of wages, although the estimated is not statistically significant.

As to the flexibility of the firms' cost structure and the characteristics of their labor force, the results show that firms where the flexible pay components account for a greater share of total labour costs exhibit a higher degree of base-wage flexibility. To the extent that workers with permanent contracts have more bargaining power in the wage-setting process than workers with temporary contracts, the "insider-outsider model" (Lindbeck and Snower (1988)) implies higher wage rigidity for the former group of workers. In line with the theory, the results show that the impact of the share of permanent employees on wage flexibility is negative. The literature

Table 3: Wage rigidity
Probit estimates

Regressors	Estimated coefficients	Average marginal effects
<i>Characteristics of the workforce:</i>		
Permanent workers	-0.7090*** (0.2337)	-0.1384*** (0.0433)
High-skilled workers	-0.3719* (0.2241)	-0.0726* (0.0427)
<i>Wage bargaining setup:</i>		
Firm-level agreements	0.4182 (0.4310)	0.0816 (0.0828)
<i>Margins of labour cost adjustment:</i>		
Share of flexible components	0.6041** (0.2873)	0.1179** (0.0547)
Use of flexible components	-1.0059*** (0.2290)	-0.1964*** (0.0388)
<i>Sectors and sizes:</i>		
Large firms (≥ 199)	-0.7232** (0.3280)	-0.1412** (0.0648)
Medium-sized firms (50-199)	-0.6728*** (0.3087)	-0.1314** (0.0615)
Small firms (20-49)	-0.4698 (0.4110)	-0.0917 (0.0802)
Construction	0.5699 (0.4252)	0.1113 (0.0819)
Trade	0.2431 (0.2901)	0.0475 (0.0569)
Business services	0.3323 (0.2667)	0.0649 (0.0518)
Number of observations: 312	Wald $\chi^2(12)=39.61$ (p=0.000)	
Log pseudo-likelihood: -89.285	McFadden's Pseudo R ² =0.2186	
Robust standard errors are in parentheses; ***, **, * denote significance at 1, 5 and 10 percent level, respectively.		

also suggests that the wages of high-skilled workers are likely to display higher downward rigidity than those of low-skilled, either because the effort of high-skilled workers is more valuable and more difficult to monitor or because costs of hiring and training costs are higher for high-skilled workers making firms more reluctant to cut their wages (see, for instance, Shapiro and Stiglitz (1984), Akerlof (1982) and Akerlof and Yellen (1990)). From Table 3, we see that, in comparison to low-skilled workers, firms with a higher share of high-skilled workers are less likely to freeze their base wages following negative shocks. On the other hand, a more frequent use of the alternative price margins of labour cost adjustment is negatively related with the level of base wage flexibility. This indicates that these margins provide firms with additional room to reduce their labour costs, in particular in a context where

base wages exhibit downward rigidity.

7 Concluding remarks

1. The modal frequency of wage and price changes is once a year. However, changes in wages occur slightly less frequently than changes in prices;
2. The evidence points to a significant degree of clustering in wage setting, as 81 percent of the firms concentrate wage changes in a particular month (January in about two-thirds of them); this is less widespread for prices, as only 37 percent of the firms change their prices in specific months;
3. The results suggest that there is some degree of synchronisation between the timing of price and wage changes, with around 50 per cent of firms recognising that a connection does exist. However, only 20 per cent admit that the link is strong;
4. The results from a multivariate analysis show that the frequency of price changes is lower when competitive pressures are weaker and when labour costs account for a higher fraction of firms' total costs;
5. The results from a probit model reveal that the constraint imposed by the presence of downward base wage rigidity is lower in firms where the fraction of permanent and high-skilled workers is lower and where the share of flexible pay components is higher. The results also show that firms use alternative margins of labour cost adjustment such as monetary and non-monetary benefits as substitutes for downward base wage rigidity;

Appendix - Covariates

Model on price rigidity (section 5)

1. *Market competition* - Dummy that equals one if firms consider a price cut as likely or very likely in a situation where their main competitors decide to cut their prices;
2. *Share of exports* - Share of exports on total sales
3. *Pricing autonomy* - Dummy that equals one if firms can set prices their prices autonomously;
4. *State dependent* - Dummy that equals one if firms reported to change their prices without any defined frequency, being reviewed in reaction to market conditions
5. *Labour cost share* - Dummy that equals one for those firms where the labour cost share exceeds the median labour cost share in the sample (labour share obtained from the *Banco de Portugal Central Balance Sheet*).

Model on wage flexibility (section 6)

1. *Firm-level agreement* - Dummy that equals one if the firm applies a firm-level collective agreement;
2. *Permanent workers* - Dummy that equals one for firms where the share of permanent workers is equal or greater than the sample median;
3. *High-skilled workers* - Dummy that equals one for firms where the share of high-skilled workers is equal or greater than the sample median;
4. *Use of flexible components* - Dummy that equals one for firms that chose at least one of the following three options to reduce labour costs: "Reduction or elimination of bonus payments and other monetary benefits", "Reduction or elimination of non-monetary benefits" or "Slowdown or freeze the rate at which promotions are filled"
5. *Share of flexible components* - Share of the flexible pay components in total labour costs (obtained from the *Banco de Portugal Central Balance Sheet*)

Appendix - Questions used in this paper

- Q1 Composition of the workforce by type of contract (per cent)
 - Full-time with permanent contract ... per cent
 - Part-time with permanent contract ... per cent
 - Temporary ... per cent
 - Other types of contracts ... per cent
- Q4 Composition of the workforce by occupation (per cent)
 - Low-skilled blue collars ... per cent
 - High-skilled blue collars ... per cent
 - Low-skilled white collars ... per cent
 - High-skilled white collars ... per cent
- Q8 If there were no legal or contractual constraints, would you consider the possibility of changing the average base wage in your firm last year differently?
 - Yes
 - * The average base wage would increase by... per cent.
 - * The average base wage would decline by... per cent.
 - No
- Q10 Is there any firm-level agreement in your firm?
 - Yes
 - No
- Q18 Under normal circumstances, are base wage changes concentrated in any particular month(s)?
 - No
 - Yes. Please indicate which month(s)....
- Q20 Over the last 5 years, has the base wage of some of your workers ever been frozen?
 - No
 - Yes (indicate the percentage of employees affected in the last situation) ... per cent
- Q23 Have you ever used any of the following strategies to reduce labour costs? (you may choose more than one option)

- Recruitment of new employees with similar skills and experience at a wage lower than that of those who left the firm;
 - Reduction or elimination of bonus payments and other monetary benefits
 - Reduction or elimination of non-monetary benefits
 - Change the policy of shifts (reducing the number of hours and/or the shift payments)
 - Reducing the number of employees
 - Slowdown or freeze the rate at which promotions are filled
- Q25 How would your firm react to an unanticipated slowdown in the demand of your main product?
 - Reduce prices
 - Reduce margins
 - Reduce output
 - Reduce costs, if you select this option, what would be your favourite option:
 - * Reduce base wages
 - * Reduce flexible wage components
 - * Reduce the number of employees with permanent contract
 - * Reduce the number of employees with temporary contract or other type of workers
 - * Reduce the number of hours worked per employee
 - * Reduce other non-labour costs
- Q27 How would your firm react to an unanticipated increase in the cost of an intermediate input?
 - Increase prices
 - Reduce margins
 - Reduce output
 - Reduce costs, if you select this option, what would be your favourite option:
 - * Reduce base wages
 - * Reduce flexible wage components
 - * Reduce the number of employees with permanent contract
 - * Reduce the number of employees with temporary contract or other type of workers
 - * Reduce the number of hours worked per employee
 - * Reduce other non-labour costs

- Q31 How does the timing of your price changes relate to that of wage changes? (indicate only the most relevant option)
 - There is no link between the two
 - There is a link but not a particular pattern
 - Decisions are taken simultaneously
 - Price changes are defined after wages are set
 - Wage changes are defined after prices are set
 - Wage changes are defined after prices are set
 - This question does not apply to my firm
- Q32 Last year, what share of your revenue was generated by the sale of your product in the following markets?
 - Domestic market ... per cent
 - Foreign markets ... per cent
- Q33 How is the price of your main product set in its main market? (choose the most relevant option)
 - The price is not set autonomously because it is regulated by an external entity
 - The price is not set autonomously because it follows largely the price(s) of our main competitor(s)
 - The price is not set autonomously because it is largely set by our main customer(s)
 - The price is set autonomously but it is largely affected by the price of our main competitor(s)
 - The price is set autonomously without being largely affected by the price of our main competitor(s)
- Q35 Suppose your main competitor decreases its price; how likely is your to react by decreasing its own price? (please indicate the most relevant option)
 - Very likely
 - Likely
 - Not likely
 - Not at all
 - It doesn't apply
- Q37 The price of your main product is reviewed, but not necessarily changed (please indicate the most relevant option):

- At a well-defined frequency (annually, quarterly,...)
 - Generally at a well-defined frequency, but sometimes also in reaction to market conditions (changes the price of raw materials or in demand conditions...)
 - Without any defined frequency, being reviewed in reaction to market conditions (changes the price of raw materials or in demand conditions...)
 - It doesn't apply
- Q38 Under normal circumstances, at what frequency is the price of your main product changed? (please indicate the option closest to your particular situation)
 - Daily
 - Weekly
 - Fortnightly
 - Monthly
 - Quarterly
 - Half-yearly
 - Yearly
 - Every two years
 - Less than every two years
 - No defined pattern
 - Q39 Under normal circumstances, are price changes concentrated in any particular month(s)?
 - No
 - Yes. Please indicate which month(s)....

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— *Ildeberta Abreu*
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— *António Rua*
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2012

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— *João Pedro Pereira, António Rua*
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— *Diana Bonfim, Qinglei Dai*

2013

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