Wage rigidity and employment adjustment at the firm level: Evidence from survey data[*]

Daniel A. Dias[†], Carlos Robalo Marques[‡], and Fernando Martins[§]

January 10, 2012

Abstract

This paper investigates how Portuguese firms adjust their labour costs in the presence of wage rigidities. Using firm level survey data we document that Portuguese firms, besides reducing employment or freezing base-wages, also make frequent use of other non-wage cost-cutting strategies to adjust labour costs in the face of negative labour demand or supply shocks. We show that the utilization of these different adjustment strategies is affected by workers' and firms' attributes, as well as by some indicators of the economic environment in which firms operate. Finally, we also show that firms with more flexible base wages are less likely to reduce employment, and that such effect may be significantly strengthened by the existence of alternative labour-cost adjustment margins that firms can use in bad times, like freezing or cutting some more flexible compensation components (bonus, benefits and promotions) or recruiting new employees at wages lower than those received by the employees that have left the firm.

JEL classification: J32, J60
Key words: Wage rigidity, non-wage labour costs, unemployment, probit model.

1 Introduction

Understanding the impact of shocks in the economy is a fundamental question in macroeconomics. In particular, understanding how wage and employment adjustments interact in the face of negative shocks is crucial for the understanding of economic dynamics and the design of monetary policy. This paper contributes to this literature by analysing how firms combine different channels of labour-cost adjustment in response to adverse shocks in the presence of institutional and structural restrictions.

In the real economy, the way in which firms distribute shocks across various labour-cost adjustment channels (wages versus employment) depend not only on technological restrictions and market characteristics, but also on institutional and structural constraints of the economy, including wage rigidity and employment protection legislation.

Wage rigidity is expected to have implications for unemployment because, in the face of negative shocks, employment adjustment is likely to be larger when (nominal or real) wages are rigid downwards. Wage rigidity is also thought to have important implications for monetary policy, as it conditions the inflation target that monetary authorities should pursue. If nominal wages were perfectly flexible it would be optimal to aim at zero inflation but, in the presence of downward nominal wage rigidity, a certain amount of inflation may be required to "grease the wheels" of the labour market by easing reductions in real wages (see, among many others, Akerlof et al. (1996)).

The Portuguese labour market is usually seen as displaying a high degree of nominal wage rigidity as the available studies invariably place the country among the European economies having the highest degree of downward nominal wage rigidity. However, the bulk of the empirical literature aimed at assessing the extent and the effects of nominal wage rigidities, including that for Portugal, has focused mainly on base wages or permanent wages (base wages plus other components that are paid on a permanent or regular basis, such as meals allowances, tenure-related components, etc.), leaving aside potentially more flexible pay components, such as performance-related bonuses, commissions and other benefits that are not paid on a regular basis, which may strongly

attenuate the negative impact on employment of strict downward nominal base-wage rigidity.[1]

In contrast, the Portuguese labour market was characterised as displaying a low level of real wage rigidity during the 1980's and 1990's (see, for instance, Dias et al. (2004)). However, estimates based on more recent data suggest that things might have changed dramatically during the last decade or so, as the sensitivity of real wages to changes in the unemployment rate seems to have, by and large, faded way (see Portugal et al. (2010)).

This paper discusses wage rigidity in a broader context by focusing also on other adjustment mechanisms that involve the use of labour inputs. In the presence of rigid base wages there may be alternative ways of reducing labour costs that can be used when firms face negative exogenous shocks. These include the adjustment of flexible pay components such as bonuses and other monetary or non-monetary benefits, the adjustment of labour costs through the reorganization of production, or the use of labour turnover to adjust labour costs in reaction to changes in economic activity. Since firms are primarily concerned with total compensation per employee, the assessment of the importance of these alternative labor cost adjustment strategies is crucial in order to evaluate the overall degree of labour cost flexibility and its implications. In particular, in a situation of rigid base wages, one may expect the alternative ways of reducing labour costs to become an important adjustment tool to dampen the effects of negative shocks on firms' employment.

Based on a firm-level survey conducted by Banco de Portugal in 2008 on a sample of Portuguese firms from different sectors of activity, we evaluate the relative importance of these alternative margins of labour cost adjustment in terms of their contribution to attenuate the negative impact of base-wage rigidities on employment in the Portuguese

---

[1]We believe that the lack of studies involving performance related benefits stems from the fact that datasets based on administrative data usually contain little information on such components, making it virtually impossible for downward nominal wage rigidity measures to properly account for their presence.

labour market.[2]

Our dataset shows that, among the firms that have cut labour costs, the reduction in the number of employees was by far the most commonly used strategy (around 72 percent of the firms), followed by the use of "flexible margins", i.e., non base-wage margins (around 45 percent of the firms), which include the reduction or elimination of bonus payments and other monetary benefits, the reduction or elimination of non-monetary benefits and the slowdown or freezing of promotions. The recruitment of new employees with a wage lower than the one of those who left the firm ("cheaper hires") was used by around 30 percent of the firms and, finally, around 26 percent of the firms answered that they used "base-wage freezes". Also, the use of the different strategies does not seem to vary much across sectors or firm sizes.

From the estimated models, we find that the use of each strategy is related to several workers' and/or firms' attributes such as the tenure and skill distribution, to some measures of the unions' bargaining power, as well as to some indicators of the economic environment in which they operate. Firms operating in foreign markets, which typically face a more competitive environment, tend to use some of these strategies more heavily.

The estimated results suggest that "cheaper hires" were mainly used as substitutes for "base-wage freezes" by Portuguese firms, i.e., they were predominantly used in situations in which firms were unable to freeze base wages following a negative labour demand shock or to compensate abnormal or unexpected base-wage increases following a negative labour supply shock. In contrast, the relationship between the "flexible margins" and "base-wage freezes" is positive (even though not significantly so), which suggests that the reduction or elimination of bonuses and other benefits was predominantly used as a complement to "base-wage freezes" in reaction to negative labour

---

[2]The use of qualitative information from a firm survey has the important advantage of making it possible to address a broad set of issues, such as the firms' labour cost adjustment practices, most of which are not generally observable in the available matched employer-employee administrative databases. But, of course, some of the well-known limitations inherent to qualitative survey data should not be overlooked. These relate mainly to the the possibility of ill-judged interpretation of the questions raised. In addition, the responses may also be affected by other factors, such as the way questions are formulated or the economic outlook in which they occur. However, the fact that in our model we mostly use ordinal information mitigates these potential measurement errors significantly.

demand shocks.

We also found a clear negative association between "base-wage freezes", which we interpret as a measure of base-wage flexibility, and the likelihood of a firm reducing employment. We estimate that the probability of a firm reducing employment is around 21 percentage points lower for a firm that has frozen base wages than for an otherwise identical firm. In turn, the ability to use the "flexible margins" or the "cheaper hires" decreases the probability of a firm reducing employment (around 6.5 percentage points in both cases). Together, for a firm that has frozen base wages, used the "flexible margins" and "cheaper hires", the probability of reducing employment is around 35 percentage points lower than for an otherwise identical firm.

These results show that wage flexibility is likely to have a strong positive impact on employment in the face of negative labour supply and demand shocks, and that such positive impact is significantly reinforced by the existence of alternative margins of labour cost adjustment. In particular, the existence of more flexible compensation components (bonus, benefits and promotions) that firms can freeze or cut in bad times, and the possibility of recruiting new employees at a wage lower than the one of those who have recently left the firm have certainly contributed to partly offset the negative impact of base-wage rigidities on employment.

We notice, however, that some of the results in the paper must be interpreted with caution. Limitations of our dataset, namely the lack of information on when and how often the different margins were used by the firm, is expected to have implications for the probabilities estimated in the paper.

The rest of the paper is organised as follows. Section 2 describes the dataset. Section 3 provides the institutional and theoretical background for the econometric models used in the empirical section of the paper. Section 4 presents some preliminary analysis of the data. Section 5 discusses the econometric methodology, presents the estimated models and discusses the main results. Section 6 provides some concluding remarks. Finally, Appendix A derives the implications for the estimates of some of

the parameters of our model stemming from potential limitations of our dataset, and Appendix B describes how the different variables were constructed.

2   Data sources

Most of the data used in this study come from a survey on wage and price setting practices carried out by Banco de Portugal in 2008 on a sample of Portuguese firms[3].

Among many other questions, in this survey firms were asked two questions pertaining to the different margins of labour cost adjustments, including base-wage freezes, reduction or elimination of flexible total compensation components and reduction of employment.

As regards wage freezes firms were asked the following question: *"Over the last five years, has the base wage of some workers in your firm ever been frozen?"*. Under the assumption of a common negative shock, and in the absence of nominal wage cuts, wage freezes identify those firms in the sample where base wages exhibit the lowest degree of real downward rigidity. Thus, for the purposes of the present paper we look at base wage freezes as a measure of downward wage flexibility.[4]

In the second question, firms were asked if they had ever used ways of cutting labour costs other than changing their base wages. In particular, they were asked the following question: *"Have you ever used any of the following strategies to reduce labour costs?"* Firms participating in the survey were allowed to choose as many options as

---

[3]Details on the sample selection method as well a copy of the full questionnaire can be found in Martins (2011).

[4]Information on wage freezes is usually used in the literature as a measure of the degree of downward nominal wage rigidity (see, for instance, Babecký et al. (2009, 2010)). In our view, however, wage freezes can be seen as a measure of downward nominal wage rigidity only if the analysis is restricted to the population of firms where wages have been frozen or cut. In fact, in order to measure the degree of downward nominal wage rigidity, the literature usually computes te proportion of wage freezes on the total of wage freezes and wage cuts (see for instance, Holden (2004), Dickens et al. (2007), Holden and Wulfsberg (2008)). Such measure is usually seen as identifying the proportion of wage cuts prevented by downward nominal wage rigidity. In the case of the Portuguese economy, given the absence of base wage cuts, such measure would be equal to one irrespective of the extension of wage freezes. In other words, because nominal base wages cannot be cut, downward nominal wage rigidity pertaining to base wages is not identifiable for the Portuguese economy.

they wished from the list below:[5]

1) *Reduce or eliminate bonus payments and other monetary benefits*;

2) *Reduce or eliminate non-monetary benefits*;

3) *Slow or freeze the rate at which promotions are filled.*

4) *Recruit new employees at a lower wage than those who left the firm*;

5) *Reduce the number of employees.*

These five strategies together with wage freezes summarise the main labour cost-cutting strategies available to Portuguese firms in the face of negative shocks. Wage freezes, the reduction or elimination of bonus and non-monetary benefits, the slowdown or freezing of the rate at which promotions are filled and the recruitment of new employees at a wage lower than the one of those who left the firm may be seen as affecting the average price of labour. The reduction in the number of employees (strategy 5 in the second question) affects the quantity of labour and will be denoted simply as "reduce employees".

Further below, for estimation purposes, and for tractability reasons, strategies 1 to 3 in the second question (the reduction or elimination of bonus and non-monetary benefits and the slowdown or freezing of promotions) will be aggregated in a single margin and denoted together as "flexible margins" as they are usually seen as more flexible than base wages.

Besides the questions on the wage freezes and the alternative margins of labour cost reduction, the survey also contains information on a large set of firms' characteristics. These include information on the composition of the labour force (share of white collar vs. blue collar workers; share of low skilled vs. high skilled workers; share of workers with permanent contracts), the percentage of workers covered by collective wage agreements, the share of exports in firms' total sales, and the relevance of some

---

[5]The original question included also the option *"Change the policy of shifts (reducing the number of hours and or shift premia)"*. The answers to this option are not analised in the paper because they involved a small proportion of firms and also because we believe that such option is basically used by firms whose product has very specific characteristics, making it difficult to find a meaningful set of regressors capable of explaining why some firms use that option with higher probability than others.

factors as obstacles to wage cuts/freezes in a context where firms may desire to reduce their labour costs, such as the constraints imposed by collective wage agreements, the negative impact on firms' reputation or the difficulties in attracting new workers in the future.

After excluding from the sample those firms that have not fully answered the two questions on the alternative strategies to reduce labour costs, we were able to obtain detailed information on 1319 firms from different branches of activity. More specifically, our sample includes firms with 10 or more employees, covering manufacturing (38 percent), energy (3 percent), construction (11 percent), retail and wholesale trade (17 percent), and other business services (31 percent).

However, for estimation purposes, and for reasons that will become clear further below, we restrict the analysis to firms that have reduced costs, i.e, that have used at least one cost-cutting strategy, which reduces the original sample to 757 firms. Also for estimation purposes the information from the survey was supplemented with data from *Quadros de Pessoal*, a large administrative database collected by the Ministry of Employment and Social Security, which, among other, includes information about all the Portuguese firms with wage earners (size, ownership, location, etc.). From this database we obtained information on size (number of employees) and workers' tenure.

By combining these two datasets through the individual tax identification number of each firm, and after excluding the firms that have not answered to all the questions that are used as regressors in the estimated models the initial sample is reduced to 635 firms. This will be the sample retained for estimation purposes.

An important feature of our dataset regards its qualitative nature. Ideally, we would like to have quantitative data on wage freezes (amount of base wages frozen), on employment reduction (number of employees dismissed) and on the use of other margins (amount of bonus payments reduction, for instance), rather than simple qualitative information on whether such margins were used or not. In the absence of any quantitative information, our dataset allows us, for instance, to make inference on the

probability of a firm reducing employment, but prevents us from making inference on the extent of firms' employment reductions, which could also be seen as an interesting matter. Another important feature of our dataset stems from the fact that it has no information on the number, type and timing of the shocks (to which the firms have reacted). We see this as an important caveat pertaining to our dataset. The available sample data are likely to be the outcome of both negative labour supply and labour demand shocks. Ideally, in order do draw conclusions on substitution effects among the different adjustment channels, in the context of our model, we would like to have data on the reaction of firms to the each type of shock, as well as information on the number of shocks faced by the firm. As we only have information on whether the firm has ever used each of the margins, but no information on the number of times each margin was used by the firm, we proceed under the restrictive identifying assumption that firms in the sample have used each margin at most once. All these qualifications require, of course, that the estimated parameters be interpreted with caution. In particular, we notice that the results obtained in the paper are conditional on the distribution of the negative labour demand and supply shocks that took place in economy in the period under analysis.[6]

3   Institutional and theoretical background

In the face of negative shocks firms are expected to respond through adjustments that affect directly their demand (price of the product) and/or their supply (costs of production). For reasons of data availability and econometric tractability, this paper focuses on the labour-cost adjustment strategies that Portuguese firms have used in the face of negative labour demand and supply shocks.[7]

---

[6]Appendix A discusses the consequences for the estimation of some key parameters, that measure substitution effects, stemming from the restrictive identifying assumption that firms in the sample have used each margin at most once. It is shown that these parameters are likely to be upward biased, so that the effects obtained in this paper can be seen as conservative estimates of the true (unknown) substitution effects.

[7]Implicitly, in the econometric analysis below, we assume that the character of a firm's product market should determine whether costs rather than prices are adjusted, but it should not be directly

3.1 Institutional background

In the face of negative labour demand or labour supply shocks, firms are expected to react by trying to reduce employment or/and labour costs. In the real economy, however, firms face restrictions in terms of the channels of adjustment they can use, so that the way in which firms distribute shocks across the various labour-cost adjustment channels are expected to depend not only on technological and market restrictions, but also on institutional and structural constraints of the economy, including wage rigidity and employment protection legislation.

As regards nominal wage rigidity, 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 (2006)). 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. As a general rule, only bonus, commissions and other monetary or non-monetary benefits associated to the worker's performance, not included in the collective agreement, may legally be reduced (Portuguese Labour Code, art. 129, 258 and 260). Also, collective negotiations are usually conducted at the industry or occupation level, and collective agreements stipulate minimum working conditions, in particular 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

---

relevant for cost-adjustment strategies. This allows a two-stage estimation procedure, where the estimation of cost-adjustment specifications takes into account potential sample selection issues.

establishes a wage floor for many workers, introduce strong additional rigidity in the wage-setting process.[8]

However, until recently, at least, the Portuguese labour market was seen as displaying a very low level of real wage rigidity. This conclusion emerges not only from the literature that investigates the degree of real wage rigidity from micro data by computing measures of downward real wage rigidity from the distribution of wages changes (see Dickens et al. (2007) and Messina et al. (2010)), but also from the literature that looks at the wage curve using micro or macro data, where real wages appear as highly responsive to the unemployment rate (see OECD (1992), Luz and Pinheiro (1993), Gaspar and Luz (1997), Dias et al. (2004) and Marques (2008)). Estimates based on more recent data, however, suggest that things might have changed dramatically during the last decade or so. According to Portugal et al. (2010), the large cyclical sensitivity of real wages, prevailing in the 1980s and the 1990s, has basically vanished in the most recent period.[9]

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 of finding ways to get around individual dismissals regulation by negotiating voluntary quits.

3.2 Theoretical background

Given the characteristics of the Portuguese labour market described above, we assume a "*right to manage*" situation where base wages are bargained collectively but other

---

[8]In recent years, however, the number of firm-level agreements, which are supposed to allow greater wage flexibility, has increased. According to our survey, they were present in around 10 percent of the firms.

[9]The estimated semi-elasticity of real wages to changes in the unemployment rate drops from -2.46 in the 1986-2000 period to about zero in the 2002-2007 period for job-stayers, and from -0.955 to -0.343 for new-hires.

components of total compensation and employment are chosen optimally by firms subject to adjustment costs (namely hiring and firing costs), as well as to institutional constraints. In such a setting, the ability of wages and employment to respond to shocks depends not only on the elasticity of labour demand and supply, but also on institutional features and specific market conditions, including employment protection legislation and wage bargaining institutions.

In order to facilitate the discussion, we start by resorting to a very stylised model - similar to the one presented in Bertola et al. (2010) - that allows us to discuss the impact of shocks on wages and employment. For ease of presentation, we assume that firms do not pay bonuses or benefits nor have the possibility of using "cheaper hires", so that total compensation coincides with base wages. To maximise profits in a "*right to manage*" situation firms must choose employment so as to equate the wage, which they take as given, to labour's marginal impact on firm's revenues. Let us assume that the inverse labour demand schedule of firm i may be written as:

$$w_i = -\theta_i l_i + d_i \tag{1}$$

where w is the log of firm's labour cost, l_i is the log of employment, d_i measures other factors that affect labour demand (marginal revenues) and θ_i is the inverse of the elasticity of the labour demand schedule.

Similarly, let us assume that firm i faces the following inverse log-linear labour supply schedule:

$$w_i = \lambda_i l_i + s_i \tag{2}$$

where λ_i is the inverse of labour supply elasticity and s_i measures other factors that

affect labour supply. Solving the two equations for wages and employment, we get:

$$w_i = \frac{\theta_i}{\lambda_i + \theta_i} s_i + \frac{\lambda_i}{\lambda_i + \theta_i} d_i, \tag{3}$$

$$l_i = \frac{1}{\lambda_i + \theta_i}(d_i - s_i) \tag{4}$$

In this simple framework, a labour demand shock may be represented by Δd_i. Labour demand shocks might reflect technological shocks, fluctuations in the price of factors other than labour (e.g., energy) if factor intensities differ across firms, or output demand shocks. The equilibrium wage and employment reactions to labour demand shocks is given by:

$$\Delta w_i = \frac{\lambda_i}{\lambda_i + \theta_i} \Delta d_i \tag{5}$$

$$\Delta l_i = \frac{1}{\lambda_i + \theta_i} \Delta d_i \tag{6}$$

Since the elasticity of labour demand depends on the the degree of decreasing returns to labour, on labour's substitutability with other factors of production and on the elasticity of product demand (see Hamermesh (1987)), all these features affect the reaction of employment to shocks.

The response of employment to labour demand shocks is small when the labour supply curve is inelastic, i.e., λ_i is large. In contrast, if wages do not change, i.e., λ_i is very small, possibly because they are set by binding collective wage agreements, then employment responds strongly to labour demand shocks.

In a dynamic context, however, wages and employment need not vary along the static labour demand curve. Employment protection legislation can smooth employment dynamics in the face of shocks, so that employment fluctuations are expected to be less frequent and also less pronounced on average (see Bertola (1999)). The ability of wages to respond to firm-level and common shocks also depends on institutional features, as well as on local labour market conditions, especially when labour mobility

is low (see Topel (1986)).

Thus, in the face of a negative labour demand shock several final adjustments are possible. If the firm is not able to freeze nominal wages (the most likely situation under downward real wage rigidity), it will likely reduce employment and answer in the survey that it has reduced employment but has not frozen wages. If, by negotiating with the workers' representatives, the firm manages to freeze nominal wages (the best it can aim at, given the existence of strict base-wage nominal downward rigidity), the firm will answer in the survey that it has frozen wages and reduced employment (if freezing wages was not enough to prevent employment reduction) or that it has frozen wages and not reduced employment, otherwise.

Let us now consider a wage shock which we represent by Δs_i. The employment impact of such shock is given by:

$$\Delta l_i = \frac{-1}{\lambda_i + \theta_i} \Delta s_i \tag{7}$$

Thus, employment responses are expected to be larger when θ_i is small, i.e., labour demand is more elastic, which in turn reflects the degree of market competition, as well as the substitutability of labour with other factors. In the face of a negative labour supply shock (for instance, an unexpected base-wage increase imposed by collective agreements), the most likely final outcome (in the absence of other adjustment mechanisms) is a reduction in employment, so that the firm will answer in the survey that it has reduced employment but has not frozen wages.

Summing up, the cases in which firms have reacted by freezing base wages (reducing or not employment at the same time) are responses to a negative labour demand shock. The cases in which firms have reduced employment but have not frozen base wages may be the reaction either to a negative labour demand or to a negative labour supply shock.[10]

---

[10]Appendix A shows that this difficulty in disentangling labour demand from labour supply shocks does not have relevant implications for the estimation and interpretation of the parameters that measure the relevant substitution effects in the econometric model estimated in section 5.

The role played by the alternative mechanisms investigated in this paper, like the flexible components of total compensation (such as bonus and other monetary and non-monetary benefits) and the possibility of recruiting new employees at a lower wage than those who have recently left the firm, may be discussed by noting that they operate in the model by affecting total compensation and thus the labour supply and demand curves. Thus, in the context of downwardly rigid base wages, the negative impact on employment of a negative labour demand shock will be lower if the firm has the possibility of freezing or reducing some components of total compensation (freezing or reducing bonuses and benefits or recruiting new employees at a lower wage than the one of those who have recently quit). Similarly, in the face of a negative labour supply shock, these margins may be used to attenuate the increase in total compensation, reducing the negative impact on employment. In the case of a negative labour demand shock, these two margins will emerge in the sample either as complements to base-wage freezes (if firms manage to freeze wages), or as substitutes (if firms are unable to freeze base wages) while, in the case of a negative supply shock, they will necessarily emerge as substitutes to base-wage increases.

Given that the way in which firms distribute shocks across the various labour-cost adjustment channels depends on labour demand and supply elasticities, as well as on the institutional and structural framework where firms make their decisions, we now summarise the existing literature on the sources of labour cost rigidity and derive potential implications for the empirical models presented in the next section.

Any factor affecting the degree of labour demand elasticity, like the degree of product competition and the substitutability of labour with other factors of production, is expected to be a relevant factor in explaining the degree of labour adjustment in response to shocks. In particular, international economic integration is likely to increase both competition and factor substitutability, thus increasing the elasticity of labour demand and labour productivity (see Andersen et al. (2000)). Firms operating in such an environment should also feel stronger pressure to reduce costs and thus one may

expect a more intense adjustment of wages and employment in reaction to shocks.

As regards wage rigidity, the literature suggests that wages of high-skilled or white-collar workers are likely to display higher downward rigidity than those of low-skilled or blue-collar workers 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 and/or white-collar workers making firms more reluctant to cut their wages (see, for instance, Shapiro and Stiglitz (1984), Akerlof (1982) and Akerlof and Yellen (1990)). In turn, 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)) will imply higher wage rigidity for the former group of workers.

According to the literature we may also expect the degree of wage rigidity to vary with tenure, but the direction in which rigidity is expected to vary is unclear. According to the turnover model (see, for instance, Stiglitz (1974)), we can expect wages of high-tenured workers to be more rigid downwards than those of low-tenured workers, but it may also be argued that high-tenured workers are more likely to face higher costs of job loss and thus might be expected to have lower bargaining power and thus lower degree of downward wage rigidity.[11]

As made quite clear in the discussion above, the role played by labour unions in the wage setting process and the employment protection legislation are also likely to have strong implications for wage rigidity and for employment responses to shocks. The higher is the unions' bargaining power, the more rigid wages are expected to be and thus changes in employment are also likely to be higher. For instance, in the model developed in Holden (2004) downward wage rigidity is likely to be stronger the

---

[11]If we consider the tenure profile of wages predicted by Lazear (1979), who suggests that workers are likely to earn less than the value of their marginal productivity (VMP) when they are young and to earn more than their VMPs when they are old, together with the shirking model (see Shapiro and Stiglitz (1984)), we conclude that the cost of job loss may be higher for older workers and workers with higher tenure. In fact, it is typically more difficult for older workers to find a new job and workers with long tenure often lose their tenure component of wages when changing jobs. Thus, whether higher tenure is associated with higher or lower wage rigidity appears to be basically an empirical matter.

higher the coverage of collective agreements and the stricter the employment protection legislation. The idea is that with collective wage agreements wage cuts need the consent of employees and such cuts are more difficult to implement under stricter employment protection legislation.

Finally, we account for the possibility that wage rigidity varies with firm size. If monitoring costs and/or turnover costs are higher in larger firms (Oi (1983), Barron et al. (1987)) such firms are more likely to pay efficiency wages in order to reduce the probability of shirking or to avoid the hiring and training costs and thus to exhibit stronger downward wage rigidity.

These predictions help us building a set of regressors for the empirical models estimated in this paper. Based on the results listed above, one might expect those factors that increase workers' downward wage rigidity to operate in the estimated models by decreasing the probability of firms freezing wages or reducing other components of total compensation or by increasing the probability of firms reducing employment, in the face of negative shocks.

4   Preliminary data analysis

As mentioned above the different cost-cutting strategies are our variables of interest. Table 1 summarises some useful information on these variables by displaying the distribution of the different strategies in our sample of firms that have reduced costs by sectors and firm size.

From Table 1, we see that the reduction in the number of employees ("reduce employees") is by far the dominant strategy. Indeed, around 72 percent of the firms in the sample answered that they had used this margin in the past. The "flexible margins", which aggregates the reduction or elimination of bonus payments and other monetary benefits ("reduce bonus"), the reduction or elimination of non-monetary benefits ("reduce benefits") and the slowdown or freezing of promotions ("slowdown

promotions"), ranks second with around 45 percent of the firms, and the recruitment of new employees with a wage lower than those who left the firm ("cheaper hires") ranks third with around 30 percent of the firms.

Table 1: Labour cost-cutting strategies
(Share of firms that have used each margin at least once)

Sectors and firm sizes	Base wage freezes	Flexible wage margins			Flexible margins	Cheaper hires	Reduce employees
		Reduce bonuses	Reduce benefits	Slow promotions			
Total	0.258	0.243	0.148	0.246	0.454	0.297	0.715
Manufacturing	0.284	0.254	0.167	0.227	0.448	0.284	0.732
Energy	0.190	0.190	0.095	0.238	0.333	0.333	0.857
Construction	0.254	0.127	0.127	0.282	0.423	0.282	0.803
Trade	0.252	0.289	0.111	0.163	0.422	0.274	0.681
Business services	0.254	0.221	0.136	0.296	0.479	0.315	0.690
Large firms	0.244	0.269	0.154	0.260	0.474	0.349	0.724
Small firms	0.276	0.208	0.140	0.227	0.429	0.277	0.702

Note: "Flexible margins" is the aggregation of "reduce bonus", "reduce benefits" and "slow promotions". Large firms are those firms with 100 or more employees, while firms with less than 100 employees are considered as small firms. Number of observations: 757.

Table 1 also shows that the use of the different strategies by Portuguese firms does not vary much across sectors, with the possible exception of energy and construction. The energy sector displays a slightly lower usage of "base-wage freezes" and "flexible margins" and a relatively higher usage of "cheaper hires" and "reduce employees", while firms in the construction sector also use the "reduce employees" strategy more frequently than the average firm.

As regards the distribution by firm size, Table 1 does not reveal strong asymmetries even though large firms seem more likely to use the "flexible margins" and "cheaper hires", as opposed to small firms which seem to make a more extensive use of "base-wage freezes".

According to the discussion in section 3, we may expect employment adjustment to be larger or more frequent when base wages are rigid but and, at the same time, the implications of base-wage rigidity for employment to be be partly offset by the availability of other mechanisms through which firms can reduce their labour costs without changing their base wages, such as the possibility of using the flexible components of

total compensation and/or recruiting new employees at a lower wage than those who have recently left the firm. In order to investigate whether some of these relationships are apparent in the data, we computed some sample conditional proportions, as well as tetrachoric correlation coefficients for pairings of different margins (see Tables 2 and 3, respectively).

Table 2: Sample conditional proportions

	Reduce employees	Cheaper hires	Flexible margins	Wage freezes
P(.)	0.715	0.297	0.454	0.258
P(. | Wage freezes=1)	0.564	0.215	0.503	1
P(. | Flexible margins=1)	0.657	0.305	1	-
P(. | Cheaper hires=1)	0.680	1	-	-

Number of observations: 757.

Table 3: Tetrachoric correlation coefficients between
different pairs of labour cost-cutting strategies[a]

	Reduce employees	Cheaper hires	Flexible margins	Wage freezes
Wage freezes	-0.330***	-0.195***	0.097	1.000
Flexible margins	-0.193***	0.027	1.000	
Cheaper hires	-0.086	1.000		
Reduce employees	1.000			

(a) ***,** and * stand for significance at 1, 5 and 10 percent level, respectively;
Number of observations: 757.

From Table 2, we see that around 72 percent of the firms in the sample have reduced employment but only around 26 percent have frozen wages, which suggests that a large proportion of firms has reduced employment without freezing wages. However, among the firms that have frozen wages only around 56 percent of the firms have reduced employment. In turn, from Table 3, we see that the correlation coefficient between "base-wage freezes" and "reduce employees" is significantly negative (-0.330). Thus, overall the sample evidence suggests that wage freezes might have been used as a substitute to employment reduction.

A similar picture emerges for "cheaper hires". Conditional on having frozen wages only around 22 percent of the firms have used "cheaper hires", compared to around 30 percent in the full sample. The correlation between "base-wage freezes" and "cheaper hires" is also significantly negative (-0.195) .

In contrast, there is no indication that "base-wage freezes" could have been used as a substitute for "flexible margins". If anything, data suggest that firms that managed to freeze wages also tended to use the "flexible margins". In other words, flexibility in the total compensation components ("base-wage freezes" and "flexible margins") seems to be positively correlated, even though not significantly so (Table 3).

As regards the other strategies, Table 2 suggests that "flexible margins" or "cheaper hires" could also have been used as substitutes to employment reduction, but according to Table 3 only the correlation between "flexible margins" and "reduce employees" appears as significantly different from zero. Finally, according to Tables 2 and 3 there seems to be no relationship whatsoever between the use of "flexible margins" and "cheaper hires".

Overall, Table 2 and Table 3 suggest that in the sample some margins were used as substitutes to other margins ("base-wage freezes" for "reduce employees" and for "cheaper hires" and "flexible margins" for "reduce employees"), but no significant evidence emerges as regards complementarity relationships. In the next section these relationships will be further characterised using an appropriate econometric model.

5   Empirical Analysis

This section presents the econometric model used and analyses the output of the estimated model focusing on the factors that affect the use of each labour cost-cutting strategy and on the relationships involving the different margins of adjustment.

5.1 An econometric model for the cost-cutting strategies

In order to build a model for the labour cost-cutting strategies, we assume that the degree of price stickiness and the costs of wage and employment adjustment determine the relative importance of the price versus the cost channel, but that the relationship among the different labour-cost margins is chiefly determined by their relative adjustment costs. This allows a two-stage approach where it is assumed that firms first decide whether to reduce prices and/or costs and then, conditional on having decided to reduce costs, they determine which type of costs they are going to cut, subject to technical or institutional restrictions.

Against this background, we model firms' cost-cutting strategies by assuming the following multivariate recursive probit model:

$$y_{i1}^* = x_{i1}'\beta_1 + \epsilon_{i1} \tag{8}$$

$$y_{i2}^* = x_{i2}'\beta_2 + \alpha_1 y_{i1} + \epsilon_{i2} \tag{9}$$

$$y_{i3}^* = x_{i3}'\beta_3 + \beta_1 y_{i1} + \beta_2 y_{i2} + \epsilon_{i3} \tag{10}$$

$$y_{i4}^* = x_{i4}'\beta_4 + \gamma_1 y_{i1} + \gamma_2 y_{i2} + \gamma_3 y_{i3} + \epsilon_{i4} \tag{11}$$

where y_{ij}^* (i=1,..N; j=1,...4) represents a latent variable which measures the amount of cost-cutting strategy j used by firm i; x_{ij}' is a set of regressors whose impacts are measured by vector β_j. As y_{ij}^* is not observed we define, as usually:

$$y_{ij} = 1 \quad if \quad y_{ij}^* > 0; \quad y_{ij} = 0 \quad if \quad y_{ij}^* \leq 0, \quad i = 1,..N; j = 1,...4. \tag{12}$$

Equations (8)-(11) describe the most general recursive triangular model that complies with the *condition for logical consistency*. It has been shown in the literature that such a model allows for causal interpretations enabling us to understand the underlying mechanisms generating the observations (see Maddala (1983)). It has also been shown

that such a model does not suffer from identification problems.[12]

In what follows we shall define the 4 variables as follows: y_{i1}=base-wage freezes, y_{i2}=flexible margins, y_{i3}=cheaper hires and y_{i4}=reduce employees. By ordering base-wage freezes first, we are assuming that base wages are basically negotiated outside the firm, through collective agreements, such that they are not significantly affected by adjustments in the other cost margins, in line with a *right-to-manage* situation. In turn, by ordering employment reduction last, we are assuming that the probability of employment reduction may depend on whether or not the remaining margins can also be used. *Ceteris paribus*, employment adjustment is expected to be lower when base wages are flexible, the firm has the possibility of reducing bonus and/or benefits, i.e., of using the flexible margins, or has the chance of recruiting new employees at a lower wage than those who left the firm.

In model (8)-(11) it may further be assumed that:

$$corr(\epsilon_{ij}, \epsilon_{ik}) = \rho_{jk} \neq 0 \quad \forall j, k = 1, 2, 3, 4 \quad (j \neq k) \tag{13}$$

Under assumption (13) the dependent variables y_{ij} (j=1,2,3) in the right-hand side of equations (9)-(11) are endogenous for the equations where they appear as regressors, and the full model (8)-(11) must be estimated using maximum likelihood methods. But if $\rho_{jk} = 0, \quad \forall j, k \quad (j \neq k)$, the dependent variables y_{ij} in the right-hand side of equations (9)-(11) become exogenous for estimation purposes and the model may be estimated using single equations methods.

Estimating model (8)-(11) also raises the issue of which data to use. In the survey, we only directly observe the reaction of firms that have reduced costs in the face of negative shocks, so that in order to correctly identify the relationships among the different cost-cutting strategies, we focus only on those firms that have reduced costs.

---

[12]Wilde (2000) has shown that identification of the model is achieved if the same exogenous regressor appears in all equations, provided these regressors are sufficiently variable, so that theoretical identification does not require availability of any additional instruments. See also Freedman and Sekhom (2010). Still, equations (8) and (9) in the estimated model include three additional regressors in order to ensure proper empirical identification of the model.

Restricting the sample to firms that have reduced costs may raise sample selection issues because the restricted sample becomes endogenously determined. However, sample selection will only be a problem if the residuals in the selection equation are correlated with the residuals of the model estimated over the restricted sample. In order to handle this situation we start by estimating model (8)-(11) together with the selection equation which, in our case, is a probit model for the price margin defined over the full sample:

$$w_i^* = z_i'\delta + v_i, \quad w_i = 1[(w_i^* > 1], \tag{14}$$

where $w_i = 1$ if the firm has reduced costs (has used one cost margin at least), and $w_i = 0$ otherwise; z_i' is a vector of exogenous regressors.[13] From this model we may proceed by testing the joint hypothesis of endogeneity of the y_{ij} variables (j=1,2,3) in equations (9)-(11) and the existence of sample selection problems, i.e.,:

$$H_0 : \rho_{jk} = \theta_r = 0, \quad j, k, r = 1, 2, 3, 4 \quad (j \neq k) \tag{15}$$

where

$$\rho_{jk} = corr(\epsilon_{ij}, \epsilon_{ik}) \quad \forall j, k = 1, 2, 3, 4 \quad (j \neq k) \tag{16}$$

$$\theta_r = corr(v_i, \epsilon_{ir}) \quad r = 1, 2, 3, 4 \tag{17}$$

According to the likelihood ratio (LR) test, the null hypothesis in equation (15) is not rejected at standard significance levels. More specifically, from the estimated model we get LR(10)=3.745 with P=0.958, so that the test suggests the absence of any significant correlation among the residuals of the recursive triangular model (8)-(11), as well as among those residuals and the residuals of the selection equation, suggesting that endogeneity and sample selection are not relevant issues in our case.

---

[13]The sample selection model is estimated by maximum likelihood methods using the mvprobit Stata routine with some modifications. Further details are available from the authors upon request.

It is well-known that inference on multivariate binary models is generally very demanding in terms of sample sizes (see, for instance, Fabbri et al. (2004)) so that estimating the model using single equation methods is expected to imply strong efficiency gains. Thus we proceed by estimating the model using single equation probit methods whose results are analised below.[14]

5.2 Estimation results

Table 4 presents the results of the estimated model, and Table 5 reports the average direct marginal effects of each of the covariates on the probability of a firm using each labour cost-cutting strategy.[15]

The choice of the regressors used in the empirical models was guided by the literature summarised in section 3. These include regressors aimed at measuring the importance of workers' and firms' attributes such as tenure, the proportion of high-skilled blue- and white-collar workers, the proportion of permanent employees or of employees covered by collective wage agreements, the importance of competition, etc.

We start by investigating how worker, firm or sectoral characteristics affect the use of labour cost-cutting strategies which we label "exogenous regressors", and then we

[14]As a robustness check we also conducted a single exogeneity test for the dependent variables y_{ij} (j=1,2,3) that appear as regressors in equations (9)-(11) by testing the correlation among the residuals of model (8)-(11). This hypothesis was tested using both the likelihood ratio (LR) test and the conditional moments (CM) test. The first one requires estimating the full model by maximum likelihood methods, but the second one is particularly attractive as it is based on univariate probit estimation of the four equations. Simulations performed in Monfardini and Radice (2008) in a bivariate context show that the size of these two tests is not very sensitive to misspecification errors (omission of a relevant variable). For the two tests we get LR(6)=2.957 with P=0.814 and CM(6)=2.157 with P=0.905. Thus, both tests suggest the absence of any significant correlation involving the residuals of the recursive triangular model.

[15]The average marginal effects were calculated from the difference in the predicted probabilities conditional on marginal changes for continuous regressors and zero and one for discrete variables in each equation. We notice that in our triangular model the total marginal effect on y_j from a covariate x_k may be decomposed into the sum of a direct effect (the partial effect computed directly from the equation for y_j) and an indirect effect coming from the contribution of the equations that precede y_j in the triangular model. For instance the impact of x_k on the probability of "reduce employees" involves first a direct effect through the "reduce employees" equation and second an indirect effect on "reduce employees" through the effect from the other margins "base-wage freezes", "flexible margins" and "cheaper hires" (if x_k enters those equations as a regressor). Figures in Table 5 refer to the direct marginal effects, as in our case the indirect effects do not add a significant contribution to the total effect.

proceed by analysing the relationships among these strategies, with a special focus on wage-freezes and employment.

5.2.1 Exogenous regressors

For ease of presentation, we grouped the exogenous regressors into the following four categories: 1) labour force composition, 2) role of labour unions, 3) barriers to wage freezing and 4) other characteristics. The different regressors are described in Appendix B.

Labour force composition

This group includes the regressors that provide information about the labour force composition of the firm: proportion of workers with less than 5 years of tenure, the proportion of high-skilled blue- and white-collar workers, and the share of permanent employees.

The results for tenure indicate that it does not have a significant impact on the two compensation related margins, suggesting that it is not a relevant variable as regards firms' decisions on freezing base-wages or reducing the flexible margins. In contrast, firms with a higher proportion of less experienced or younger workers are more likely to use the margin "cheaper hires".[16] This result suggests that, as could be expected, firms with a higher proportion of less experienced or younger workers are also the ones where quits are more frequent, allowing firms to reduce labour costs by paying lower wages to new employees. In the case of "reduce employees", however, the coefficient is negative suggesting that firms with higher proportion of high-tenured workers are

---

[16]Tenure is usually seen as an endogenous variable in wage or dismissals equations defined at the worker level, where tenure endogeneity is due to unobserved worker's match and/or heterogeneity effects. However it is unclear whether one should expect tenure endogeneity to be an important issue for equations defined at the firm level and pertaining not to wage or unemployment levels equations, but to the probability of a firm freezing wages or reducing employment. Yet, to see whether tenure endogeneity could be a problem in our equation for "reduce employees" (tenure is not significant in the equations for "base-wage freezes" and "flexible margins"), we carried out a simple endogeneity test by estimating a bivariate probit model involving the equation for "reduced employees" (which includes tenure as a regressor) and an equation for tenure, but the test results clearly suggested the absence of any significant endogeneity problem.

more likely to reduce employment in the face of negative shocks. This effect may stem from the fact that a higher proportion of high-tenured workers is proxying the age of the firm, and it is known that collective dismissals are more frequent in older firms.

As regards the skill composition, we see that, in comparison to low-skilled workers (blue- and white-collar), firms with more high-skilled workers are more likely to use the first three margins of adjustment: "base-wage freezes", "flexible margins" and "cheaper hires", but less likely to "reduce employees" . These results, apparently not in line with most theories, are likely to reflect a greater use of flexible pay components among high-skilled workers.[17]

With respect to the relative share of permanent employees, we see that the impact on each of the margins tends to be negative (the exception is "base-wage freezes"), even though not statistically significant for most of the margins. This result suggests that the higher the share of permanent workers, the harder it is in general to use the adjustment margins.

Union activity

In order to capture the role played by unions in the wage setting process, we included the variables "coverage" and "legislation". The first measures the proportion of workers covered by collective agreements and the second is a dummy variable which equals one if the firm considers labour regulation or the collective wage agreement as a relevant or very relevant factor that prevents wages from being cut or frozen.[18] From Tables 4 and 5, we see that the two regressors, with the exception of "reduce employees" are not

---

[17]In practice, the sign and magnitude of the estimated parameters for some regressors, in the model for a given margin, are likely to depend not only on workers' relative bargaining power but also on how widespread that margin is across the different type of workers. For instance, the use of the "flexible margin" (bonus, benefits or promotions) is likely to be more widespread among the class of high-skilled and/or white-collar workers. Under these circumstances, firms with higher proportion of high-skilled and/or white-collar workers may emerge in the estimated models as displaying higher probability of reducing the flexible margin, in contrast to what the theory would suggest.

[18]Notice that "legislation", "reputation of the firm" and "workers attraction" are included only in the first two equations. On the one hand, we believe that these regressors are capturing firm's characteristics that are expected to be more relevant for compensation related components and, on the other, by excluding them from the other two equations, we intend to ensure proper empirical identification of the model. See also footnote 12.

Table 4: Labour cost-cutting strategies
Probit estimates

Regressors	Base-wage freezes	Flexible margins	Cheaper hires	Reduce employees
constant	−0.6016*** (0.2314)	−0.1915 (0.2177)	−1.1316*** (0.1937)	−1.3731*** (0.2108)
tenure less than 5 years	−0.2473 (0.2335)	0.0508 (0.2088)	0.4154* (0.2152)	−0.7949*** (0.2238)
high-skilled blue-collar	0.0055*** (0.0019)	0.0008 (0.0017)	0.0046** (0.0018)	−0.0035* (0.0020)
high-skilled white-collar	0.0055** (0.0024)	0.0040* (0.0022)	0.0078*** (0.0023)	−0.0056** (0.0025)
permanent employees	0.0962 (0.1502)	−0.2458* (0.1416)	−0.2261 (0.1567)	−0.2113 (0.1551)
coverage	−0.0098 (0.1172)	−0.0034 (0.1070)	0.0659 (0.1120)	0.3124*** (0.1155)
legislation	−0.2068 (0.1337)	0.1273 (0.1295)	−	−
reputation of the firm	−0.4832*** (0.1163)	−0.2184** (0.1106)	−	−
workers attraction	0.1462 (0.1180)	−0.2179** (0.1088)	−	−
openness	0.0396 (0.1366)	0.2594** (0.1245)	0.2596** (0.1323)	0.0739 (0.1417)
size	−0.0499 (0.1249)	0.0218 (0.1125)	0.1498 (0.1194)	0.0570 (0.1244)
services	0.1415 (0.1328)	0.1052 (0.1238)	−0.0453 (0.1285)	0.0652 (0.1336)
wage freezes	−	0.1554 (0.1174)	−0.3661*** (0.1281)	−0.6236*** (0.1237)
flexible margins	−	−	0.0339 (0.1077)	−0.2122* (0.1097)
cheaper hires	−	−	−	−0.2097* (0.1207)
Number of observations	χ^2= 31.0 (P=0.00)	χ^2= 26.4 (P=0.01)	χ^2= 36.4 (P=0.00)	χ^2= 61.2 (P=0.00)
N=635	R^2 =0.046	R^2 =0.031	R^2 =0.044	R^2 =0.080

very relevant to explain differences across firms in the use of the different cost-cutting strategies. In the case of coverage, we see that it particularly increases the likelihood of a firm reducing employment, which suggests that the presence of unions does not limit the firms' ability to adjust the quantity margin. Overall, the results for the two regressors suggest that unions exert pressure on firms that results on rigid base wages structures, and that firms try to overcome such restrictions by acting on other margins, like reducing employment.

Table 5: Labour cost-cutting strategies
Probit Model - Average marginal effects (direct effects)

Regressors	Base-wage freezes	Flexible margins	Cheaper hires	Reduce employees
tenure less than 5 years	−0.0761 (0.0718)	0.0195 (0.0802)	0.1393* (0.0719)	−0.2421*** (0.0663)
high-skilled blue-collar	0.0017*** (0.0006)	0.0003 (0.0007)	0.0016** (0.0006)	−0.0011* (0.0006)
high-skilled white-collar	0.0017** (0.0007)	0.0015* (0.0009)	0.0026*** (0.0007)	−0.0017** (0.0008)
permanent employees	0.0302 (0.0480)	−0.0937* (0.0530)	−0.0733 (0.0488)	−0.0666 (0.0503)
coverage	−0.0030 (0.0361)	−0.0013 (0.0411)	0.0221 (0.0375)	0.0968*** (0.0359)
legislation	−0.0661 (0.0440)	0.0488 (0.0493)	−	−
reputation of the firm	−0.1539*** (0.0372)	−0.0847** (0.0429)	−	−
workers attraction	0.0446 (0.0356)	−0.0843** (0.0421)	−	−
openness	0.0123 (0.0426)	0.1000** (0.0476)	0.0897* (0.0467)	0.0223 (0.0423)
size	−0.0154 (0.0386)	0.0084 (0.0432)	0.0502 (0.0398)	0.0174 (0.0381)
services	0.0444 (0.0424)	0.0405 (0.0477)	−0.0151 (0.0426)	0.0196 (0.0399)
wage freezes	−	0.0600 (0.0453)	−0.1177*** (0.0387)	−0.2084*** (0.0432)
flexible margins	−	−	0.0114 (0.0362)	−0.0651* (0.0342)
cheaper hires	−	−	−	−0.0653* (0.0384)

Barriers to freezing wages

In the third group, we included two variables that could help explaining why firms decide not to freeze or cut nominal wages, which we labelled as "reputation of the firm" and "workers attraction". These are dummy variables which equal one if the firm considers that the negative consequences for the reputation of the firm and the difficulties in attracting new employees are relevant or very relevant factors that prevent cutting or freezing their nominal wages. We see from Tables 3 and 4 that the impact of these two regressors is negative both for "base-wage freezes" and "flexible margins", which means that these two obstacles to reducing or freezing base wages are also obstacles to reducing the flexible margins.[19]

---

[19]Assuming, as we have done in this paper, that bonus and other monetary and non-monetary

Other characteristics

Finally, we also considered openness, size and services as a group of variables potentially relevant to explain the differences in the use of the labour cost-cutting strategies. Openness measures the importance of exports for the firm (is a dummy variable that equals one if the share of exports on total sales is 50 percent or higher). From Tables 4 and 5, we see that firms that export more are also firms that adjust more their flexible margins and take advantage of existing cheaper workers. This result is in line with what could be expected because exporting firms face more competition and therefore need to be able to adjust their costs more promptly and/or more frequently.

From Tables 4 and 5, we conclude that large firms do not make more intensive use of the labour cost-cutting strategies than small firms. A similar conclusion holds for firms operating in the services sector.

5.2.2 Wage flexibility and labour-cost cutting strategies

In general, we may expect the adjustment of a given margin to depend on the degree of rigidity/flexibility of the alternative margins. For instance, the probability of a firm using employment adjustment as a reaction to a negative labour demand shock is expected to be higher when base wages are rigid and smaller if alternative more flexible and less expensive margins are available.

We start by noticing that the estimated results are in line with what could be expected given the preliminary analysis in section 4. From the probit equation for "reduce

---

benefits are more flexible than base wages appears to be a reasonable hypothesis for countries like Portugal where contracted wages cannot be cut for legal reasons. However, in general, this must be seen as debatable assumption. On the one hand, it may be argued that benefits over which the firm has at least some discretion are likely to be less rigid than wages because firms have more (and more subtle) ways to lower benefits than to lower wages. It has also been suggested that one of the reasons firms provide some benefits to employees is to reduce nominal wage rigidity (see Oyer (2005)). But, on the other hand, it may be claimed that many of the theories suggested in the literature to justify the presence of downward nominal wage rigidity, mentioned in section 3, are likely to apply to benefits too. For instance, efficiency wage theories would suggest that firms may be very reluctant to cut back bonus and benefits if they think that would reduce workers effort and/or induce workers to shirk or to leave the firm, consequently increasing monitoring, supervising and/or turnover costs. The estimated results for the covariates "reputation of the firm" and "workers attraction" show that this type of effect is indeed present in data. Thus, in general, whether bonus and benefits are significantly less rigid downwards than base wages is to be seen as an empirical matter.

employees" in tables 4 and 5, we see that "base-wage freezes", "flexible margins" and "cheaper hires" have been used as substitutes for employment reduction by Portuguese firms. In particular, from Table 5, we conclude that the probability of a firm reducing employment is around 21 percentage points lower for a firm that has frozen wages, and around 6.5 percentage points lower for a firm that has used the "flexible margins" or the "cheaper hires".[20]

The probability of a firm using "cheaper hires" is around 12 percentage points lower for a firm that has frozen wages. This result suggests that "cheaper hires" and "base-wage freezes" were mainly used as substitutes by Portuguese firms, i.e., they were mainly used in situations in which firms were unable to freeze wages following a negative labour demand shock or to compensate abnormal or unexpected base-wage increases following a negative labour supply shock.

In contrast, the "flexible margins" do not emerge as substitutes to "base-wage freezes". That would be the case if they had been mainly used to compensate for abnormal or unexpected base-wage increases. Rather, the relationship between these two margins is positive (even though not significantly so) which means that the "flexible margins" have been predominantly used as a complement to "base-wage freezes" in reaction to negative labour demand shocks.

The probability for a firm of reducing employment if it has frozen wages and used the "flexible margins" is around 29 percentage points lower than for an otherwise identical firm, and the probability for a firm of reducing employment that has frozen wages, used the "flexible margins" and recruited employees at a wage lower than the one of those who left the firm is around 35 percentage points lower than for an otherwise identical firm.[21] According to the results in Appendix A, these estimates are likely to be biased

---

[20]Once again we notice that these are direct effects only, but that they do not significantly differ from the total effects. For instance, the total effect of "wages freezes" on "reduce employees" that takes into account the indirect effect through "cheaper hires" (and the one that could be expected to differ the most from the direct effect) is around one percentage point less than the direct effect reported in Table 5.

[21]These correspond to the following probabilities (not shown in Table 5):

$\text{Prob}(y_4 = 1 | y_1 = 1, y_2 = 1, y_3, x_4)$ - $\text{Prob}(y_4 = 1 | y_1 = 0, y_2 = 0, y_3, x_4)$ and

$\text{Prob}(y_4 = 1 | y_1 = 1, y_2 = 1, y_3 = 1, x_4)$ - $\text{Prob}(y_4 = 1 | y_1 = 0, y_2 = 0, y_3 = 0, x_4)$ respectively, where

upwards (i.e., closer to zero) stemming from the fact that the dataset is mute on the number of times that firms have reacted to shocks. Thus, if anything, one might expect the decrease in the probability of a firm reducing employment if it manages to freeze wages and use the "flexible margins" and the "cheaper hires", to be even higher than the estimate above.

These are very important results as they show that base-wage flexibility has a strong negative impact on the probability of a firm reducing employment, and that such effect has been significantly strengthened by the existence of alternative margins of labour cost adjustment, like more flexible compensation components that firms can freeze or cut in bad times (flexible margins), and the recruitment of new employees at a wage lower than the one of those who quit the firm.

6   Concluding remarks

The studies aimed at assessing the extent and the effects of nominal wage rigidities have focused mainly on base wages or permanent wages (base wages plus the other components that are paid regularly on a monthly basis, such as meals allowances, tenure-related components, etc.), leaving aside potentially more flexible pay-components such as performance related bonus and other labour cost-cutting strategies which may strongly attenuate the negative impact on employment of base-wage rigidities.

Using survey data, this paper investigates the implications for employment of base-wages rigidity together with other strategies that Portuguese firms have used to cut labour costs in the event of exogenous negative labour demand and supply shocks. Our dataset shows that, among the firms that have reduced labour-costs, the reduction in the number of employees was by far the most commonly used strategy (around 72 percent of the firms) followed by the use of "flexible margins", i.e., more flexible total compensation components, which include the reduction or elimination of bonus

---

y_4=reduce employees, y_3=cheaper hires, y_2=flexible margins and y_1=wage freezes and x_4=vector of exogenous regressors entering equation for y_4.

payments and other monetary benefits, the reduction or elimination of non-monetary benefits and the slowdown or freezing of the rate at which promotions are filled (around 45 percent of the firms). The recruitment of new employees with a wage lower than the one of those who left the firm ("cheaper hires") was used by around 30 percent of the firms and, finally, around 26 percent of the firms answered that they had frozen base wages.

We found significant heterogeneity in the use of each of these strategies across firms. The use of each margin depends on several workers' and/or firms' attributes such as the tenure and skills distribution, measures of the unions' bargaining power, as well as some indicators of the economic environment in which firms operate. In particular, firms operating mainly in the foreign market, a more competitive environment, tend to use some of these strategies more heavily.

The estimated results suggest that "cheaper hires" and "base-wage freezes" were mainly used as substitutes by Portuguese firms, i.e., they were predominantly used in situations in which firms were unable to freeze base wages following a negative labour demand shock or to compensate abnormal or unexpected base-wage increases following a negative labour supply shock. In contrast, the relationship between the "flexible margins" and "base-wage freezes" is positive (even though not significantly so) which suggests that the "flexible margins" were predominantly used as a complement to "base-wage freezes" in reaction to negative labour demand shocks.

We also found a clear negative association between "base-wage freezes", which we use as a measure of base-wage flexibility, and the likelihood of a firm reducing employment. In particular, we found that the probability of a firm reducing employment is around 21 percentage points lower for a firm that has frozen base wages than for an otherwise identical firm. In turn, the ability to use the "flexible margins" or "cheaper hires" also decreases the probability of a firm reducing employment (around 6.5 percentage points in both cases). Together, the probability for a firm of reducing employment if it has frozen base wages, used the "flexible margins" and the "cheaper

hires" is around 35 percentage points lower than for an otherwise identical firm.

Overall, we conclude that base-wage flexibility has a strong positive impact on employment, and that such positive impact may have been significantly strengthened by the possibility of firms resorting to alternative margins of labour cost adjustment, like more flexible compensation components (bonus, benefits and promotions) and the recruitment of new employees at wages lower than the ones of those who leave the firm.

We notice, however, that the results obtained in the paper must be interpreted with caution. Our dataset has information on whether the firm has used each of the four margins investigated in the paper, but has no information on the number of times each margin was used, i.e., has no information on the number, type and timing of the shocks to which firms are assumed to have reacted. This is likely to have implications for the parameters of the model used. Some of these parameters are shown to be upward biased (i.e., towards zero), so that their real impact may be higher than the one presented in this paper.

Appendix A - Consequences of more than one shock

In our sample we do not have information on the number of times that firms have used their margins of adjustment so that the identification of the shocks in the paper implicitly assumes that each firm has been hit just once by a negative labour demand or a negative labour supply shock (or has just reacted once either to the accumulation of small demand or supply shocks).

Here we discuss the implications for the estimation and interpretation of some of the more important parameters estimated in the paper, by assuming that firms have reacted to more than one shock, i.e., have frozen base wages or reduced employment several times over time, such that base-wage freezes do not necessarily coincide in time with employment reductions (and similarly for the other margins).

In order to address this issue, let us start by the simplest model in which we assume that total compensation coincides with base wages (the firm does not pay bonuses or benefits nor has the possibility of using "cheaper hires"). Under this simplifying assumption, we may characterize the information in the sample through simple pairs of binary variables (W,L) such that W=1 if the firm answers in the survey that it has frozen wages and L=1 if the firm answers that it has reduced employment (both are zero otherwise). Then, our sample may be summarized as having N_1 cases (1,1), N_2 cases (1,0), (which, as discussed in the main text, are responses to negative labour demand shocks) and N_3 cases (0,1) (which are responses either to negative labour supply or to negative labour demand shocks)

The assumption that firms could have reacted to more than one shock has consequences only for the identification of the case (1,1). This case (firm that has frozen wages and reduced employment) is clearly a response to a labour demand shock if the firm has reacted only once. If the firm has reacted to more than one shock in different periods of time, the case (1,1) in our sample may correspond to some true cases (1,1) (labour demand shocks), but also to the combination of some cases (1,0), which correspond to labour demand shocks and some cases (0,1), which may correspond to labour

34

demand shocks, as well as to labour supply shocks. This means that, everything else constant, we will have in our sample less cases (1,1) and more cases (1,0) and (0,1).

Now we consider the implications for one of the most important parameters estimated in section 5. This is the one that measures the decrease in the probability of a firm reducing employment if it manages to freeze nominal wages, i.e., P(L=1|W=1)-P(L=1|W=0), which we denote by γ and is given, in terms of our hypothetical sample, by $\gamma = N_1/(N_1 + N_2) - N_3/N_3$, so that whether the case (0,1) is a response to a supply or to a demand shock is irrelevant for the computation of γ.

We notice also that the interpretation of γ is the same irrespective of the proportion of demand or supply shocks in the sample. By definition it is the difference between the probability of the firm reducing employment it it manages to freeze wages and the probability of reducing employment if it does not, irrespective of whether it is reacting to supply or to demand shocks. Thus, the interpretation of γ, as the decrease in the probability of a firm reducing employment if wages are frozen, does not depend on the discrimination between demand and supply shocks.

As regards the consequences for the estimation of γ, it is straightforward to show that the estimate of γ, obtained in the paper under the assumption of a single shock, is likely to be biased upwards (i.e., towards zero). To see this, just notice that in the formula for γ above, by reducing N_1, the number of cases (1,1), and increasing N_2 and/or N_3, the number of cases (1,0) and (0,1) the estimate of γ can only be reduced.

Let us now look at the more general model estimated in the paper in which the firm has 4 margins of adjustment which we denote by (y_1, y_2, y_3, y_4), where the y_i (i=1,2,3,4) are dummy variables representing whether or not the firm has "frozen base-wages", used the "flexible margins" and/or the "cheaper hires", or "reduced employment", respectively. By noticing that y_1, y_2 and y_3 pertain to total compensation we may think of the general model as the case in which the firm besides base wages has two additional channels to make total compensation more flexible in the face of negative shocks.

Our sample, under the assumption that firms have reacted of a simple shock, may be summarized as having N_1 cases $(1,y_2,y_3,1)$ and N_2 cases $(1,y_2,y_3,0)$, (which are responses to negative labour demand shocks), and N_3 cases $(0,y_2,y_3,1)$ and N_4 cases $(0,y_2,y_3,0)$ (which are responses either to negative labour supply or to negative labour demand shocks).

Under the assumption that firms may have reacted to more than one shock, the number of cases $(1,y_2,y_3,1)$ will be reduced (decreasing N_1) and the number of cases $(1,y_2,y_3,0)$ and $(0,y_2,y_3,1)$ will be increased (increasing N_2 and/or N_3).

Under these circumstances, γ, estimated in the paper under the assumption of a single shock, is again biased upwards (i.e., towards zero). To see this, just notice that now $\gamma=N_1/(N_1+N_2)$-$N_3/(N_3+N_4)$, so that by reducing N_1, the number of cases $(1,y_2,y_3,1)$, and increasing N_2 and/or N_3, the number of cases $(1,y_2,y_3,0)$ and $(0,y_2,y_3,1)$, γ can only decrease.

Another important parameter estimated in the paper, which we will denote by γ^*, is the one that measures the decrease in the probability of a firm reducing employment if it manages to freeze base wages and to use the "flexible margins" and the "cheaper hires", i.e., $\gamma^*=P(y_4=1|y_1=1, y_2=1, y_3=1)$-$P(y_4=1|y_1=0, y_2=0, y_3=0)$.

To investigate the consequences for the estimation of this parameter in the presence of multiple reactions by firms let us start by assuming that in our sample, under the assumption of a single shock, we have N_1^1 cases $(1,1,1,1)$, N_2^1 cases $(1,1,1,0)$ (which correspond to labour demand shocks) and N_3^1 cases $(0,0,0,1)$ (which correspond to labour demand or to labour supply shocks). Notice that these are the only relevant cases to compute γ^*. The sample estimate is given by $\gamma^*=N_1^1/(N_1^1+N_2^1)$-$N_3^1/N_3^1$. If we assume that the presence of multiple reactions by firms implies a decrease of N_1^1 and possibly an increase in N_2^1 and N_3^1 it follows that γ^* will be reduced, so that the estimate obtained in the paper will be upward biased (i.e., biased towards zero).[22]

---

[22]We notice, however, that it is also possible to have γ^* negatively biased in our sample. Suppose, for instance, that in the presence of multiple reactions only N_2^1 decreases. In this case the estimate obtained in the paper for γ^* will be negatively biased. This situation, however, seems less likely than the one just described, as the probability of having multiple shocks is higher in cases $(1,1,1,1)$ than in

Appendix B - The covariates

In this Appendix, we describe the covariates used in the probit models whose results are presented in section 4, and provide the corresponding summary statistics. The details are as follows:

Tenure – Proportion of employees whose tenure is less than 5 years.

High-skilled blue-collar – Proportion of High-skilled blue-collar employees in total employment.

High-skilled white-collar – Proportion of High-skilled white-collar employees in total employment.

Permanent employees – Dummy variable that is equal to one if the proportion of permanent workers is higher than 98 percent of total workforce.

Coverage – Dummy variable that is equal to one if the proportion of employees covered by collective agreements is equal to eighty percent or higher.

Labour legislation – Dummy variable that equals one if the firm considers labour legislation or the collective agreement as an important or very important obstacle to freeze wages in a context where the firm needs to reduce costs.

Firm's reputation – Dummy variable that equals one if the firm considers that the negative impact on firm's reputation is an important or very important obstacle to freeze wages in a context where the firm needs to reduce costs.

Workers attraction – Dummy variable that equals one if the firm considers that the difficulties in attracting new employees is an important or very important obstacle to freeze wages in a context where the firm needs to reduce costs.

Openness– Dummy variable that equals one if the proportion of sales in the foreign market is 50 percent of total sales or higher.

Size – Equal to one if the number of employees is larger than 100.

Services – Equal to one if the firm operates in the Services sector.

---

cases (1,1,1,0).

References

Akerlof, G. A. (1982), 'Labor contracts as partial gift exchange', *Quarterly Journal of Economics* **97**(4), 543–569.

Akerlof, G. A., Dickens, W. R. and Perry, G. L. (1996), 'The macroeconomics of low inflation', *Brookings Papers on Economic Activity* **27**(1), 1–76.

Akerlof, G. A. and Yellen, J. (1990), 'The fair wage-effort hypothesis and unemployment', *Quarterly Journal of Economics* **105**(2), 255–283.

Babecký, J., Caju, P. D., Kosma, D., Lawless, M., Messina, J. and Rõõm, T. (2009), The margins of labour cost adjustment: Survey evidence from European firms, Working Paper 1106, European Central Bank.

Babecký, J., Caju, P. D., Kosma, T., Lawless, M., Messina, J. and Rõõm, T. (2010), 'Downward nominal and real wage rigidity: Survey evidence from European firms', *Scandinavian Journal of Economics* **112**(4), 884–910.

Barron, J. M., Black, D. A. and Loewenstein, M. A. (1987), 'Employer size: The implications for search, training, capital investment, starting wages, and wage growth', *Journal of Labor Economics* **5**(1), 76–89.

Behr, A. and Pötter, U. (2010), 'Downward wage rigidity in europe: A new flexible parametric approach and empirical results', *German Economic Review* **11**, 169–187.

Bertola, G. (1999), Microeconomic perspectives on aggregate labor markets, *in* O. Ashenfelter and D. Card, eds, 'Handbook of Labor Economics', Vol. 3 of *Handbook of Labor Economics*, Elsevier, chapter 45, pp. 2985–3028.

Bertola, G., Dabusinskas, A., Hoeberichts, M., Izquierdo, M., Kwapil, C., Montornès, J. and Radowski, D. (2010), Price, wage and employment response to shocks - evidence from the WDN survey, Working Paper Series 1164, European Central Bank.

Dias, F., Esteves, P. and Félix, R. (2004), Revisiting the NAIRU estimates for the Portuguese economy, Economic Bulletin, Banco de Portugal.

Dickens, W. T., Goette, L., Groshen, E. L., Holden, S., Messina, J., Schweitzer, M. E., Turunen, J. and Ward, M. E. (2007), 'How wages change: Micro evidence from the International Wage Flexibility Project', *Journal of Economic Perspectives* **21**(2), 195–214.

Fabbri, D., Monfardini, C. and Radice, R. (2004), Testing exogeneity in the bivariate probit model: Monte Carlo evidence and an application to health economics, Working Paper 514, Dipartimento Scienze Economiche, Universitá di Bologna.

Freedman, D. A. and Sekhom, J. S. (2010), 'Endogeneity in probit response models', *Political Analysis* **18**(2), 138–150.

Gaspar, V. and Luz, S. (1997), Wages and unemployment in Portugal, Economic Bulletin, Banco de Portugal.

Hamermesh, D. S. (1987), The demand for labor in the long run, *in* O. Ashenfelter and R. Layard, eds, 'Handbook of Labor Economics', Vol. 1 of *Handbook of Labor Economics*, Elsevier, chapter 8, pp. 429–471.

Holden, S. (2004), 'The costs of price stability: Downward nominal wage rigidity in Europe', *Economica* **71**, 183–208.

Holden, S. and Wulfsberg, F. (2008), 'Downward nominal wage rigidity in the OECD', *The B.E. Journal of Macroeconomics* **8**(1), (Advances), Article 15.

Knoppik, C. and Beissinger, T. (2006), Downward nominal wage rigidity in Europe: An analysis of European micro data from the ECHP 1994-2001, Working Paper 275, Universät Hohenheim, Stuttgart.

Lazear, E. P. (1979), 'Why is there mandatory retirement?', *Journal of Political Economy* **87**(6), 1261–1284.

Lindbeck, A. and Snower, D. J. (1988), *The insider-outsider theory of employment and unemployment*, MIT Press, Cambridge, MA.

Luz, S. and Pinheiro, M. (1993), Unemployment, vacancies and wage growth, Economic Bulletin, Banco de Portugal.

Maddala, G. S. (1983), *Limited-Dependent and Qualitative Variables in Econometrics*, Cambridge University Press.

Marques, C. R. (2008), Wage and price dynamics in Portugal, Working Paper Series 945, European Central Bank.

Martins, F. (2011), Price and wage setting in Portugal: Learning by asking, Working Paper Series 1314, European Central Bank.

Messina, J., Duarte, C. F., Izquierdo, M., Caju, P. D. and Hansen, N. L. (2010), 'The incidence of nominal and real wage rigidity: An individual-based sectoral approach', *Journal of the European Economic Association* **8**(2-3), 487–496.

Monfardini, C. and Radice, R. (2008), 'Testing exogeneity in the bivariate probit model: A Monte Carlo study', *Oxford Bulletin of Economics and Statistics* **70**(2), 271–282.

OECD (1992), *OECD Economic Surveys: Portugal 1991/92*, Organization for Economic Co-operation and Development, Paris.

Oi, W. Y. (1983), 'The fixed employment costs of specialized labor', *in The measurement of labor cost,* pp. 63–122, Chap. 2, J. Triplett (ed.), University of Chicago Press, Chicago.

Oyer, P. (2005), Can employee benefits ease the effects of nominal wage rigidity?: Evidence from labor negotiations, Working paper, Graduate School of Business, Stanford University.

Portugal, P., Carneiro, A. and Guimarães, P. (2010), On the cyclical sensitivity of real wages, Economic bulletin, Banco de Portugal.

Shapiro, C. and Stiglitz, J. E. (1984), 'Equilibrium unemployment as a worker discipline device', *American Economic Review* **74**(3), 433–44.

Stiglitz, J. E. (1974), 'Alternative theories of wage determination and unemployment in LDC's: The labor turnover model', *Quarterly Journal of Economics* **88**(2), 194–227.

Topel, R. H. (1986), 'Local labor markets', *Journal of Political Economy* **94**(3), S111–S143.

Venn, D. (2009), Legislation, collective bargaining and enforcement: Updating the OECD employment protection indicators, OECD Social, Employment and Migration Working Paper 89, OECD.

Wilde, J. (2000), 'Identification of multiple equation probit models with endogenous dummy regressors', *Economics Letters* **69**(3), 309–312.