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ABSTRACT

Wage Cyclicality and Labour Market Institutions*

Do labour institutions influence how wages respond to the business cycle? Such responsiveness can then shape several economic outcomes, including unemployment. In this paper, we examine the role of two key labour market institutions – collective bargaining and temporary contracts – upon wage cyclicality. Our evidence is drawn from rich, 2002-2020 matched data from Portugal. We find that workers not covered by collective agreements exhibit much higher wage cyclicality, especially if new hires, compared to covered workers. In contrast, workers under fixed-term contracts do not exhibit sizable differences in cyclicality compared to counterparts under open-ended contracts. Our findings highlight a novel angle through which labour institutions influence the labour market and the economy.

JEL Classification: J31, J52

Keywords: real wages, business cycles, collective bargaining, temporary contracts, matched data

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1. Introduction

Real wages have evolved remarkably differently across the OECD in the recent years. For instance, when comparing 2022 and 2023, in the aftermath of the pandemic and in the context of the war in Ukraine, real wages have dropped by 0.7% in the US, by 1.8% in France, by 3.3% in Germany, and by 7.3% in Italy.

While the real wage cyclicality (RWC, henceforth) that may underpin such large differences in wage changes can be driven by several factors, in this paper we explore the role of a dimension largely ignored so far – labour market institutions. We argue that such institutions can be an important driver of wage cyclicality across countries given the large international differences in such institutions and their important role in wage determination. Indeed, these institutions can shape the bargaining power of firms and workers, their outside options, and even productivity, thus influencing not only the sharing of the surplus from each employment relationship but also the surplus itself. Critically, labour market institutions may influence the likelihood and extent of wage renegotiations in different business cycle environments.

Our analysis is focused on two major labour market institutions, namely collective bargaining (and more specifically its coverage) and employment contract type (open-ended or fixed-term contracts).[v] CB can introduce major changes in wage determination with respect to the classical model of spot labour markets or the search and matching

[v] Collective bargaining (CB) is generalised in most OECD countries, but with significant differences in coverage and the institutional framework (OECD, 2019; Jäger et al., 2022; OECD, 2023). Fixed-term contracts also have a relevant role in European labour markets (Booth et al., 2002; OECD, 2015). For example, in 2022, 24 million people aged 15–64 worked under fixed-term contracts in the EU (EUROSTAT, 2023). We use indistinctly the terms permanent/open-ended contracts and temporary/fixed term-contracts, even if the latter may have important differences.

model (Mortensen and Pissarides, 1994). For instance, as soon as a worker is covered by a CB agreement, she will typically be protected against wage cuts during downturns. For instance, CB wage floors can make it difficult for nominal wages to fall during a recession, especially in the case of workers in continuing employment spells and paid at these wage floors. On the other hand, collective agreement renegotiations leading to wage increases may take a longer time to take effect, leading to longer lags in wage increases during expansions.

Regarding temporary contracts, they may increase labour market flexibility. This will be the case in comparison to open-ended contracts that are protected by restrictive legal provisions against dismissal, including high levels of firing costs (Booth et al., 2002). Consequently, besides the cases of temporary or seasonal needs, the volume of temporary work may serve as a buffer stock which allows firms to adjust their employment to changes in business cycle conditions (Varejão and Portugal, 2007).

These factors may have important consequences in terms of real wage cyclicality (RWC) and explain its heterogeneity across time periods and countries. Depending on each country's labour institutions, different types of macroeconomic responsiveness may emerge. Such heterogeneity may be particularly important in regions such as the Eurozone where CB can have a relevant role in the wage setting process (OECD, 2023). In this case, policy reforms around these institutions can make wages more responsive to the business cycle and thus potentially reduce macroeconomic volatility.

In this paper, the CB dimension is analysed in terms of its coverage, considering both what we refer to as an extensive margin (a worker being covered or not by a collective agreement) and an intensive margin (a worker being paid at the collectively agreed

minimum wage or at a higher wage). The FTC dimension concerns the type of employment contract of the worker – an open-ended (or permanent) contract or a temporary (fixed-term) contract.[vi]

As well as the ease of adjusting employment volumes over the business cycle, temporary contracts may also be associated to distinct levels of RWC. In fact, there is typically a significant wage gap between temporary and permanent workers (Booth et al., 2002; OECD, 2015), which may have its counterpart in different levels of RWC. Several explanations have been proposed for such wage gap, including compensating wage differentials (Rosen, 1986).[vii] Another explanation sees temporary contracts as a way of firms screening workers given the uncertainty about match quality (Jovanovic, 1979; Faccini, 2014). Under these circumstances, workers may accept lower wages in the FTC period in the expectation of a higher wage following conversion (Booth et al., 2002). The wage gap between temporary and permanent workers can also be rationalised within the insider-outsider framework (Bentolila and Dolado, 1994): permanent workers (the insiders) are in better position than temporary (the outsiders) to bargain for higher wages.

Both the insider-outsider and the screening hypotheses point to a higher wage cyclicality of temporary workers in the downturns. However, in the upswings, it should be the

[vi] Moreover, differently from De la Roca (2014), we also distinguish between stayers and new hires according to the type of employment contract, as the relevant RWC for job creation in terms of the search and matching model is concerned with new hires (Pissarides, 2009).

[vii] According to this explanation, wages should be an increasing function of the level of insecurity of the job and, consequently, the wages of temporary workers should be higher than that of permanent. Empirical evidence points in the opposite direction, assuming that productivity is adequately controlled for (OECD, 2015).

permanent workers that experience higher wage increases in face of their higher bargaining power and lower uncertainty about their skills and the quality of the match. Therefore, across the business cycle, the net effect of contract temporality on wage cyclicality is not clear. It may depend on the business cycle distribution between upswings and downturns and distribution of workers between temporary and permanent and the respective percentage of new hires.

Our research adds to previous literature in several ways. First, we simultaneously analyse the role of CB coverage and of temporary/open-ended contracts in RWC. Second, CB coverage is considered both in terms of its extensive and intensive margins. Third, the effect of the kind of contract on RWC is considered both for stayers and new hires, whereas previous research did not distinguish between these groups. Fourth, our control for composition effects over the business cycle is stronger than that of previous studies on RWC and labour market institutions: previous studies considered only worker fixed effects, whereas in this paper we also include firm-job fixed effects. Fifth, we present a systematic set of tests comparing the different industrial bargaining regimes and labour contracts (including possible interactions between them) in terms of RWC. Finally, we assess how the relationship between real wages and labour productivity is shaped by both institutions (bargaining regime and type of contract).

Our empirical case study considers the case of Portugal, where CB and temporary contracts are widespread[viii]. Our empirical evidence is drawn from a rich matched

[viii] Appendix 1 provides a description of the institutional framework of labour law, CB and temporary contracts in Portugal. Card and Cardoso (2022), section 2, provides data on the percentage of covered/uncovered workers.

employer-employee dataset from Portugal, which allow us to control for composition changes over the cycle.

We find that labour institutions can indeed greatly influence RWC. This is the case of CB and its coverage. This result is consistent with the hypothesis that CB changes the relative bargaining power and outside options of workers and employers. In a related result, we also find that the CB greatly influences the relationship between new hires' wages and labour productivity. Specifically, only in the case of uncovered workers is the wage-productivity relationship proportional. Finally, we also conclude that not all labour institutions matter necessarily in terms of RWC. We find that the contract type does not seem to play a relevant role in RWC.

The remaining of the paper is organised as follows. The next section presents the literature. Section 3 presents the data set and describes the main characteristics of the labour market institutions considered. Section 4 presents the methodological approach followed in the empirical analysis. Section 5 presents our baseline empirical results. Section 6 extends our baseline empirical model considering asymmetric effects over the business cycle and different effects for men and women. Section 7 presents the robustness analysis and Section 8 concludes.

2. Literature review

The degree to which wages respond to the business cycle is an important parameter in research and policy (Keynes, 1939; Dunlop, 1938; Tarshis, 1939). Indeed, several macroeconomic models rely on this parameter to understand and predict labour market

dynamics over the business cycle (Keynes, 1936; Rotemberg and Woodford, 1991; Barro and King, 1984; Mankiw, 1989; Mortensen and Pissarides, 1994).

Early research on this topic based on macroeconomic data pointed to a weak cyclicality of real wages but struggled to find definitive robust conclusions (Abraham and Haltiwanger, 1995; Brandolini, 1995). These difficulties were directly related to the use of aggregated data (Mitchell et al., 1985; Solon et al., 1994; Abraham and Haltiwanger, 1995; Brandolini, 1995). Such aggregated data do not allow composition changes (workers, firms, occupations, and quality of the match) to be controlled for over the business cycle, leading to biased – typically underested – estimates of RWC (Bils, 1985; Solon et al., 1994).

Subsequent research based on microeconomic longitudinal data (Martins, 2007; Carneiro et al., 2012; Martins et al., 2012; Stüber, 2017; Verdugo, 2016; Dapi, 2020; Gertler et al., 2020; among many others) improved the estimates of real wage cyclicality (RWC), taking advantage of rich matched employer-employee microdata and improved econometric methods. Most of these studies concluded that real wages are considerably procyclical. Moreover, some concluded that RWC is higher for new matches than for continuous workers (Pissarides, 2009; Carneiro et al., 2012; Martins et al., 2012), but others found no significant differences between both groups, mainly when controls for the quality of the match are considered (Gertler and Trigari, 2009; Gertler et al., 2020; Stüber, 2017; Dapi, 2020; Grigsby et al., 2021).

To the best of our knowledge, only Devereux and Hart (2006) and Gartner et al. (2013) consider the dimension covered/uncovered by CB and De la Roca (2014) distinguishes temporary and permanent workers in his analysis of real wage cyclicality in Spain. The

first of these papers presents some evidence that the wages of internal movers (within firms) uncovered by collective agreements are more responsive to unemployment than those of their counterparts covered by collective agreements. In other cases, the differences are not significant. The evidence reported in the second paper is not significant as regards the different effects of unemployment on wages according to the bargaining regime (covered and uncovered by collective agreements). Finally, De la Roca (2014) finds higher real wage cyclicality for workers under temporary contracts but does not distinguish between stayers and new hires.

3. Data Description and Preliminary Analysis

3.1 Data Description

We use worker-level data from *Quadros de Pessoal* (QP), a matched employer-employee panel data set from Portugal's Ministry of Employment. This is a mandatory census that covers all enterprises in the private sector in Portugal with at least one employee. This data set has been used before in the wage cyclicality literature, including Martins (2007), Carneiro et al. (2012) and Martins et al. (2012).

QP is submitted annually by each employer, providing information with respect to the month of October, including detailed characteristics of workers, establishments, and firms. Worker-level information includes their wages (base wage, variable pay, and total earnings), normal and overtime hours of work, age, tenure with the firm, schooling,

occupation,[ix] collective agreement, and collective agreement job level. Firm-level information includes industry, region, capital equity, and annual sales. Furthermore, QP also includes time invariant unique firm and worker identifiers, which allows firms and workers to be tracked over time (panel dimension) and multiple types of fixed effects to be controlled.

Since 2002, QP also includes information on workers employed by public entities but under private sector employment contracts. As will be seen below, an important part of these workers is uncovered by collective agreements. Hence, starting the analysis in 2002 is a necessary condition for having comparable and reliable data about workers uncovered by collective agreements. In addition, the information on temporary contract status is also only available from 2000. Finally, we also note that, given its nature, the data set does not provide information about the unemployed, civil servants, the self-employed and the armed forces.

We impose a small number of inclusion criteria on our final data set: at least 120 hours of work in the reference month (October) of each year and aged 18 to 64. The data set contains a total of 39,806,250 observations corresponding to 5,800,343 workers and 701,106 firms from 2002 to 2020.[x]

As dependent variables we use the log of hourly earnings and the log of hourly base wage. Both wage measures are at 1985 constant prices being deflated by the private

[ix] We used the three-digit level classification of the Portuguese system of occupations starting in 2010 (CPP-2010). This classification is available for workers covered and uncovered by collective agreements. We converted the occupational categories of the previous system (CNP-1994), used in QP over the period 2002–2009, to the new CPP-2010 code, using the 2010 modes of 2009 occupations of continuing employees.

[x] When a worker has more than one employment in October of a given year, we only consider that with the highest number of hours worked. Workers in agriculture, unpaid family workers, apprentices, and workers whose base wage is less than 80% of the national minimum wage were excluded.

consumption deflator. Table A provides the descriptive statistics of the main variables used in this study. Finally, information about labour productivity and aggregate employment was obtained from Statistics Portugal.[xi]

3.2 Preliminary Analysis

Table 1 shows the evolution of the percentage of workers covered and uncovered by collective agreements over the period 2002–2020. Here we separate covered workers into two sub-groups. The first corresponds to workers whose base wage (W_{base}) is equal to the contractual wage established in their collective agreement for their job title (W_{CBT}), henceforth $W_{base} = W_{CBT}$ workers. The minimum contractual wage is computed as the mode of the base wage for each worker category within a given collective agreement and year (Cardoso and Portugal, 2005; Martins, 2021a). The second sub-group corresponds to workers whose base wage is higher than the minimum contractual, $W_{base} > W_{CBT}$, for their job title, henceforth $W_{base} > W_{CBT}$ workers. The latter group is somewhat outside the constraints imposed by the CB process as firms pay these workers more than the CB minimum wage that they were required to pay. Therefore, this group of workers is closer to the market mechanisms than other workers whose base wage is binding.

[insert table 1, about here]

Regarding the distribution of workers between the covered and the uncovered sectors, most workers are covered by collective agreements, but this percentage decreased from

[xi] https://www.pordata.pt/portugal/produtividade+aparente+do+trabalho-2817, last accessed 01/05/2023 and https://www.pordata.pt/subtema/portugal/emprego-10, last accessed 01/05/2023.

95% in 2002 to about 84% in 2020. Consequently, there is an increasing percentage of uncovered workers over the same period (5% to 16%). Within the covered sector, the largest group is that of workers that are paid above the applicable CB minimum wage. This category has been decreasing over time representing between 54% and 43% of the total number of private sector employees. The second largest group of workers is that of individuals paid exactly at their CB minimum wage, ranging between 38% and 43%.[xii]

Another important dimension to contrast these workers concerns their observable characteristics where we find important differences. On average, the uncovered group displays higher hourly wages,[xiii] are younger, have lower number of years of tenure with their firms, and are more likely to be university graduates. Their firms are larger in terms of their sales and in the number of employees in 2020. Moreover, their firms also exhibit a higher percentage of public and foreign capital ownership than the covered group (see Table 2).[xiv]

[insert table 2, about here]

[xii] Regarding the distribution of firms between the covered and uncovered groups, most of them either have only covered or uncovered workers (Table 1). The percentage of firms that employs both covered and uncovered workers is small, although it has increased slightly over time. Finally, the percentage of firms in each one of these groups has closely followed the evolution of the respective percentage of workers.

[xiii] Card and Cardoso (2022) found a similar result for Portugal using the same data set. These findings for Portugal contrast with those for other countries (the US, the UK, Canada and Germany) where, typically, the uncovered workers receive lower wages than their covered counterparts (Card et al., 2004; Addison et al., 2016; Jäger et al., 2022).

[xiv] Another relevant difference between the covered and the uncovered sectors concerns the firms' average age, which is lower in the last sector. Therefore, the growth of this sector was pushed up by new firms and, eventually, by new activities. Indeed, the analysis of the industrial and occupational structures of both sectors shows that there are relevant differences between them. First, the uncovered group is more concentrated at the top of the occupational structure (professionals, technicians and associate professionals and clerks), whereas the covered group has higher predominance in less skilled occupations (service workers and shop and market sales workers, craft and related trades workers and plant and machine operators and assemblers).

Second, as regards the industry distribution, the uncovered sector is more concentrated in the following industries: manufacturing, information and communication, administrative and support service activities (the leading industry in 2020, accounting for 16% of the uncovered employees), and human health and social work activities (15% of the uncovered employees in 2020). In contrast, the leading covered industries are manufacturing (24% of all covered employees, again considering 2020 figures), wholesale and retail trade (20%), and accommodation and construction (9%). Hence, in addition to the administrative extensions of collective agreements (and their changes over time) and the business cycle, there may be other factors (workers' and firms' characteristics, including their industries) which also influence CB coverage.

With regard to the dual system of fixed-term and open-ended contracts in Portugal, the former is the most relevant means of hiring, i.e., from a flows perspective (Table 3). Moreover, considering the different types of workers according to their status on the CB coverage (above the collective agreement minimum wage, at such minimum wage, and uncovered workers), we always find that fixed-term contracts represent at least half of all new hires, but usually this percentage is higher than 70%. In striking contrast, the percentage of fixed-term contracts amongst stayers (defined here as workers hired in previous years) is much lower, at no more than 24%.

[insert table 3, about here]

4. Methodology

To estimate the response of real wages to the business cycle according to the workers' institutional framework, we adopt the following specification of an augmented Mincerian equation:

$$lnw_{ift} = \beta_0 X_{it} + \beta_{1g,c,s} \sum_{g=1}^{3} I_{gift} \sum_{c=1}^{2} I_{cift} \sum_{s=1}^{2} I_{sift} + \\ + \mu_{0,g,c,1} \sum_{g=1}^{3} I_{gift} \sum_{c=1}^{2} I_{cift} \times stayer \times bcy_t + \\ \mu_{1,g,c,2} \sum_{g=1}^{3} I_{gift} \sum_{c=1}^{2} I_{cift} newhire_{it} bcy_t + time\ trend_t + fe_{ifj} + error_{ifjct} \quad (1)$$

The dependent variable, lnw_{it}, is the log of real hourly earnings of the worker *i* in firm *f* at time *t*. We also use additional subscripts regarding each worker, namely, occupation *j, CB* institutional setting *g*, employed under contract of type *c* and seniority level *s*. $X_{ifjgcst}$ is a vector of mostly time-varying individual characteristics, such as education and age; I_{gift} are dummies identifying the CB institutional setting, *g*, of the worker *i* in firm *f* in the year *t*.

With respect to the CB institutional setting, workers are divided into two major groups: the covered (g = 1, 2) and the uncovered by collective agreements (g = 3). The former group is also divided between $W_{base} > W_{CBT}$ workers (g = 1) and $W_{base} = W_{CBT}$ workers (g = 2); I_{cift} are dummies identifying the kind of contract that the worker *i* has in firm f in year t: permanent (c = 1) or temporary (c = 2); bcy_t is a business cycle indicator, such as the lagged unemployment rate or lagged employment; *stayer* (s = 1) is a dummy that identifies the workers whose tenure with the firm is higher than or equal to one year at the time *t ;* conversely, $newhire_{ift}$ (s = 2) identifies the workers whose tenure with the firm f is less than one year at the time *t*; $time\ trend$; fe_{ifj}: are the fixed effects considered; and $error_{ifjct}$is the error component.

The first-step specification includes worker and firm-occupation fixed effects. This specification is equivalent to that which includes dummies for all workers, firms, occupations and a dummy for each firm-occupation pair (Carneiro et al., 2012). This allows us to control for composition changes over the business cycle (workers, firms,

and jobs) but also for the quality of the match (Gertler and Trigari, 2009), avoiding the problem of biased estimates in consequence of the failure to control for cyclical job up- and downgrading (Stüber, 2017).

Equation (1) is specified in levels, which allows us to analyse the real wage cyclicality of new hires, as the data set by construction does not include information of non-employed workers coming either out of the labour force or from unemployment, the self-employed and civil servants. A first differences estimator would imply restricting the sample to employed workers over two consecutive periods and not considering the new hires coming from groups not included in the QP data set.[xv]

Hence, in the first step of this procedure, we estimate the following general equation from which we obtain the group average estimates that will be used in the second step:

$$lnw_{i,f,j,g,c,s,t} = \psi_{0,g,c,t} T_t \sum_{g=1}^{3} I_{gift} \sum_{c=1}^{2} I_{cift}\, stayer + \psi_{1,g,c,t} T_t \sum_{g=1}^{3} I_{gift} \sum_{c=1}^{2} I_{cift} newhire_{it} + \\ + \beta_0 X_{it} + \beta_{1g,c,s,t} \sum_{g=1}^{3} I_{gift} \sum_{c=1}^{2} I_{cift} \sum_{s=1}^{2} I_{sift} + fe_{ifj} + error_{ifjct} \quad (2)$$

The mean group estimates from the first step ($\widehat{\psi_{0,g,c,t}}$ and $\widehat{\psi_{1g,c,t}}$) measure the variation in wages beyond the part that is explained by observed characteristics and time-invariant unobserved heterogeneity. These estimates are then regressed

[xv] The explanatory variables included in equation (1) vary in both the individual and the time dimension. However, the business cycle indicator and its interactions with the institutional variables are group variables that only change over time and between groups. Therefore, these variables are subject to the problem pointed out by Moulton (1990) of downward-biased standard errors and spurious inference in regressions with both individual and group variables. One possible way to overcome this potential problem would be to estimate equation (1) with clustered standard errors at year level, the largest unit of aggregation included in our base specification (Angrist and Pischke, 2008; Carneiro et al., 2012; Dapi, 2020). However, as the number of years (clusters) covered in our panel is relatively small and the number of observations in each cluster is large (Cameron and Miller, 2015), more reliable estimates can be obtained with the two-step procedure widely used in the empirical literature of real wage cyclicality (Solon et al., 1994; Angrist and Pischke, 2008; Stüber, 2017).

separately on the business cycle indicator (bcy_t) and in a time trend to obtain the estimates of real wage cyclicality:

$\widehat{\psi_{0,g,c,t}} = \mu_{0g,c} bcy_t + time\ trend + error$, for g=1,2,3; c=1, 2; s=1 (3)

$\widehat{\psi_{1,g,c,t}} = \mu_{1,g,c} bcy_t + time\ trend + error$, for g=1,2,3; c=1, 2; s=2: (4)

The μ_{0gc} terms are the estimates for stayers (tenure ≥ 1 year) of the impact on wages of the business cycle indicator, according to the institutional arrangement to which the worker belongs (g = 1,2,3) and the kind of contract (c = 1,2); the μ_{1gc} terms, in turn, quantify the differential impact on the new hires' wages of the business cycle indicator, according to g and c.

Equations (3) and (4) are a special case of seemingly unrelated regressions (Zellner, 1962) as the regressors and the data are the same in all the equations. In this case, these equations can be estimated separately by OLS (Wooldridge, 2002) as in previous studies on RWC. In the next section we carry out several tests comparing the response of wages to the business cycle for workers under different bargaining regimes and kinds of contract. These tests involve parameters estimated in different models (equations 3 and 4), but on the same data. To carry out these tests we used the Stata SUEST command which builds a simultaneous matrix of variance-covariance for the estimates in different equations based on the sandwich estimator (Cameron and Trivedi, 2022).

Our baseline estimations are carried out with a quadratic time trend. In the robustness analysis we consider an alternative method to detrend the data, the Hodrick-Prescott filter. The lagged unemployment rate is used as business cycle indicator since wages in

Portugal are typically set between six months to one year in advance. Finally, the second step estimates are weighted by the number of observations/year for each category of workers (Devereaux, 2001; Angrist and Pischke, 2008).

5. Main results

Our empirical analysis starts with the model that takes the labour market as homogeneous (model 1, table 4). This model does not distinguish workers either as regard to the institutional arrangement of wage bargaining – individual or collective – or the type of contract – temporary or open-ended – under which they are employed. This homogenous market model corresponds to the standard specification considered in the literature of real wage cyclicality (Carneiro et al., 2012; Stüber, 2017; Dapi, 2020; Gertler et al., 2020; among many others). Progressively, we relax this assumption allowing for a potential role played by labour market institutions, namely temporary contracts and collective agreement coverage. Furthermore, the covered group will be also divided between $W_{base} > W_{CBT}$ workers and $W_{base} = W_{CBT}$ workers. The specification of models 1 to 5 is presented in appendix 2.

[insert table 4, about here]

[insert table 5, about here]

In the model that considers the labour market as homogeneous (model 1), our estimates of real wage cyclicality (Tables 4 and 5) indicate that real wages are procyclical and the new hires' semi-elasticity is significantly higher than that of stayers – about 38% more.

This is in line with most previous longitudinal studies (Abraham and Haltiwanger, 1995; Brandolini, 1995), including those for Portugal (Martins, 2007; Carneiro et al., 2012; Martins et al., 2012). However, the estimated semi-elasticities to unemployment are considerably lower (in absolute values) than those of previous studies: about -2.00 for stayers and -2.80 for new hires (Carneiro et al., 2012), whereas our estimates are, respectively, -0.549 and -0.757 in an equivalent specification.[xvi]

These RWC estimates are also considerably lower than those of some recent studies such as Stüber (2017) for Germany or Dapi (2020) for Norway. However, the estimates presented here are close to those of Gertler et al. (2020) for the USA in their first differences estimator and in their analysis of new hires free from composition effects.[xvii]

Next, we extend the basic RWC model, separating workers that have a temporary contract from those that have an open-ended contract (model 2, Table 4 and Table 5), maintaining the hypothesis of homogeneity relative to wage setting.

The estimates show that workers' wages are procyclical for both contracts and that the new hires' wages are more responsive to the business cycle than those of stayers (Table 4, model 2). As the relevant parameter for job creation in terms of the search and matching model is the new hires' semi-elasticity to unemployment, in Table 5 we test the hypothesis that this semi-elasticity is not different for workers under temporary and those under permanent contracts. This hypothesis is not rejected, although the point estimate of the new hires' semi-elasticity for the workers under temporary contracts is

[xvi] Martins (2021b) shows that real wage cyclicality decreased dramatically in Portugal from 1992 due to the change of macroeconomic regime as the country prepared to join and then joined the European monetary union, which led to much lower levels of inflation. Therefore, previous estimates for Portugal (which cover periods starting in the 1980s and stop in the early 2000s) and ours (which cover the 2000s and 2010s) are not comparable.

[xvii] Gertler et al. (2020) consider the new hires from unemployment free of composition effects (job upgrading). We control for those effects through the firm-job fixed effect in the first step as it is not possible to know with certainty the origin of the new hires from non-employment in our data set.

somewhat higher (10%). At this level of aggregation, it seems that separating workers according to the type of contract does not make much difference in terms of real wage cyclicality. Consequently, firms seem to follow a similar wage policy for all workers, independently of they have a temporary or an open-ended contract.

In the next stage, we to introduce the effect of the bargaining regime – individual or collective – on RWC. Initially, we do not separate temporary and permanent workers. The estimates displayed in Tables 4 and 5 show again that wages are procyclical and that the new hires' wages are more procyclical than those of continuous workers, either for covered or uncovered workers. In terms of the parameter of interest, the semi-elasticity of wages of the new hires, this parameter is about 66% higher in the uncovered sector than in the covered. This is an important finding. In the previous RWC studies that considered workers covered and uncovered by collective agreements (Devereux and Hart, 2006; Gartner et al., 2013), only Devereux and Hart (2006) present some evidence of different wage responses to the business cycle according to workers' industrial bargaining regime. However, the set of controls that we consider in the first step of our methodological approach is broader than those of the Devereux and Hart, as we also consider firm-job fixed effects and not only the worker fixed effects which they included. Therefore, our results are more robust than those of Devereux and Hart. In addition, our results also show that the architecture of the bargaining system influences how wages react to the business cycle. In fact, the wages bargained directly between the worker and the firm, as considered in the search and matching model, are considerably more cyclical than those bargained between workers' and firms' representatives.

Model 4 divides the covered and the uncovered workers' categories between those that have temporary and open-ended contracts. The incremental effects are significant in

general, and the signs are the expected (Table 4), including the incremental effects of the new hires, which are typically higher than those of the corresponding category of stayers (except the covered temporary group).

The tests shown in Table 5, regarding the new hires' semi-elasticities to unemployment, also reject the hypothesis of a homogeneous labour market. The point estimates of these semi-elasticities for the uncovered group are higher than those of the covered, either for temporary (+57%) or open ended (+80%) contracts, and these differences are statistically significant (Table 5).

Are all these differences explained by the kind of bargaining regime, or does the kind of contract play some role in explaining them interacting with the bargaining regime? To address this question, assuming that the magnitude of the effect of the bargaining regime is the same for temporary and for permanent contracts, we can test the null hypothesis that the difference in semi-elasticities between permanent contracts is the same as the difference between temporary contracts. The statistic of the test given in Table 5 regarding model 4 (irrelevance of contracts between bargaining regimes) does not reject this null hypothesis and, therefore, we cannot reject the hypothesis that the bargaining regimes – covered or uncovered – explain all the difference in semi-elasticities, either for temporary or open-ended contracts. That is, contract type does not interact with the bargaining regime to enlarge/shrink the differences of semi-elasticities between bargaining regimes. [xviii]

Still regarding model 4, within each bargaining regime, only in the case of the covered group does a significant difference in RWC arise between contracts and even so at the

[xviii] This test and others that we present in this paper were carried out with the SUEST and TEST commands in STATA (see section 3).

10% significance level. In the uncovered sector, firms seem to follow a very similar wage policy for temporary and open-ended contracts over the business cycle.

In the next stage (model 5), we analyse the effects in terms of RWC of separating the covered group into $W_{base} > W_{CBT}$ and $W_{base} = W_{CBT}$ workers, whereas the uncovered group is as in model 3. This division implies a different wage policy within the constraints of the same collective agreement such as in Cardoso and Portugal (2005). Therefore, a natural question that arises is whether these different policies also change over the business cycle. In that case, the RWC of both groups of workers should be significantly different.

As before, this analysis is initially carried out without separating workers regarding contract type, which may also provide some additional insights. The findings in Table 4 show that the wages of $W_{base} = W_{CBT}$ stayers are significantly less procyclical than those of $W_{base} > W_{CBT}$ stayers – about -14%. Moreover, as in model 3, the wages of the stayers uncovered by collective agreements are significantly more procyclical than both categories of stayers covered by collective agreements.

These findings once again highlight the difficulty in adjusting stayers' real wages in times of low inflation and with significant levels of nominal wage rigidity (Carneiro et al., 2014; Grigsby et al., 2021; Schmitt-Grohé and Uribe, 2013), particularly for workers whose base wage is binding, i.e., $W_{base} = W_{CBT}$ workers. For $W_{base} > W_{CBT}$ workers, firms may have the chance of not entirely following the wage policy of the collective agreement, adjusting it to the business cycle conditions and regaining some wage flexibility within the constraints of the collective agreement. Therefore, it seems that as well as having a different wage policy within the covered group, firms also adjust that policy over the business cycle, that is, the wage cushion is not constant.

As regards the wage cyclicality of the new hires, the respective differential effects are all significant even in relation to their respective stayers (Table 4; A-tests). The largest semi-elasticity is (once again) in the uncovered group (Table 5). Within the covered group, the difference between the semi-elasticities of the new hires is insignificant, although the magnitude of that difference is higher than that between stayers – 18% versus 14% (Table 5). This may be a consequence of the greater uncertainty in the estimates of the new hires in face of the smaller number of observations involved.

In a study for Portugal using the same data set as ours, but for the period 2010–2016, a period mostly characterised by a deep recession, Card and Cardoso (2022) found that there is an average 50% passthrough rate from the wage floor increases which are bargained in the collective agreements for workers' wages. So, the change of the wage cushions absorbs part of the bargained wage increases. This finding indicates a different wage policy within the constraints of the same collective agreement. Our findings for a longer period and with a more balanced business cycle are partly compatible with this finding as the wages of $W_{base} > W_{CBT}$ stayers are more flexible than those of $W_{base} = W_{CBT}$ stayers. In the case of new hires, the differences in wage cyclicality between both groups are not significant, although RWC is higher in point estimates for ($W_{base} > W_{CBT}$) workers. Now we extend previous framework of $W_{base} = W_{CBT}$ workers, $W_{base} > W_{CBT}$ workers and workers uncovered by collective agreements, considering temporary and open-ended contracts in each group (model 6, our base model). The findings show that, in general, the pattern of previous results remains invariant with the differential effects being significant and the expected signals (Table 4, model 6). Of particular interest are also the incremental effects of the new hires groups, which are in general significant, particularly

for the uncovered workers, and higher than the corresponding group of stayers (except for the temporary $W_{base} = W_{CBT}$ workers).

However, as in model 5, there is no strong evidence of the importance of the division of the covered group between $W_{base} = W_{CBT}$ and $W_{base} > W_{CBT}$ workers. In fact, considering temporary and open-ended contracts, the only significant effect is for $W_{base} = W_{CBT}$ stayers with permanent contracts. In this case, RWC is somewhat lower (-13.6%) than that of the base category (10% significance level). This demonstrates the difficulties of wage adjustment within the CB framework, particularly when the base wage is binding (Martins, 2021b).

Table 5 (model 6) presents the tests comparing the various industrial bargaining regimes for each of the labour contracts considered. As before, this analysis is carried out in terms of the implied semi-elasticities of the new hires, the relevant parameter for job creation within the context of the search and matching model (Pissarides, 2009). The first hypothesis to consider is that all industrial bargaining regimes, independently of the contract under which workers are employed, are not significatively different in terms of RWC. This is the hypothesis of a homogeneous labour market (model 1), which is again clearly rejected.

The next hypothesis we test considers the complete homogeneity across industrial bargaining regimes according to the type of contract. This hypothesis is also rejected for both contracts. We add more detail to the analysis, testing comparisons of industrial regimes, pair by pair, according to the kind of labour contract. In this case, the differences are mainly significant when both covered groups are compared with the uncovered group, independently of the kind of contract; between the covered sub-groups, they are only significant (at 10%) for the new hires with open-ended contracts.

We also test the homogeneity between temporary and open-ended contracts within each group. For the uncovered group, as in model 4, there are no significant differences. For the covered sub-groups, only in the case of $W_{base} = W_{CBT}$ workers are the differences statistically significant (10% significance level).

Finally, as in model 4, we also test whether the differences in RWC between bargaining regimes depend only on the bargaining regime or also on the kind of labour contract.[xix] So, in practice, we test whether the pairwise differences in RWC between bargaining regimes for temporary and permanent contracts are not statistically different. Furthermore, a global test for the equality of all the differences between temporary and open-ended contracts across bargaining regimes is also computed. All these tests do not reject the hypothesis that the difference between temporary and permanent contracts is constant across bargaining regimes. Therefore, there is no evidence of interaction between any kind of contract and the bargaining regimes (Table 6, block of irrelevance of contracts)

6. Additional results

6.1 Asymmetric effects

Previous estimates of RWC may hide real wages behaving differently during upswings and downturns, which may overestimate the real capacity of adjustment of real wages to absorb the increased unemployment during the downturns. That would be the case if the estimates of RWC were fundamentally explained by the periods of decreasing unemployment, whereas in the periods of increasing unemployment, real wages were

[xix] As before, this test is based on the hypothesis that the influence of the bargaining regime on RWC is the same either for temporary or for open-ended contracts.

inelastic. This is issue will be analysed considering the hypothesis of asymmetric effects on RWC: Table 6 presents the estimates of model 6, considering an asymmetric response of wages to unemployment over the business cycle.

[insert table 6, about here]

In general, the coefficient estimates indicate a higher sensibility of wages to unemployment when it is decreasing than when it is increasing. Most of these differences are significant (Table 6, fourth column, test (1) = (2)). Hence, these estimates suggest that the response of wages to unemployment is higher in the upswings than in the downturns, when various mechanisms of nominal wage rigidity (minimum wages, CB minimum wages, workers' psychology, etc.) may constrain the wage adjustment.

Table 7 complements this analysis with the estimates of the implied semi-elasticities for new hires, which are again somewhat higher in the upswings. These differences are significant, mostly of them at the 10% significance level. Moreover, the difference in magnitude of the semi-elasticities in the different phases of the business cycle is at most around 20%. So, the asymmetry in the response of wages to the business cycle is not great and the estimates of the semi-elasticities in the downturns are close to the average estimates for the entire period (Table 5). This finding may be influenced by the fact that in most years (12 out of 19) of our sample, the unemployment rate increased.

[insert table 7, about here]

We should also highlight that the institutional influences on RWC that we found for the entire business cycle remain valid when it is split into upswings and downturns. So, the main institution influencing RWC is the workers' coverage by CB. Contracts continue to have a limited effect on RWC and only within the covered workers' group. Finally, the hypothesis of constant differences in RWC between temporary and open-ended contracts across bargaining regimes remains valid in the different phases of the business cycle.

6.2 Gender differences

In this subsection, we extend our analysis of institutional influences on RWC considering separate estimates for men and women. Previous studies typically show that RWC is higher for men than for women (Solon et al., 1994). Park and Shin (2005) show that in the case of the USA, the differences in RWC between men and women can be explained by the men's greater representation in more cyclical occupations. A natural question that arises is whether the pattern of institutional influences on RWC remains valid when the sample is divided between men and women. To uncover this possibility, we estimate model 6, our base model, for men and for women separately.

Table 8 displays the second step estimates of model 6 for men and for women separately. These estimates suggest that there are gender differences in RWC as most coefficient estimates are significatively different between men and women, in contrast with the findings of Martins (2007), also for Portugal, but for the period 1986–2004.

[insert table 8, about here]

In Table 9, we present the new hires' implied semi-elasticities to unemployment according to the institutional setting considered in model 6 and previous tests carried out for the whole sample (Table 5), now for men and women separately.

[insert table 9, about here]

The results show that, in general, the estimates of the implied semi-elasticities are significatively different for men and for women, except in the case of the uncovered workers. The higher occupational and industrial concentration of the uncovered sector as compared to the covered sector (Table 2) may be an explanation for this, transposing the finding of Park and Shin (2005) for the Portuguese context. In fact, as the uncovered sector seems to be more concentrated in occupational and industrial terms than the covered (Table 2), this may favour a similar response of men's and women's wages to unemployment. Nonetheless, our control for firm-job fixed effects should control for this possibility directly. This raises the possibility of other factors explaining the different movements of men's and women's wages over the business cycle, particularly in the case of the covered sector (Blau and Kahn, 2017).

Regarding the institutional pattern of influences on RWC found in the aggregated estimates of men and women, the separate estimates for both genders do not reveal major differences, as the bargaining regime (covered or uncovered) continues to be the main determinant of the differences of RWC for each gender. However, these disaggregated estimates also show that some of the role of the kind of contract that we found in the aggregated estimates seems to be explained by the women's sample. This

is the case of the significant (at 5%) difference in cyclicality between temporary and open-ended contracts for W_{base} = W_{CBT} women workers, which is not significant in the corresponding men's group, and also the significant difference in cyclicality between the covered women groups under open-ended contracts, which is not found in the men's case. Finally, the findings displayed in Table 9 also show that in the case of women, the difference in cyclicality is not constant between the covered groups under different contracts (Table 9, block of irrelevance of contracts). In fact, comparing the point estimates of women's semi-elasticities in the covered sector, it can be concluded that the difference between the temporary contracts is much smaller than the difference between the permanent – 0.030 versus 0.165. This reveals a more homogeneous wage policy over the business cycle for the temporary contracts than for the permanent within the covered group in the case of women.

7. Robustness checks

To assess the robustness of our results, we consider three alternative business cycle indicators, the contemporaneous unemployment rate, (log) lagged employment and (log) contemporaneous aggregated productivity. We also consider an alternative approach to detrend the data, the Hodrick-Prescott filter,[xx] and an alternative measure of wages, the hourly base wage. This wage corresponds to the monthly base pay divided by the normal hours of work, whereas the hourly earnings include the base wage, regular benefits and overtime pay, divided by the total hours of work. The measure of wages based on earnings should be more cyclical as it includes components which are

[xx] The smoothing parameter for the HP filter as λ = 100 as in Backus and Kehoe (1992) and Stüber (2017).

more flexible/variable and therefore more exposed to the business cycle (Verdugo, 2016; Swanson, 2007).

With respect to the alternative business cycle indicators, the coefficient of real hourly wages on the aggregated labour productivity assumes special interest as measure of wage rigidity. In fact, if wages are perfectly flexible, then the new hires' wages should respond in an approximately proportional way to labour productivity and, consequently, this elasticity should be equal or close to one; on the contrary, if wages on the new matches are perfectly rigid, this elasticity should be zero (Pissarides, 2009; Haefke et al., 2013). To the best of our knowledge, this is the first time that this test has been carried out in the context of comparing different industrial bargaining regimes (covered/uncovered) and type of contract in relation to RWC. This gains special interest as the CB process imposes constraints on the wage formation process that does not exist in the case of uncovered firms. Therefore, the link between productivity and wages should be stronger for uncovered workers.

Table 10 displays the second step estimates for the different robustness indicators considered in our analysis. The general pattern of these estimates is quite similar to that found in our base model (Table 4, model 6), independently of the business cycle indicator, the measure of wages and the method of detrending the data. Hence, in general, wages are procyclical, this procyclicality being higher for the new hires than for stayers, mainly for the uncovered workers (temporary and open-ended contracts) and for $W_{base} > W_{CBT}$ workers with open-ended contracts.

[insert table 10, about here]

Table 11a displays the implied semi-elasticities for the new hires, according to the indicator included in the robustness analysis and the corresponding tests as in Table 5. The pattern of the estimates is again qualitatively quite stable in relation to the base estimates shown in Table 5. The major sources of uncertainty (variation) concern the test of equality between temporary and open-ended contracts for $W_{base} = W_{CBT}$ workers and the difference in RWC between $W_{base} = W_{CBT}$ and $W_{base} > W_{CBT}$ workers with open-ended contracts. In the base model, these tests were not unequivocally significant either, so some variation in these tests according to the measure of robustness seems normal. Furthermore, the gender analysis suggested that the significance of these results is directly linked to the women's case.

Of special interest are the results for the influence of labour productivity on wages and how they differ among bargaining regimes. These findings show that in the case of the uncovered workers, there is a significant and proportional (or near proportional) relation between productivity and wages as the estimated elasticity is very close to one. Conversely, when wages are set in the context of CB, the relation between productivity and wages is weaker as the estimated elasticity is lower than 1 – but significant – for $W_{base} > W_{CBT}$ new hires, whereas for $W_{base} = W_{CBT}$, new matches are non-significant.

As stated earlier, these are novel and important results in the context of RWC studies, which also correspond to what could be expected *a priori*. Indeed, when wages are bargained directly between the worker and the firm, there are no other major constraints, beyond the national minimum wages, to wages reflecting workers' expected productivity directly. Conversely, the CB process imposes constraints on wages as they cannot be lower than that established in CB tables for a given job title. In this

way, in the case of $W_{base} = W_{CBT}$ new hires, the wages are not really bargained by them, but by the continuous workers that have voice and power within the union that bargains wages with the firm(s). Therefore, the link between productivity and wages is broken because the wages of continuous workers do not follow the evolution in productivity as closely as the wages of the new hires with real capacity to bargain (Haefke et al., 2013). The positive – but lower than 1 – elasticity in the case of $W_{base} > W_{CBT}$ new hires reflects precisely the fact that firms and workers have some margin to bargain wages, but even so are constrained by the terms of the collective agreement.

[insert tables 11a and 11b, about here]

Table 11b shows the tests of equal difference between the semi-elasticities of the different bargaining regimes according to the type of contract and robustness analysis indicator. On the whole, these tests do not reject the hypothesis that the difference in RWC between temporary and between permanent contracts is equal among bargaining regimes. Therefore, we cannot exclude the hypothesis that the differences of cyclicality for each kind of contract between bargaining regimes are explained by differences of bargaining power and not by other factors. In spite of this, in the case of hourly base wages, it seems that there is some interaction between the kind of contract and the bargaining regime.

8. Conclusions

Several important conclusions arise from this study. First, we provide further evidence that the institutional framework of the labour market matters for real wage cyclicality

(RWC). Institutions shape the extent to which real wages respond to the business cycle, which may then have several subsequent economic implications. Second, CB coverage is found to be a key labour market institution, at least in Portugal and most likely in similar institutional contexts such as those of other continental European countries. CB coverage weakens considerably the relationship between real wages and unemployment. In fact, the response of the new hires' real wages to unemployment is at least 50% higher for uncovered workers than for covered workers. Coverage is even more important than the CB minimum wage bite as most differences arise between covered and uncovered workers and not within the covered group.

Third, the type of contract does not play a significant role in RWC. In fact, a firm's wage policy is established by their collective agreements, which apply in the same way to both types of contracts. In any case, we also found no significant differences in RWC between temporary and open-ended contracts, even for uncovered workers. Fourth, a theoretical proportionality (elasticity = 1) in the relationship between new hires' real wages and productivity over the business cycle arises only for uncovered new hires. For those covered, this relationship is less than proportional (elasticity < 1) for workers paid above the CB level (and not significant for workers paid at CB minimum wages). In this sense, CB weakens the relationship between new hires' wages and labour productivity as their wages are partly or totally bargained by incumbent workers and not the new hires. This result speaks to debates about the representativeness of social partners and its effects on economic outcomes.

Overall, our findings remain qualitatively invariant to different business cycle indicators, a different measure of wages, and a different method of detrending the data. However,

we find some evidence of asymmetric effects in the relationship between real wages and unemployment between different phases of the business cycle (upswings and downturns). We also find that RWC is higher for men than women within the covered group, a potential driver of the gender pay gap that may merit further research.

In terms of policy implications, our evidence indicates that CB constrains the response of real wages to unemployment. CB therefore weakens the capacity of the economy to absorb shocks. Introducing flexibility into the CB framework, for example as has been done in Germany (Jäger et al., 2022), and not imposing collective agreements on non-signatory parties may help the economy to absorb shocks at a lower unemployment cost. Hence, specific policy measures may be considered, such as opt-out (hardship) and opening clauses (Dustmann et al., 2014; OECD, 2017) in collective agreements, restricting administrative extensions, not imposing mandatory regimes on uncovered workers, and restricting the ultra-activity of expired, but not renewed, agreements.

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Appendix 1 – Institutional Framework: Labour Law, Collective Bargaining and Temporary Contracts in Portugal

In Portugal, the Labour Code (LC) establishes the general framework of labour relations and minimum working conditions that are to be followed in employment contracts. At the same time, this code allows deviations from several of its own provisions if determined by CB between employers' and employees' representatives. In some cases, the deviations set in a collective agreement can be less favourable to employees, provided that the overall agreement is regarded as more favourable than the provisions of the LC or the previous version of the collective agreement.

Trade unions have the constitutional right to negotiate formal collective agreements with the employers' representatives. (Informal collective agreements can be conducted by works councils.) Initially, collective agreements cover the workers that are simultaneously members of the subscribing union(s) and are employed by firms which subscribe to the agreement, either directly (firm-level agreements) or indirectly through their employers' association (sector-level agreements). However, in practice, most firms seek to extend their collective agreements to non-unionised workers (*erga omnes*).

Furthermore, the coverage of the agreements is usually extended beyond the subscribing firms. This framework of low representation and high coverage is driven by widespread administrative extensions. These extension mechanisms have been widely applied in Portugal, as in many other European countries (most notably France), imposing a vast set of minimum wages (and other regulations) on specific occupations across a large share of private sector employees (Martins, 2021b). This means that most employees in the private sector in Portugal are covered by collective agreements, despite the low levels of employer and trade union representation (Addison et al., 2017). With the exception of the period 2011–2014, when objective representativeness criteria were in force, most sectoral collective agreements are subject to extensions. This architecture of the CB system has advantages, but also disadvantages (Martins, 2021a), including the amplification of nominal wage rigidity, which may limit the ability of the labour market to deal with negative shocks, particularly in times of low inflation (Bewley, 1999 and others).

Despite the minimum wage for each job title set by collective agreement, firms are of course free to pay wages above this minimum. Indeed, a substantial part of the workers receives wages above this minimum (Cardoso and Portugal, 2005). Consequently, these workers are somewhat outside the wage constraints imposed by the CB process. These workers may be regarded as closer to the decentralised market mechanisms than in the cases of other workers whose base wages are equal to the minima set by CB.

Indeed, in Portugal, as in many other European countries, most workers have their wages set by collective agreements (Cardoso and Portugal, 2005; Addison et al., 2017). However, there is also a growing percentage of workers whose wages are set outside the system of CB (this percentage increased from about 5% in 2002 to about 16% in 2020). There is hence special interest in comparing the wage cyclicality of workers covered and uncovered by collective agreements, as the uncovered group bargains their

wages individually in an environment closer to the search and matching model (Mortensen and Pissarides, 1994) than the covered group. Therefore, we could expect higher wage volatility for this group of workers than for the covered group in face of the constraints imposed by the CB process.

Another aspect of Portuguese CB is the possibility of the unilateral cessation of collective agreements, without replacement by another agreement or another version of the same agreement bargained by the same parties. This possibility was introduced by the Labour Code that came into force in 2003. Until then, labour law only allowed the end of a collective agreement if all signatory parties agreed (through the establishment of a new agreement or a revision of the earlier agreement). Moreover, the earlier provision of labour law establishing an indefinite duration of a collective agreement was also included in many collective agreements established before 2003. In order to allow these older agreements to potentially also be terminated, a transition procedure was established in 2003. This system involved a duration of three to five years between the time at which one of the parties of the agreement indicated their will to terminate the collective agreement and the time when the agreement would come to an end (ultra-activity). Note that, even after the agreement is terminated, its provisions continue to apply to employees that were hired when the agreement was in force.

The widespread use of temporary contracts (22% of total employment, as of 2019) is another important dimension of the labour market in Portugal. This is also an important feature of many other countries, most notably Spain (25%) and Poland (23%). An important driver of such a large percentage of temporary contracts in Portugal may be the very restrictive legal provisions against (individual) dismissals in open-ended (or permanent) contracts. Indeed, Portugal has one of the most restrictive regimes in such dismissals in the OECD (OECD, 2017).

Temporary contracts (including fixed-term contracts) are allowed in the Portuguese law (articles 140 and 148 of the Labour Code) when enterprises have a “temporary need and only during the time period of that need”. In addition to this general context, and over the period studied in this paper, temporary contracts are also permitted for new firms, when existing firms launch a new activity of uncertain duration or a new establishment (only for firms with less than 750 employees – Cahuc et al., 2023), or when a worker is long-term unemployed or is searching for their first job.

The admissibility conditions, the number of renewals and the maximum duration of these contracts have been subject to several reforms over time (Silva et al., 2018; Martins, 2021c). In general, these contracts can have a maximum duration of three years, including up to three renewals.

Appendix 2: model 1-model 6

General model of RWC (model 6)

$$lnw_{i,f,j,g,c,s,t} = \beta_0 X_{it} + \beta_{1g,c,s} \sum_{g=1}^{3} I_{gift} \sum_{c=1}^{2} I_{cift} \sum_{s=1}^{2} I_{sift} +$$
$$+ \ \mu_{0,g,c} \ \sum_{g=1}^{3} I_{gift} \sum_{c=1}^{2} I_{cift} \times stayer \times bcy_t \quad +$$
$$\mu_{1,g,c} \sum_{g=1}^{3} I_{gift} \sum_{c=1}^{2} I_{cift} newhire_{it} bcy_t + time\ trend_t + fe_{ifj} + \ error_{ifjct} \quad (1)$$

X_{it}= age, age^2, education dummies.

I_{gift}: dummies identifying the CB institutional setting: g=1: ($W_{base} > W_{CBT}$) worker; g=2: ($W_{base} = W_{CBT}$) worker ; g=3: uncovered worker}

I_{cift}: dummies of the kind of contract (c=1: permanent, c=2: temporary)

I_{sift}: dummies for seniority: s=1 stayer (tenure>=1), s=2 new hire)

new hire (tenure<1)

stayer (tenure>=1)

fe_{ifj}: fixed effects

{g=1: ($W_{base} > W_{CBT}$) workers; g=2 ($W_{base} = W_{CBT}$) workers ; g=3=uncovered}

{c=1=permanent contract; c=2=temporary contract}

{s=1: stayer; s=2=new hire}

base category: g=1; c=1; s=1.

1st step:

$$lnw_{i,f,j,g,c,s,t} =$$
$$\psi_{0,g,c,t} T_t \sum_{g=1}^{3} I_{gift} \sum_{c=1}^{2} I_{cift}\ stayer + \psi_{1,g,c,t} T_t \sum_{g=1}^{3} I_{gift} \sum_{c=1}^{2} I_{cift} newhire_{it} +$$
$$+\beta_0 X_{it} + \beta_{1g,c,s,t} \sum_{g=1}^{3} I_{gift} \sum_{c=1}^{2} I_{cift} \sum_{s=1}^{2} I_{sift} + fe_{ifj} + \ error_{ifjct} \quad (2)$$

2nd step:

$\widehat{\psi_{0,g,c,t}} = \mu_{0g,c} bcy_t + time\ trend + error$, for g=1,2,3; c=1, 2; s=1 (3)

$\widehat{\psi_{1,g,c,t}} = \mu_{1,g,c} bcy_t + time\ trend + error$, for g=1,2,3; c=1, 2; s=2: (4)

$\mu_{0,g,c}$: semi-elasticity (base category) and incremental effects for stayers;

semi-elasticity (base category): $\mu_{\mathbf{0,1,1}}$

$\mu_{1,g,c}$: incremental Effect for the new hires (s=2) of group (g) and contract (c)

Implied semi-elasticities of the new hires (g,c): $\mu_{\mathbf{0,1,1}}+\mu_{\mathbf{1},g,c}$

model 1

Homogeneous labour market, there is no distinction either of workers or of contracts. Workers differ in their seniority:

$$lnw_{i,f,j,t} = \beta_0 X_{it} + \beta_{1,2} newhire + \mu_{01}\, bcy_t + \mu_{1,2} newhire_{it} bcy_t + time\ trend_t + fe_{ifj} + error_{ifjct}$$

{s=1: stayer; s=2=new hire}

base category: s=1;

1st step:

$lnw_{i,f,j,t} = \beta_0 X_{it} + \beta_{1,2} newhire_{it} + \psi_{0,t} T_t + \psi_{1,t} T_t newhire_{it} + fe_{ifj} + error_{ifjct}$

2nd step:

$\widehat{\psi_{0,t}} = \mu_{0,1} bcy_t + time\ trend + error$, for s=1

$\widehat{\psi_{1,t}} = \mu_{1,2} bcy_t + time\ trend + error$, for; s=2:

$\mu_{0,1}$: implied semi -elasticity for stayers;

Implied semi-elasticity for the new hires: $\mu_{0,1}+\mu_{1,2}$.

model 2: model 1 + temporary and permanent contracts

model of RWC:

$$lnw_{i,f,j,c,s,t} = \beta_0 X_{it} + \beta_{1,c,s} \sum_{c=1}^{2} I_{c,i,f,t} \sum_{s=1}^{2} I_{s,i,f,t} + \mu_{0,c} \sum_{c=1}^{2} I_{c,i,f,t} \times stayer \times bcy_t + \mu_{1,c} \sum_{c=1}^{2} I_{c,i,f,t} newhire_{i,t} bcy_t + time\ trend_t + fe_{i,f,j} + error_{i,f,j,c,t}$$

base category: c=1; s=1

1st step:

$lnw_{i,f,j,c,t} = \beta_0 X_{it} + \beta_{1,c,s} \sum_{c=1}^{2} I_{c,i,f,t} \sum_{s=1}^{2} I_{s,i,f,t} +$
$+ \psi_{0,c,t} T_t \sum_{c=1}^{2} I_{cift}$ stayer$+\psi_{1,c,t} T_t \sum_{c=1}^{2} I_{c,i,f,t}\, newhire + fe_{ifj} +$
$error_{ifjct}$

2nd step:

$\widehat{\psi_{0,c,t}} = \mu_{0,c} bcy_t + time\ trend + error$, for c=1, 2; s=1

$\widehat{\psi_{1,c,t}} = \mu_{1,c} bcy_t + time\ trend + error$, for c=1, 2; s=2:

$\mu_{0,c}$: semi-elasticity for the base category and incremental effects for stayers;

Implied semi-elasticity for the base category: $\mu_{0,1}$

$\mu_{1,c}$: incremental Effect for the new hires (s=2) with contract (c)

Implied semi-elasticities for the new hires (c=1,2): $\mu_{0,1}+\mu_{1,c}$

Model 3: model 1 with workers divided between covered and uncovered by CB

group (g) = {covered=1, uncovered=2};

seniority (s)= {stayer=1, newhire=2}

base category: g=1; s=1

model of RWC:

$$lnw_{i,f,j,g,s,t} = \beta_0 X_{it} + \beta_{1g,s} \sum_{g=1}^{2} I_{gift} \sum_{s=1}^{2} I_{sift} + \mu_{0,g} \sum_{g=1}^{2} I_{gift} \times stayer \times bcy_t + \mu_{1,g} \sum_{g=1}^{2} I_{gift}\, newhire_{it} bcy_t + time\ trend_t + fe_{ifj} + error_{ifjct}$$

1st step:

$lnw_{i,f,j,g,t} = \beta_0 X_{it} + \beta_{1g,s} \sum_{g=1}^{2} I_{gift} \sum_{s=1}^{2} I_{sift} +$
$+ \psi_{0,g,t} T_t \sum_{g=1}^{2} I_{gift}$ stayer$+\psi_{1,g,t} T_t \sum_{g=1}^{2} I_{gift} newhire_{it} + fe_{ifj} +$
$error_{ifjct}$

2nd step:

$\widehat{\psi_{0,g,t}} = \mu_{0,g} bcy_t + time\ trend + error$, for g=1,2; s=1

$\widehat{\psi_{1,g,t}} = \mu_{1,g} bcy_t + time\ trend + error$, for g=1,2; s=2:

$\mu_{0,g}$: implied semi-elasticity for the base category and incremental effects for stayers;

semi-elasticity: $\mu_{0,1}$ for covered stayers.

Incremental effect for new hires: $\mu_{1,g}$

Implied semi-elasticity for new hires [(g=1,2); s=2]= $\mu_{0,1}+\mu_{1,g}$

model 4: model 3 with temporary and permanent contracts

model of RWC:

$lnw_{i,f,j,g,c,s,t} = \beta_0 X_{it} + \beta_{1g,c,s} \sum_{g=1}^{2} I_{gift} \sum_{c=1}^{2} I_{cift} \sum_{s=1}^{2} I_{sift} +$
$+ \mu_{0,g,c} \sum_{g=1}^{2} I_{gift} \sum_{c=1}^{2} I_{cift} \times stayer \times bcy_t +$
$\mu_{1,g,c} \sum_{g=1}^{2} I_{gift} \sum_{c=1}^{2} I_{cift} newhire_{it} bcy_t + time\ trend_t + fe_{ifj} + error_{ifjct}$

group (g) = {covered=1, uncovered=2}

contracts (c)= {permanent=1; temporary=2}

seniority (s)= {stayer=1, newhire=2}

base category: g=1; c=1; s=1;

1st step:

$$lnw_{i,f,j,g,c,s,t} = \psi_{0,g,c,t} T_t \sum_{g=1}^{2} I_{gift} \sum_{c=1}^{2} I_{cift}\, stayer + \psi_{1,g,c,t} T_t \sum_{g=1}^{2} I_{gift} \sum_{c=1}^{2} I_{cift} newhire_{it} + + \beta_0 X_{it} + \beta_{1g,c,s,t} \sum_{g=1}^{2} I_{gift} \sum_{c=1}^{2} I_{cift} \sum_{s=1}^{2} I_{sift} + fe_{ifj} + error_{ifjct}$$

2nd step:

$\widehat{\psi_{0,g,c,t}} = \mu_{0g,c} bcy_t + time\ trend + error$, for g=1,2; c=1,2; s=1

$\widehat{\psi_{1,g,c,t}} = \mu_{1,g,c} bcy_t + time\ trend + error$, for g=1,2; c=1,2; s=2

$\mu_{0,g,c}$: semi-elasticity (base category) and incremental effects for stayers;

semi-elasticity (base category): $\mu_{0,1,1}$

$\mu_{1,g,c}$: incremental Effect for the new hires (s=2) of group (g) and contract (c)

Implied semi-elasticities of the new hires (g,c): $\mu_{0,1,1}+\mu_{1,g,c}$

model 5:

workers: [g=1: ($W_{base} > W_{CBT}$) workers; g=2 ($W_{base} = W_{CBT}$) workers; g=3 uncovered workers]; contracts: no distinction; seniority [s=1=stayers; s=2=new hires]

model of RWC:

$$lnw_{i,f,j,g,s,t} = \beta_0 X_{it} + \beta_{1g,s} \sum_{g=1}^{3} I_{gift} \sum_{s=1}^{2} I_{sift} + \mu_{0,g} \sum_{g=1}^{3} I_{gift} \times stayer \times bcy_t + \mu_{1,g} \sum_{g=1}^{3} I_{gift}\, newhire_{it} bcy_t + time\ trend_t + fe_{ifj} + error_{ifjct}$$

1st step:

$$lnw_{i,f,j,g,s,t} = \beta_0 X_{it} + \beta_{1g,s} \sum_{g=1}^{3} I_{gift} \sum_{s=1}^{2} I_{sift} +$$
$$+ \psi_{0,g,t} T_t \sum_{g=1}^{3} I_{gift} \text{ stayer} + \psi_{1,g,t} T_t \sum_{g=1}^{3} I_{gift} newhire_{it} + fe_{ifj} +$$
$$error_{ifjct}$$

2nd step:

$\widehat{\psi_{0,g,t}} = \mu_{0,g} bcy_t + time\ trend + error$, for g=1,2,3; s=1

$\widehat{\psi_{1,g,t}} = \mu_{1,g} bcy_t + time\ trend + error$, for g=1,2,3; s=2

$\mu_{0,g}$: implied semi-elasticity for the base category and incremental effects for stayers;

Implied semi-elasticity: $\mu_{0,1}$ for covered stayers.

Incremental effect for new hires: $\mu_{1,g}$

Implied semi-elasticity for new hires [(g=1,2,3); s=2]= $\mu_{0,1}+\mu_{1,g}$

Table A: means of selected variables, Portugal, 2002-2020

Variable	Mean / share
Age (years)	39.49
	(10.57)
Education (share of workers)	
Non-defined	0.00
Less than basic school	0.01
Basic school	0.16
Preparatory	0.18
Lower secondary	0.24
Upper secondary	0.24
New hire	0.16
Temporary contract	0.25
Uncovered workers	0.10
($W_{base} > W_{CBT}$) workers	0.50
Hourly earnings (log)	0.36
	(0.53)
Hourly base wages (log)	0.20
	(0.51)
N	39,806,250

Note: standard errors are in parenthesis

TABLES AND FIGURES

Table 1: Distribution of employment in the private sector in Portugal (%), 2002-2020

Year	Workers covered by collective agreements			Uncovered workers	Firms (%)		
	$W_{base} > W_{CBT}$	$W_{base} = W_{CBT}$	total		uncovered	With covered and uncovered employees	covered
2002	52.4	42.5	94.9	5.1	3.3	0.4	96.3
2003	53.5	41.4	94.8	5.2	3.3	0.5	96.2
2004	53.8	39.7	93.5	6.5	3.6	1.3	95.1
2005	52.2	39.9	92.0	8.0	4.0	1.4	94.6
2006	51.9	38.4	90.3	9.7	5.0	1.6	93.4
2007	52.4	38.1	90.5	9.5	5.8	1.8	92.4
2008	51.6	38.7	90.4	9.6	6.5	1.9	91.6
2009	51.7	38.5	90.2	9.8	6.7	1.9	91.4
2010	52.4	39.2	91.6	8.4	4.7	0.6	94.7
2011	52.2	38.9	91.0	9.0	5.0	0.6	94.4
2012	50.4	38.9	89.3	10.7	7.1	0.7	92.2
2013	49.7	39.1	88.8	11.2	7.6	0.8	91.6
2014	47.7	40.9	88.6	11.4	8.2	0.9	91.0
2015	49.4	38.8	88.2	11.8	8.6	0.9	90.4
2016	47.5	39.6	87.1	12.9	9.2	1.0	89.8
2017	46.2	40.1	86.2	13.8	10.3	1.0	88.7
2018	46.1	39.5	85.6	14.4	11.1	1.0	87.8
2019	46.1	38.7	84.8	15.2	12.0	1.1	86.9
2020	43.4	40.2	83.6	16.4	12.9	1.2	85.9

Notes: Authors' calculations based on the "Quadros de Pessoal" data set. W_{base}: base wage; W_{CBT}: minimum contractual wage for a given job title within a given collective agreement. Firms uncovered: firms where all employees are not covered by collective agreements; firms covered: firms whose employees are all covered by collective agreements.

Table 2: Means of selected variables, workers covered and not covered by collective agreements, Portugal, 2002 and 2020

	2002		2020	
	Covered workers	Uncovered workers	Covered workers	Uncovered workers
Real hourly earnings (log)	.3 (.54)	.58 (.67)	.43 (.47)	.55 (.52)
Real hourly base wage (log)	.15 (0.5)	.43 (.66)	.26 (.44)	.39 (52)
Age (in years)	37.33 (10.67)	35.35 (10.11)	41.65 (10.99)	39.12 (10.63)
Tenure (in years)	8.05 (11.51)	5.09 (9)	8.37 (9.31)	6 (7.74)
Lower secondary education	.18	.15	.27	.18
Upper secondary education	.17	.25	.32	.31
University degree	.08	.25	.21	.39
Number of employees	886.84 (2625.43)	487.72 (830.62)	1058.52 (3520.23)	1295.04 (2758.29)
Sales (log) – current prices	15.05 (2.79)	15.21 (2.7)	15.41 (2.83)	15.86 (2.57)
Majority of capital: public	.04	0.11	.04	0.13
Majority of capital: foreign	.09	0.09	.15	0.23
Firm age (in years)	21.55 (32.59)	18.22 (28.17)	30.51 (44.61)	22.53 (21.39)
Legislators, Senior Officials and managers	.02	.03	.04	.04
Professionals	.05	.2	.11	.24
Technicians and associate Professionals	.11	.18	.11	.14
Clerks	.15	.19	.13	.19
Service workers and shop and market sales workers	.18	.15	.21	.12
Skilled agricultural and fishery workers	0	.01	0	.01
Craft and related trades Workers	.22	.07	.16	.08
Plant and machine operators and assemblers	16	.06	.12	.07
Elementary occupations	.11	.11	.11	.11
N	1,840,764	98,906	1,947,116	381,983

Notes: Authors' calculations based on the "Quadros de Pessoal" data set. The variables related to education, occupations, industries and majority of capital, represent the share of workers in the selected sample.

Table2 (cont.): Means of selected variables, workers covered and not covered by collective agreements, Portugal, 2002 and 2020

	2002		2020	
	Covered workers	Uncovered workers	Covered workers	Uncovered workers
Agriculture, forestry and fishing	0	0	0	.01
Mining and quarrying	.01	0	0	0
Manufacturing	.31	.09	.24	.12
Electricity, gas, steam and air conditioning supply	.01	.01	0	0
Water supply; sewerage, waste management and remediation activities	0	.06	0	.04
Construction	.13	.01	.09	.03
Wholesale and retail trade; repair of motor vehicles and motorcycles-	.19	.03	.2	.07
Transportation and storage	.08	.07	.06	.03
Accommodation and food service activities	.07	.01	.08	.02
Information and communication	.02	.14	.03	.11
Financial and insurance activities	04	.01	.03	.03
Real estate activities	.01	.01	.01	.01
Professional, scientific and technical activities	.03	.09	.04	.09
Administrative and support service activities	.03	.1	.06	.16
Public administration and defence; compulsory social security	0	.12	0	.02
Education	.01	.03	.02	.04
Human health and social work activities	.07	.09	.1	.15
Arts, entertainment, and recreation	0	.05	.01	.02
Other service activities	.01	.09	.02	.03
Activities of extraterritorial organisations and bodies	0	0	0	0
N	1840764	98906	1947116	381983

Notes: Authors' calculations based on the "Quadros de Pessoal" data set. The variables related to education, occupations, industries and majority of capital, represent the share of workers in the selected sample. Industries are organised according to the statistical classification of economic activities in the European Community, NACE rev. 2.

Table 3: Temporary contracts (%), Portugal, 2002-2020

Year	Workers covered by collective agreements				Uncovered Workers		total		
	$W_{base} > W_{CBT}$		$W_{base} = W_{CBT}$						
	Stayers	New hires	Stayers	New hires	Stayers	New hires	Stayers	New hires	total
2002	12.10	54.31	13.49	53.63	18.26	62.51	12.97	54.56	20.33
2003	12.89	60.24	14.02	59.91	21.27	76.05	13.75	61.30	21.08
2004	13.52	60.62	14.06	59.88	24.40	81.99	14.35	62.86	21.56
2005	13.25	59.95	14.16	60.38	27.51	85.03	14.56	63.72	23.09
2006	13.67	63.49	14.78	62.25	27.37	78.39	15.32	64.90	24.19
2007	14.78	66.50	16.30	63.97	29.82	76.12	16.68	66.54	26.36
2008	15.96	67.84	18.15	67.64	27.81	73.21	17.87	68.37	27.31
2009	16.51	68.13	19.14	66.76	23.71	72.78	18.16	68.12	26.44
2010	11.35	62.04	13.69	64.98	15.82	70.74	12.59	64.33	21.11
2011	12.66	66.70	15.22	67.29	16.68	71.49	13.96	67.52	22.28
2012	13.55	68.06	17.06	68.88	18.08	72.18	15.35	68.97	22.32
2013	14.13	70.43	17.21	72.41	17.95	75.13	15.72	71.96	23.90
2014	14.38	71.16	18.15	73.81	18.17	76.93	16.28	73.24	26.02
2015	15.32	70.63	19.37	71.74	19.34	75.56	17.27	71.89	27.36
2016	16.37	71.82	20.17	73.66	19.40	76.17	18.18	73.38	28.79
2017	17.43	71.98	21.32	74.56	20.10	77.00	19.27	74.03	30.51
2018	18.49	72.34	22.51	75.42	22.96	73.26	20.62	73.87	31.99
2019	18.76	69.74	22.90	73.47	22.52	72.90	20.83	71.99	31.86
2020	18.10	64.78	22.51	69.68	23.20	70.58	20.60	68.29	28.98

Notes: W_{base}: base wage; W_{CBT}: minimum contractual wage for a given job title within a given collective agreement. Authors' calculations based on the "Quadros de Pessoal" data set. New hires: workers whose tenure <1; Stayers: workers whose tenure>=1

Table 4: two-step estimator; N first step = 39,806,250; dependent variable: real hourly earnings (log); N second step = 19; quadratic time trend in the second step; business cycle indicator: unemployment rate (t-1), Portugal, 2002-2020.

	model 1	model 2	model 3	model 4
1. Business cycle indicator	-0.549*** (0.161)	-0.521*** (0.157)	-0.530*** (0.158)	-0.502*** (0.154)
2. Differential effects				
Stayers, temporary contract		-0.173*** (0.0450)		
Stayers, uncovered			-0.227*** (0.0500)	
Stayers, covered, temporary contract				-0.174*** (0.0417)
Stayers, uncovered, temporary contract				-0.368*** (0.0953)
Stayers, uncovered, open-ended contract				-0.232*** (0.0498)
New hires, total	-0.208*** (0.0538)			
New hires, covered workers			-0.169*** (0.0538)	
New hires, uncovered workers			-0.629*** (0.0951) A***	
New hires, temporary contract		-0.281*** (0.0694) A***		
New hires, open-ended contract		-0.206*** (0.0506)		
New hires, covered workers, temporary contract				-0.244*** (0.0699) A
New hires, covered workers, open-ended contract				-0.161*** (0.0446)
New hires, uncovered workers, temporary contract				-0.672*** (0.117) A***
New hires, uncovered workers, open-ended contract				-0.689*** (0.137) A***

Notes: These estimates are based on seemingly unrelated regressions in the second step. The second step estimates were weighted by the number of observations / year for each category of workers; A: incremental effects: $stayer_g$=new $hire_g$;; these tests were carried out with the STATA commands SUEST and TEST; Standard errors are in parentheses; ***, **, *: significant at: 1%, 5% and 10%, respectively. model 1: homogeneous labour market; model 2: model 1+ temporary and open-ended contracts; model 3: with workers covered and uncovered by collective agreements; model 4: model 3 + temporary and open-ended contracts.

Table 4 (continuation): two-step estimator; N first step = 39,806,250; dependent variable: real hourly earnings (log); N second step = 19; quadratic time trend in the second step; business cycle indicator: unemployment rate (t-1), Portugal, 2002-2020.

	model 5:	model 6:
1. Business cycle indicator	-0.554***	-0.527***
	(0.152)	(0.149)
2. Differential effects		
Stayers ($W_{base} = W_{CBT}$)	0.0769*	
	(0.0431)	
Stayers (uncovered)	-0.209***	
	(0.0520)	
Stayers ($W_{base} > W_{CBT}$) - temporary		-0.179***
		(0.0488)
Stayers ($W_{base} = W_{CBT}$), temporary		-0.0590
		(0.0727)
Stayers ($W_{base} = W_{CBT}$), open-ended		0.0718*
		(0.0398)
Stayers (uncovered), temporary		-0.336***
		(0.0960)
Stayers (uncovered): open-ended		-0.218***
		(0.0499)
New hires, uncovered workers	-0.596***	
	(0.101)	
	A***	
New hires, uncovered workers, temporary		-0.633***
		(0.123)
		A***
New hires, uncovered workers, open-ended		-0.671***
		(0.139)
		A***
New hires, workers ($W_{base} > W_{CBT}$)	-0.164**	
	(0.0626)	
New hires, workers ($W_{base} = W_{CBT}$)	-0.0568	
	(0.0820)	
	A***	
New hires, workers ($W_{base} = W_{CBT}$), temporary		-0.132
		(0.0916)
		A
New hires, workers ($W_{base} = W_{CBT}$), open-ended		-0.0375
		(0.0783)
		A**
New hires, workers ($W_{base} > W_{CBT}$), temporary		-0.227**
		(0.0831)
New hires, workers ($W_{base} > W_{CBT}$), open-ended		-0.185***
		(0.0529)

Notes: These estimates are based on seemingly unrelated regressions in the second step. The second step estimates were weighted by the number of observations / year for each category of workers; A: incremental effects: $stayer_g$=new $hire_g$; these tests were carried out with the STATA commands SUEST and TEST; Standard errors are in parentheses; ***, **, *: significant at: 1%, 5% and 10%, respectively. model 5: workers ($W_{base} > W_{CBT}$) + workers ($W_{base} = W_{CBT}$) + uncovered workers; model 6: model (5) + temporary and open-ended contracts.

Table 5: implied semi-elasticities to the business cycle indicator for new hires and equality tests between different institutional arrangements
first step dependent variable: log hourly earnings; business cycle indicator: Ut-1; quadratic time trend, Portugal, 2002-2020.

	Implied semi-elasticities for new hires			**Test**	**Implied semi-elasticities for new hires**		**Test**
	all	temporary	open-ended	temporary=open-ended	covered	uncovered	covered=uncovered
model 1	-0,757***						
model 2		**-0.802*** **	**-0.727*** **	**2.447**			
model 3					-0.699***	-1.159***	43.96***

Implied semi-elasticities for new hires				**Tests**		
covered		uncovered			temporary = open-ended, within category	
temporary	open-ended	temporary	open-ended	all equal	covered	uncovered
-0.746***	-0.663***	-1.174***	-1.191***	64.254***	**3.041***	0.015

Tests

covered = uncovered, between bargaining regimes

temporary	Open-ended
20.733***	26.876***

Irrelevance of contracts, between bargaining regimes

	Uncovered
Covered	0.505

Table 5 (cont.): implied semi-elasticities to the business cycle indicator for new hires and equality tests between different institutional arrangements, first step dependent variable: log hourly earnings; business cycle indicator: Ut-1; quadratic time trend, Portugal, 2002-2020.

	Implied semi-elasticities for new hires				**Tests**		
model 5	**($W_{base} > W_{CBT}$)**	**($W_{base} = W_{CBT}$)**	**uncovered**	**All equal**	**($W_{base} > W_{CBT}$) =($W_{base} = W_{CBT}$)**	**($W_{base} > W_{CBT}$) = uncovred**	**($W_{base} = W_{CBT}$)= =uncovered**
	-0.719* **	**-0.611*** **	**-1.151*** **	**54.057*** **	**2.656**	**33.65*** **	**50.82*** **
	Implied semi-elasticities for new hires						
	($W_{base} > W_{CBT}$)		**($W_{base} = W_{CBT}$)**		**uncovered**		
	temporary	**open-ended**	**Temporary**	**Open-ended**	**temporary**	**open-ended**	
	-0.754* **	**-0.711*** **	**-0.659*** **	**-0.564*** **	**-1.159*** **	**-1.198*** **	
	Tests						
	temporary = open-ended, within group				**Temporary, between groups**		
	all equal	($W_{base} > W_{CBT}$)	($W_{base} = W_{CBT}$)	uncovered	all equal	($W_{base} > W_{CBT}$) =($W_{base} = W_{CBT}$)	($W_{base} > W_{CBT}$)=uncovered
model 6	78.852***	0.443	**3.668***	0.077	29.615***	2.131	14.949***
	Temporary, between groups		**open-ended, between groups**				
	($W_{base} = W_{CBT}$) =uncovered	**all equal**	($W_{base} > W_{CBT}$) =($W_{base} = W_{CBT}$)	($W_{base} > W_{CBT}$) =uncovered		($W_{base} = W_{CBT}$) =uncovered	
	29.199***	39.306***	3.492*	18.241***		39.051***	
	Irrelevance of contracts, between bargaining regimes						
		($W_{base} > W_{CBT}$)	$W_{base} = W_{CBT}$)	uncovered		All	
	($W_{base} > W_{CBT}$)	-----	1.039	0.243		0.243	
	($W_{base} = W_{CBT}$)			1.105			

Notes: these estimates are based on seemingly unrelated regressions in the second step. These estimates were weighted by the number of observations / year for each category of workers. In each block of tests we display the qui-squared statistic for the null hypothesis considered; these tests were carried out with the STATA commands SUEST and TEST; ***, **, *: significant at: 1%, 5% and 10%, respectively. model 1: homogeneous labour market; model 2: model 1+ temporary and open-ended workers; model 3: with workers covered and uncovered by collective agreements; model 4: model 3 + temporary and open-ended workers; model 5: workers ($W_{base} > W_{CBT}$) + workers ($W_{base} = W_{CBT}$) +uncovered workers; model 6: model (5) + temporary and open-ended workers.

Table 6: model 6, asymmetric effects, 2nd step estimates; N first step = 39,806,250; N second step = 19; dependent variable: real hourly earnings (log); quadratic time trend in the second step; business cycle indicator: unemployment rate (t-1), Portugal, 2002-2020.

	unemployment increasing (1)	unemployment decreasing (2)	test (3): (1) = (2)
1. Business cycle indicator	-0.533***	-0.599***	0.892
	(0.153)	(0.141)	
2. Differential effects			
Stayers ($W_{base} > W_{CBT}$) - temporary	-0.187***	-0.273***	29.818***
	(0.0370)	(0.0487)	
Stayers ($W_{base} = W_{CBT}$), temporary	-0.0650	-0.131	3.572*
	(0.0744)	(0.102)	
Stayers ($W_{base} = W_{CBT}$), permanent	0.0701	0.0535	0.747
	(0.0426)	(0.0584)	
Stayers (uncovered), temporary	-0.351***	-0.537***	40.143***
	(0.0679)	(0.0888)	
Stayers (uncovered): permanent	-0.225***	-0.308***	12.417***
	(0.0393)	(0.0546)	
New hires, uncovered workers, temporary	-0.626***	-0.766***	22.756***
	(0.106)	(0.124)	
	A***	A***	
New hires, uncovered workers, permanent	-0.657***	-0.772***	3.879**
	(0.124)	(0.123)	
	A***	A***	
New hires, workers ($W_{base} = W_{CBT}$), temporary	-0.135	-0.196	2.252
	(0.0896)	(0.118)	
	A	A	
New hires, workers ($W_{base} = W_{CBT}$), permanent	-0.0366	-0.0975	3.618*
	(0.0740)	(0.0904)	
	A***	A***	
New hires, workers ($W_{base} > W_{CBT}$), temporary	-0.231***	-0.325***	16.486***
	(0.0703)	(0.0793)	
	A	A	
New hires, workers ($W_{base} > W_{CBT}$), permanent	-0.183***	-0.255***	24.196***
	(0.0320)	(0.0344)	

Notes: These estimates are based on seemingly unrelated regressions in the second step; the second step estimates were weighted by the number of observations / year for each category of workers. In column (3) is displayed the qui-squared statistic for the hypothesis considered; these tests were carried out with the STATA commands SUEST and TEST; Standard errors are in parentheses; ***, **, *: significant at: 1%, 5% and 10%, respectively.

Table 7: model 6, asymmetry tests in the response of wages to unemployment, business cycle indicator Ut-1, quadratic time trend in the second step, Portugal, 2002-2020.

	Implied semi-elasticities for new hires					
	($W_{base} > W_{CBT}$)		($W_{base} = W_{CBT}$)		uncovered	
	temporary	open-ended	Temporary	open-ended	temporary	open-ended
(1): U -increasing	-.764***	-.716***	-.668***	-.57***	-1.159***	-1.19***
(2): U -decreasing	-.925***	-.854***	-.795***	-.697***	-1.365***	-1.371***
Test: (1) = (2)	**6.887*** **	**2.861***	**3.514***	**2.872***	**5.452** **	**3.45***

Tests

	temporary = Open-ended, within category				**Temporary, between groups**		
	($W_{base} > W_{CBT}$)	($W_{base} = W_{CBT}$)	uncovered	All equal	($W_{base} > W_{CBT}$) = ($W_{base} = W_{CBT}$)	($W_{base} > W_{CBT}$) = uncovered	($W_{base} = W_{CBT}$) = uncovered
U - increasing	.557	3.759*	.046	33.661***	2.248	15.21***	32.897***
U - decreasing	1.382	3.244*	.002	41.997***	1.995	17.683***	41.458***
	All equal			**Open-ended, between groups**			
U - increasing		119.063***		44.616***	3.55*	18***	43.914***
U - decreasing		79.73***		30.871***	3.04*	22.696***	29.102***

Irrelevance of contracts, between bargaining regimes

		($W_{base} > W_{CBT}$)	$W_{base} = W_{CBT}$)	uncovered	All
U - increasing	($W_{base} > W_{CBT}$)	----	.926	.22	0.22
	($W_{base} = W_{CBT}$)			.967	
U - decreasing	($W_{base} > W_{CBT}$)	-----	.438	.286	.286
	($W_{base} = W_{CBT}$)			.749	

Notes: these estimates are based on seemingly unrelated regressions in the second step. These estimates were weighted by the number of observations / year for each category of workers. In each block of tests, we display the qui-squared statistic for the null hypothesis considered; these tests were carried out with the STATA commands SUEST and TEST; ***, **, *: significant at: 1%, 5% and 10%, respectively.

Table 8: model 6, Men and Women, 2nd step estimates; N first step - men = 21,994,941, Women= 17,562,807; N second step = 19; dependent variable: real hourly earnings (log); quadratic time trend in the second step; business cycle indicator: unemployment rate (t-1), Portugal, 2002-2020.

	Men (1)	Women (2)	test (3): (1) = (2)
1. Business cycle indicator	-0.596***	-0.429**	13.891***
	(0.145)	(0.160)	
2. Differential effects			
Stayers ($W_{base} > W_{CBT}$) - temporary	-0.213***	-0.132**	16.175***
	(0.0488)	(0.0488)	
Stayers ($W_{base} = W_{CBT}$), temporary	-0.0628	-0.0760	1.106
	(0.0757)	(0.0715)	
Stayers ($W_{base} = W_{CBT}$), permanent	0.0664	0.0645	3.287*
	(0.0433)	(0.0379)	
Stayers (uncovered), temporary	-0.294**	-0.400***	15.431***
	(0.101)	(0.109)	
Stayers (uncovered): permanent	-0.0949**	-0.367***	24.544***
	(0.0439)	(0.0835)	
New hires, uncovered workers, temporary	-0.537***	-0.743***	32.222***
	(0.140)	(0.122)	
	A***	A***	
New hires, uncovered workers, permanent	-0.619***	-0.728***	31.154***
	(0.186)	(0.111)	
	A***	A***	
New hires, workers ($W_{base} = W_{CBT}$), temporary	-0.143	-0.122	2.402
	(0.0842)	(0.107)	
	A	A	
New hires, workers ($W_{base} = W_{CBT}$), permanent	-0.0707	-0.0186	.364
	(0.0814)	(0.0890)	
	A**	A*	
New hires, workers ($W_{base} > W_{CBT}$), temporary	-0.254***	-0.161	7.075***
	(0.0807)	(0.0939)	
	A	A	
New hires, workers ($W_{base} > W_{CBT}$), permanent	-0.167**	-0.184***	13.973***
	(0.0625)	(0.0469)	

Notes: These estimates are based on seemingly unrelated regressions in the second step; the second step estimates were weighted by the number of observations / year for each category of workers. In column (3) is displayed the qui-squared statistic for the hypothesis considered. A: incremental effects: $stayer_g$=new $hire_g$ - these tests were carried out with the STATA commands SUEST and TEST; Standard errors are in parentheses; ***, **, *: significant at: 1%, 5% and 10%, respectively.

Table 9: Men and Women, model 6; first step: dependent variable: log hourly earnings, business cycle indicator Ut-1; quadratic time trend in the second step, Portugal, 2002-2020

	Implied semi-elasticities for new hires					
	($W_{base} > W_{CBT}$)		($W_{base} = W_{CBT}$)		uncovered	
	temporary	open-ended	Temporary	open-ended	temporary	open-ended
(1): Men	-.85	-.763	-.739	-.666	-1.132	-1.215
(2): Women	-.591	-.613	-.552	-.448	-1.172	-1.157
Test: (1) = (2)	13.29***	5.8**	8.934***	8.032***	.551	.153

Tests

	temporary = Open-ended, within category			**Temporary contracts, between bargaining regimes**			
	($W_{base} > W_{CBT}$)	($W_{base} = W_{CBT}$)	uncovered	All equal	($W_{base} > W_{CBT}$) = ($W_{base} = W_{CBT}$)	($W_{base} > W_{CBT}$) = uncovered	($W_{base} = W_{CBT}$) = uncovered
Men	1.439	1.571	0.179	18.829***	2.643	4.748**	14.628***
Women	.11	4.896**	.036	34.16***	.388	31.098***	31.519***
	All equal			**Open-ended, between bargaining regimes**			
Men	605.387***	43.047***		22.006***	1.136	7.161***	18.56***
Women		79.078***		52.362***	4.587**	42.334***	45.792***

Irrelevance of contracts, between bargaining regimes

	Men		**Women**	
	($W_{base} = W_{CBT}$)	uncovered	($W_{base} = W_{CBT}$)	uncovered
($W_{base} > W_{CBT}$)	.039	.516	8.691***	.161
($W_{base} = W_{CBT}$)		.782		1.323

Notes:

Notes: these estimates are based on seemingly unrelated regressions in the second step. These estimates were weighted by the number of observations / year for each category of workers. In each block of tests, we display the qui-squared statistic for the null hypothesis considered; these tests were carried out with the STATA commands SUEST and TEST; ***, **, *: significant at: 1%, 5% and 10%, respectively.

Table 10: robustness checks, model 6, 2nd step estimates for different business cycle indicators, time trend and dependent variable. N first step = 39,806250; N second step = 19, Portugal, 2002-2020.

	Business cycle indicator			Detrend method	Dependent variable
	Ut	Employment$_{t-1}$ (log)	Labour productivity (log)	HP-filtered	Hourly base wages
1. Business cycle indicator	-0.295*	0.243***	0.441	-0.546***	-0.544***
	(0.166)	(0.0608)	(0.272)	(0.144)	(0.162)
2. Differential effects					
Stayers ($W_{base} > W_{CBT}$) - temporary	-0.0616	0.0868***	0.166	-0.195***	-0.150***
	(0.0591)	(0.0228)	(0.0990)	(0.0458)	(0.0357)
Stayers ($W_{base} = W_{CBT}$), open-ended	0.106**	-0.0280	-0.196***	0.0509	0.0737*
	(0.0430)	(0.0197)	(0.0600)	(0.0336)	(0.0380)
Stayers ($W_{base} = W_{CBT}$), temporary	0.0658	0.0361	-0.123	-0.112	-0.0223
	(0.0701)	(0.0356)	(0.123)	(0.0683)	(0.0658)
Stayers (uncovered): open-ended	-0.0986	0.102***	0.244**	-0.143***	-0.164***
	(0.0635)	(0.0208)	(0.0914)	(0.0432)	(0.0474)
Stayers (uncovered), temporary	-0.0825	0.168***	0.203	-0.306***	-0.262***
	(0.107)	(0.0434)	(0.182)	(0.0912)	(0.0613)
New hires, workers ($W_{base} > W_{CBT}$), open-ended	-0.129**	0.0897***	0.238***	-0.184***	-0.235***
	(0.0470)	(0.0210)	(0.0753)	(0.0597)	(0.0618)
New hires, workers ($W_{base} > W_{CBT}$), temporary	-0.144	0.109***	0.225	-0.252***	-0.183***
	(0.0997)	(0.0363)	(0.134)	(0.0744)	(0.0538)
	A	A	A	A	A
New hires, workers ($W_{base} = W_{CBT}$), open-ended	0.0442	0.0234	-0.117	-0.0774	-0.0226
	(0.0863)	(0.0366)	(0.100)	(0.0859)	(0.0746)
	A	A***	A	A**	A**
New hires, workers ($W_{base} = W_{CBT}$), temporary	-0.0255	0.0678	-0.0241	-0.203**	-0.0867
	(0.0925)	(0.0436)	(0.148)	(0.0804)	(0.0672)
	A*	A	A	A*	A**
New hires, uncovered workers, open-ended	-0.491***	0.312***	0.591***	-0.613***	-0.567***
	(0.140)	(0.0507)	(0.192)	(0.144)	(0.123)
	A***	A***	A***	A***	A***
New hires, uncovered workers, temporary	-0.385**	0.292***	0.684***	-0.635***	-0.343***
	(0.152)	(0.0515)	(0.228)	(0.108)	(0.0597)
	A***	A***	A***	A***	A

Notes: these estimates are based on seemingly unrelated regressions in the second step. The second step estimates were weighted by the number of observations / year for each category of workers. Standard errors are in parentheses. A: incremental effects: $stayer_g$=$new\ hire_g$ - these tests were carried out with the STATA commands SUEST and TEST; Standard errors are in parentheses; ***, **, *: significant at: 1%, 5% and 10%, respectively. The smoothing parameter for the HP filter is λ=100 as in Backus and Kehoe (1992) and in Stuber (2017). Labour productivity (log)= Gross valued added per employee (log).

Table 11a: model 6, implied semi-elasticities for the new hires and tests among industrial bargaining regimes, robustness checks, Portugal, 2002-2020

	Implied semi-elasticities for new hires					
	($W_{base} > W_{CBT}$)		($W_{base} = W_{CBT}$)		uncovered	
	temporary	open-ended	Temporary	Open-ended	temporary	open-ended
bcy:ut-1	-0.754***	-0.711***	-0.659***	-0.564***	-1.159***	-1.198***
bcy: Ut	-.438***	-.423***	-.32*	-.251	-.68***	-.786***
bcy: employment-1 (log)	.352***	.333***	.311***	.266***	.535***	.555***
HP-filtered	-.798***	-.729***	-.749***	-.623***	-1.181***	-1.158***
Labour productivity (log)	**.666****	**.679****	**.417**	**.324**	**1.125****	**1.032****
Hourly base wages	-.727***	-.778***	-.63***	-.566***	-.886***	-1.11***

Tests		**temporary = open-ended, within group**			**Temporary, between groups**		
	all equal	($W_{base} > W_{CBT}$)	($W_{base} = W_{CBT}$)	uncovered	all equal:	($W_{base} > W_{CBT}$) =($W_{base} = W_{CBT}$)	($W_{base} > W_{CBT}$)=uncovered
bcy:Ut-1	78.852***	0.443	3.668*	0.077	29.615***	2.131	14.949***
bcy: Ut	26.42***	.04	1.423	.464	8.077**	2.314	3.114*
bcy: employment-1 (log)	119.287***	.444	4.137**	.125	34.425***	1.772	16.711***
HP-filtered	176.168***	1.307	10.307***	.018	16.929***	.955	13.443***
Labour productivity (log)	43.35***	.027	1.04	.345	41.272***	7.863***	8.722***
Hourly base wages	139.259***	1.841	7.93***	3.656*	17.419***	2.642	9.436***

Tests	**Temp, (cont.)**	**open-ended, between groups**			
	($W_{base} = W_{CBT}$)=uncovered	**All equal**	($W_{base} > W_{CBT}$) =($W_{base} = W_{CBT}$)	($W_{base} > W_{CBT}$)=uncovered	($W_{base} = W_{CBT}$)=uncovered
bcy:Ut-1	29.199***	39.306***	3.492*	18.241***	39.051***
bcy: Ut	7.289***	22.303***	2.936*	7.396***	21.921***
bcy: employment-1 (log)	34.314***	51.716***	3.436*	24.431***	51.595***
HP-filtered	16.924***	27.484***	1.555	11.766***	27.132***
Labour productivity (log)	32.284***	22.716***	15.368***	6.036**	18.41***
Hourly base wages	15.817***	26.526***	6.128**	12.914***	26.335***

Notes: these estimates are based on seemingly unrelated regressions in the second step. The second step estimates were weighted by the number of observations / year for each category of workers. In each block of tests, we display the qui-squared statistic for the null hypothesis considered; these tests were carried out with the STATA commands SUEST and TEST; ***, **, *: significant at: 1%, 5% and 10%, respectively. The smoothing parameter for the HP filter is λ=100 as in Backus and Kehoe (1992) and in Stuber (2017). Labour productivity (log)= Gross valued added per employee (log)

Table 11b: model 6, robustness checks, Irrelevance of contracts, Portugal, 2002-2020

	(W_{base} =W_{CBT})	uncovered	All
(W_{base} > W_{CBT})			
bcy:Ut-1	1.039	.243	.243
bcy: Ut	.781	.428	.428
bcy: employment-1 (log)	1.466	.345	.345
HP-filtered	.911	.054	.054
Labour productivity (log)	3.039*	.477	.477
Hourly base wages	9.955***	2.055	2.055
(W_{base} =W_{CBT})			
bcy:Ut-1		1.105	.243
bcy: Ut		1.375	.428
bcy: employmen$_{t-1}$ (log)		1.503	.345
HP-filtered		.452	.054
Labour productivity (log)		0	.477
Hourly base wages		6.737***	2.055

Notes: these estimates are based on seemingly unrelated regressions in the second step. The second step estimates were weighted by the number of observations / year for each category of workers. In each block of tests, we display the qui-squared statistic for the null hypothesis considered; these tests were carried out with the STATA commands SUEST and TEST; ***, **, *: significant at: 1%, 5% and 10%, respectively. The smoothing parameter for the HP filter is λ=100 as in Backus and Kehoe (1992) and in Stuber (2017). Labour productivity (log)= Gross valued added per employee (log)