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What Hides Behind the Fixed-term Contracts Wage Gap?

Filipe José Brás Silvério
Student number 617

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Professor Pedro Portugal

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Abstract

In Portugal, about 20% of full-time workers are employed under a fixed-term contract. Using a rich longitudinal matched employer-employee dataset for Portugal, with more than 20 million observations and covering the 2002-2012 period, we confirm the common idea that fixed-term contracts are not desirable when compared to permanent ones, by estimating a conditional wage gap of -1.7 log points. Then, we evaluate the sources of that wage penalty by combining a three way high-dimensional fixed effects model with the decomposition of Gelbach (2014), in which the three dimensions considered are the worker's unobserved ability, the firm's compensation wage policy and the job title effect. It is shown that the average worker with a fixed-term contract is less productive than his/her permanent counterparts, explaining -3.92 log points of the FTC wage penalty. Additionally, the sorting of workers into lower-paid job titles is also responsible for -0.59 log points of the wage gap. Surprisingly, we found that the allocation of workers among firms mitigates the existing wage penalty (in 4.23 log points), as fixed-term workers are concentrated into firms with a more generous compensation policy. Finally, following Figueiredo et al. (2014), we further control for the worker-firm match characteristics and reach the conclusion that fixed-term employment relationships have an overrepresentation of low quality worker-firm matches, explaining 0.65 log points of the FTC wage penalty.

1 Introduction

The high unemployment rates in continental Europe during the 1970s diffused the opinion among policy-makers that labor markets were excessively rigid. However, rather than reducing the employment protection legislation for permanent contracts, most European countries introduced fixed-term contracts (FTC). Portugal was not an exception, allowing firms to establish fixed-term contracts since 1976. Basically, these are contracts with an agreed duration for which, upon expiration, the termination can occur done at a small or even no cost. However, if the employer decides

to keep the worker, the contract must be converted into a permanent one, facing up to the regular firing costs.¹

Not surprisingly, it is well documented that fixed-term contracts can reduce some of those labor market rigidities (e.g. Bentolila and Saint-Paul, 1992). However, since the 1980s, some economists have been expressing concerns about the perverse effects of those “two-tier labor markets”, with a mix of theoretical and empirical analysis. Most academic researchers have been dedicating their attention to the employment effects of fixed-term contracts (e.g. Blanchard and Landier, 2002; Cahuc and Postel-Vinay, 2002; Cahuc et al., 2012; Boeri, 2011), finding that they can lead to higher job turnover, lower productivity and lower workers welfare, while the impact on employment seems unclear. Additionally, some researches have also been motivated to study the effects of using fixed-term contracts on other dimensions such as its impact on wages, job satisfaction, training and even workers career prospects (e.g. Booth et al, 2002).

Prior evidence suggests that permanent workers tend to be favored in all of those dimensions when compared to fixed-term workers. In particular, there are several studies analyzing the wage gap between permanent and fixed-term workers. Regarding the theoretical discussion, there is no consensus about the wage effects of using fixed-term contracts and the topic has given rise to a number of competing arguments. For instance, while the theory of equalizing differences predicts higher wages for fixed-term workers, the dual labor market theory supports that fixed-term contracts result in lower wages than permanent contracts.² As for empirical evidence, the existing literature suggests that fixed-term workers receive lower wages than observationally equivalent permanent workers. Nevertheless, observed measures of workers’ skills and firms’ characteristics are far from perfect, in that they leave plenty of room for unobserved heterogeneity at the worker but also at the firm level. Additionally, some authors have also considered job-title and worker-firm match characteristics as important determinants of wages, in which case the aforementioned estimated wage gaps may capture differences in returns due to differences in any of these dimensions (Abowd et al., 1999; Woodcock, 2008; Torres et. al, 2013). To control for those unobservables, some authors employed fixed-effects models to account for either time-invariant characteristics of workers or firms (e.g. Booth et al., 2002). Unfortunately, the lack of large and rich databases containing worker-firm matched information on wages and their determinants has made a more detailed analysis impossible (e.g. De la Rica, 2004).

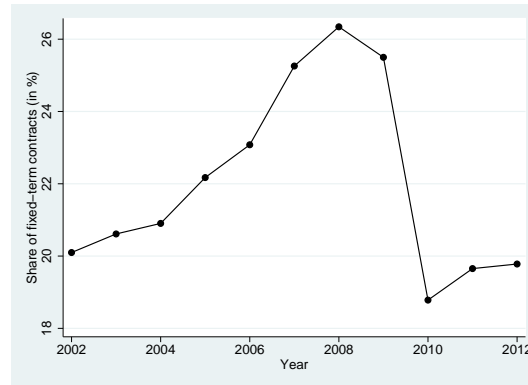
The reason of concern with these perverse effects is greater, the larger the gap between employment protection legislation for permanent and fixed-term workers. Particularly, Portugal is considered as a country with one of the largest employment protection gaps amongst OECD countries due to a mix of strict rules protecting permanent workers with only a mild regulation governing fixed-term contracts . Consequently, the use of fixed-term contracts is at the heart of political and economical debate. In fact, the numbers are worrisome. Since the mid-1990s, the majority of unemployed workers was hired with a fixed-term contract. Centeno and Novo (2012) gives evidence that, in 2010, the

¹Under some circumstances, the employer can also offer a new fixed-term contract to the worker. The restrictions associated with the use of FTC (in terms of renewals and maximum duration) are imposed to circumvent abuses; however, they may result in lower levels of job security. (OECD, 2014)

²A more detailed review of those theoretical views is presented at Section 3 of the current Thesis.

percentage of unemployed individuals hired with a FTC reached the maximum of about 90%. Moreover, around two thirds of workers who became unemployed had a fixed-term contract. Figure 1 shows the percentage of workers under a fixed-term contract which ranged from 18,8% (2010) to 26,3% (2008).³

Figure 1: Share of Fixed-term Contracts | 2002-2012



The purpose of this study is to extend the empirical analysis of the wage gap between workers under permanent and fixed-term contracts in Portugal, for which there are no similar studies. Using an employer-employee linked dataset, *Quadros de Pessoal*, covering the 2002-2012 period, we are able to estimate an extended version of the standard Mincerian wage equation that includes controls for worker, firm and job-title fixed effects. The estimation of a model with three high-dimensional effects allows us to refine the previously employed methods since we are able to filter the estimated FTC wage gap simultaneously from three different dimensions of unobserved heterogeneity.

Another contribution of our work to the existing literature on FTC wage gap is an unprecedented and detailed study of its sources. By using the methodology proposed by Gelbach's (2014), we are able to disentangle the independent contribution of workers average productivity, the firm remuneration policy and the job-title policies to the creation of that wage gap.

Finally, in order to also account for worker-firm match quality, we extend our previous three fixed effects model also for the permanent characteristics of a worker-firm match going past identification issues with the estimation of the four effects.

The remainder of this thesis is structured as follows. A brief context of the Portuguese employment protection legislation is presented in Section 2. Section 3 presents a discussion of the expected wage effects based on several competing theories, alongside a review the empirical literature on this topic, presenting some results that support those theoretical considerations. Additionally, the dataset is described in Section 4. The discussion of the empirical strategy and its results are the core of section 4; in this section, we estimate a FTC wage gap filtered from worker, firm and job-title permanent heterogeneity and then we study the sources of the FTC wage gap, by considering the independent

³The proportion of FTC was computed based on *Quadros de Pessoal* 2002-2012, with the restrictions which are described in Section 3.

contribution of the worker's average productivity, the compensation policy and the job-title policy to that wage gap. We also extend this exercise to another similar model, extended by an iteration term, in order to take into consideration the worker-firm match quality. Finally, in Section 5, we draw some concluding remarks.

2 The Portuguese Employment Protection Legislation

A well-known feature of the Portuguese labor market is its stringent overall employment protection legislation which is particularly due to the strict rules that protect permanent workers against individual dismissal. However, when compared to other European countries with a tight legislation on permanent contracts, Portugal has a peculiar characteristic that cannot be ignored: while the other European strict-EPL countries, such as Spain, usually have stringent rules for the use of temporary forms of employment, Portugal has only a mild regulation.⁴ As a consequence, Portugal is characterized by one of the largest employment protection legislation gaps between temporary and regular contracts (OECD, 2014).

After the Carnation Revolution in 1974, which overthrew a 48-year-old dictatorship, the Portuguese politicians imposed very restrictive rules on the dismissals of permanent workers. In 1976, a new government decided to introduce for the first time the possibility of using fixed-term contracts, establishing their maximum legal duration as three years. In 1986, following the accession to the European Economic Community and after a period of relative economic stagnation, a labor market reform was undertaken which softened the conditions regulating the dismissal of permanent workers and clearly defined fixed-term contracts to be used only in specific situations, setting their maximum legal duration with two renewals. Another interesting innovation introduced by this reform was the fact that a worker started having the right to a severance payment when the fixed-term contract terminates without the conversion into a permanent one.⁵

During the last decade, subsequent governments adopted several reforms aimed at promoting a more flexible labor market. The first of those was undertaken in 2004, whose main characteristic was an attempt to ease EPL by reducing the constraints governing the use of temporary contracts, while the legislation on regular contracts remained practically unchanged. More specifically, it widened the range of circumstances in which a firm could hire under fixed-term contracts and extended the maximum legal duration. There were three main changes which should be underlined. First, it introduced the possibility to hire a worker under a fixed-term contract just to meet temporary needs of the firms, extending the number of valid situations for the use of fixed-term contracts. Secondly, the maximum legal duration of a

⁴For example, according to 2013 OECD indicators, Portugal was the 15th country with a more restrictive regulation on temporary forms of employment, among the total of 34 OECD countries. However, Portugal was the OECD country with a more stringent policy related with the protection of permanent workers against (individual) dismissal.

⁵In 1989, the severance payment was initially settled to two days for each month of work. However, in 2001, it was extended to three days for each month of work. In reality, this is similar to the severance payment associated with regular contracts (30 days for each year of Seniority). However, the dismissal costs not only include severance payments but also administrative costs. Centeno and Novo (2013) discuss that administrative costs related with dismissals of permanent contracts are much higher than those for fixed-term contracts.

fixed-term contract was extended from 3 years to 6 years. Finally, the number of possible renewals until reaching its maximum legal duration was also extended from two to three times. This reform increased the legislation gap between fixed-term and regular contracts.

Later, in 2009, the labor code was once again revised with the adoption of measures to reduce substantially the EPL on regular contracts. In brief, the main changes were related with the reduction of the procedural processes for individual dismissals on permanent contracts, the extension in the trial period for all workers and the reduction of notice and severance payment due to no-fault dismissals. In addition, the maximum legal duration of fixed-term contracts was re-established to three years. Consequently, between 2003 and 2009, Portugal was the OECD country that most eased its EPL (Venn, 2009). More recently, in 2012, a broad reform was introduced to continue the path towards a more flexible labor market. Within the large set of changes, the new law allowed the fixed-term contracts to be renewed two additional times, up to the maximum of four and a half years. Unfortunately, as mentioned below, we are only able to study the 2002-2012 period due to the scope of our data set.

In the Portuguese labor market, and broadly in the other two tiers systems (such as the Spanish one), the main difference between permanent and fixed-term contracts are the procedural costs and the uncertainty related with dismissals, rather than severance payments. After the expiration of a fixed-term contract, these costs are significant for permanent workers, but nonexistent for fixed-term contracts. The dismissal of a permanent worker involves several legally established stages, depending on the type of dismissal. For example, when a firm wants to fire a worker due to reasons attributable to the worker, the firm must justify its decision; then, there is a stage for the defense and the instruction; finally, after an appreciation, a decision is taken (Martins, 2012). As all processes, the decision can also be contested in courts. These trial battles generally involve several individuals or entities, such as witnesses or even unions. Therefore, the costs of firing a worker are the procedural costs and the uncertainty about the duration of that process. In order to avoid this, firms and workers generally agree on higher severance payments than those stipulated by law. To sum up, it is not surprising that the dismissal of permanent workers is a lengthy and costly process, constituting a rigidity in the Portuguese labor market (Blanchard and Portugal, 2001).

3 Theoretical Considerations and Previous Empirical Evidence

3.1 Fixed-term Contracts and Wages

The wage effects of using fixed-term contracts have driven several theoretical considerations, which are briefly presented in this section. At the same time, we also review empirical studies that found evidence in favor of each of those - in some cases conflicting - theoretical views.

According to the theory of equalizing differences, compensating wage differentials are required to equalize disadvantages

among work activities (Rosen, 1986). Basically, the neoclassical labor market theory states that, other things being equal, in a competitive labor market, a worker on fixed-term contract should receive a higher wage than a worker on a permanent contract in order to compensate for the higher risk of unemployment or even for the uncertainty about the future working life (Booth et al., 2002).

However, even though estimates may significantly vary from one study to another, empirical research finds a wage penalty against fixed-term workers (such as Booth et al. (2002) for Britain; Blanchard and Landier (2002) for France; Hagen (2002), Pteifer (2012) for Germany; Jimeno and Toharia (1993) and De la Rica (2004) for Spain; Mertens et al. (2007) for Spain and Germany).

This empirical evidence may be supported by another strand of the literature. Doeringer and Piore (1971) originally developed the dual labor market theory, which states that the labor market is composed by a primary and a secondary segment. On the one hand, the primary segment is characterized by secure, skilled and stable jobs with good working conditions and opportunities for career progress. On the other hand, the secondary market is characterized by low-skilled, low-paid and unstable jobs with lower training opportunities and promotion prospects. In this model, as there is little mobility between segments, fixed-term employees fall in a cycle of fixed-term contracts and unemployment with low wages and wage growth over time. In fact, De la Rica (2004) suggests that workers on fixed-term contracts are segregated into low-paying firms and low-paying occupations within firms. Mertens et al. (2007) also conclude that in Spain fixed-term workers are concentrated in the secondary segment.

Additionally, firms may also use fixed-term contracts as a flexible buffer to face short-term demand shocks by adjusting the level of employment at a lower cost, leading to job positions with worse working conditions and more subject to unemployment (e.g. Varejão and Portugal, 2009). Bentolila and Saint-Paul (1992) construct a theoretical model that suggests that fixed-term contracts increase responsiveness to aggregate shocks, reducing their persistence. Consistently, Bockmann and Hagen (2001) find that positive changes in predicted or actual sales are positively related with the probability of employing temporary workers, suggesting that fixed-term contracts are used to increase flexibility.

Another relevant argument claims that in the presence of asymmetric information between workers and employers, a job is an “experience good”: the quality of a worker-firm match can only be determined after the creation and “experimentation” over time of that match (Jovanovich, 1979). According to the screening hypothesis, firms can use fixed-term contracts to extend the legally limited probation period, during which the employer screens workers with uncertain skills and abilities at a smaller cost (e.g., Booth et al., 2002; Portugal and Varejão, 2010). Therefore, if the fixed-term worker satisfies the hiring standards of the firm, his contract is converted into a permanent one. Fixed-term workers generally receive lower initial wages but they are compensated by higher future wages as they are converted into permanent contracts meaning, for starters on fixed-term contracts, wages should converge to the permanent level. The use of fixed-term contracts as a screening device is also highly supported empirically (e.g., McGinnity and Mertens, 2002, for West Germany; Boockmann and Hagen, 2001, for Germany; Both et al., 2002, for Britain; Pavlopoulos, 2013,

for UK and Germany).

There are also other determinants that can influence the wage gap. As workers on fixed-term contracts face a higher risk of unemployment and lower career prospects within the firm, they have lower incentives to invest in firm-specific capital, leading to negative and persistent wage gaps since a fixed-term contract signals lower productivity (Hagen, 2002; Pavlopoulos, 2013).

Moreover, according to the insider-outsider theory, workers on permanent contracts can influence working conditions in their favor (Lindbeck and Snower, 2002). In fact, a worker on a permanent contract has more bargaining power than a worker on fixed-term contract, *ceteris paribus*, since the higher firing costs for permanent contracts raise the value of continuing the employment relationship (Blanchard and Landier, 2002). Consequently, workers on permanent contracts are predicted to earn higher wages due to the higher bargaining power. Additionally, one cannot forget the role of unions in the wage-setting process. Theoretically, if fixed-term workers are concentrated in low unionized sectors, one should expect lower wages for the workers with fixed term contracts (Boockmann and Hagen, 2001).

In addition to these theoretical views, some countries (such as Portugal) have a clear legislation requiring equal treatment for permanent and temporary workers and forbidding wage discrimination according to the type of contract. Also, the European Commission has directives aimed at ensuring equal basic working conditions for temporary workers (including equal treatment in terms of payment).⁶

Regarding the Portuguese labor market, Varejão and Portugal (2010) find evidence that fixed-term contracts are used as screening devices. Additionally, using a Difference-in-Differences approach to the 2004 labor market reform, in which the employment protection of open-ended contracts was extended only to firms with 11-20 workers, Centeno and Novo (2012) conclude that fixed-term contracts are used as a source of flexibility, both in terms of wages and employment levels.

3.2 Why Do Fixed-term Workers Accept Fixed-term Contracts?

The compensating wage differential approach provides by itself one reason for workers accepting fixed-term contracts. However, if there are no wage differentials compensating for the worst working conditions, one may question fixed-term workers' rationality.

First of all, some jobs are only available with fixed-term contracts such as those with flexible schedules that allow to meet non-work duties or personal preferences (Hagen, 2002). Additionally, the compensating wage differential approach assumes implicitly that the worker's choice is between fixed-term and permanent contracts, not between a fixed-term contract and unemployment (Mertens et al., 2007). However, firms may only be available to offer permanent contracts to workers of high perceived ability (Booth et al., 2002). Subsequently, some individuals may accept a FTC

⁶For example, the Council Directive 99/70/EC of 28 June 1999 establishes minimum requirements governing the fixed-term contracts in order to ensure an equal treatment of those workers when compared to regular workers.

because otherwise they would be unemployed, especially in economic downturns (Silva, 2014).

Second, as mentioned above, a fixed-term contract can serve as a sorting device when there is asymmetric information between worker and employer. Therefore, the worker may use it to signal his ability and competencies. Consistently, Loh (1994) developed a model in which workers with high ability select themselves into jobs initially on FTC while low ability workers prefer jobs with no probation period. This result is quite obvious since high ability workers face a low probability of being dismissed once their ability has been revealed. In this model, the sorting mechanism is important: again, it is assumed that jobs on fixed-term contracts have lower wages, which are compensated by a future high wage increase (when they are converted into permanent contract).

4 The Dataset *Quadros de Pessoal* (2002-2012)

The database employed in this study is *Quadros de Pessoal* which is a “longitudinal matched employer-employee-job title dataset” (Cardoso et al., 2013). The data are collected in October of every year by the Portuguese Minister of Employment through a mandatory inquiry that covers every establishment operating in Portugal with at least one wage-earner.

Given the enforceability by law of this survey, some of problems usually associated with panel data sets (such as panel attrition or measurement error phenomena) are mitigated. Also, the fact that this information is of public use reinforces our trust in the quality of the information (Vilares, 2013).

This survey contains detailed information on worker’s characteristics (such as gender, age, education, earnings, occupation, tenure, work schedule and type of contract), firm’s characteristics (such as location, economic activity, number of workers, number of temporary and permanent workers, sales and legal status) and each of its affiliated establishments (such as location, economic activity and employment).

An important feature of *Quadros de Pessoal* is that the information regarding labor earnings is very exhaustive. It includes base wages (gross pay for standard working hours), overtime payments, regular benefits (such as seniority) and non-regular benefits (premiums). It also contains information on normal and overtime hours of work. As the information on labor earnings is reported by the employer, it is more likely to be truthful than worked-provided data (Cardoso et al., 2013).

As mentioned above, *Quadros de Pessoal* is, by construction, a longitudinal dataset. Each worker is assigned a unique identification code that is based on their social security number. Similarly, each firm/establishment has a unique identification number. It is also worth noting that *Quadros de Pessoal* gathers information on collective wage agreements. Basically, each worker is assigned annually to a specific professional category and the corresponding collective agreement. The identification of different occupational categories within each agreement allows us to identify the job-title that each worker holds in a given year. This method enables to track them over the years and to match, in

each year, individuals with their firms, the associated collective agreement and the corresponding job-title.

In the estimation of the fixed-term contract wage gap we impose a set of restraints on the raw database. First, because the information on the type of contract is only available since 2002, we had to restrict our analysis to full-time workers between 2002 and 2012. Additionally, we excluded individuals working in all other forms of employment apart from fixed-term or permanent contracts. Second, we focused on individuals of the age group between 16 and 65 years old. Third, workers from the Agriculture, Fishery and Mining sectors are also excluded. Fourth, in addition, we dropped from our study workers whose reported monthly wages were below 80 percent of the mandatory minimum wage as well as those whose tenure was above 50 years. Fifth, individuals who were reported as workers in more than one firm in a given year are also excised. Finally, we limited our dataset to the observations that belong to the largest connected group, dropping around 0,6% of the total number of observations. This is the only way to ensure the comparability between the estimates of fixed effects.⁷

Our final sample comprises 20,634,484 observations (from which about 22% represent individuals working under a fixed-term contract), consisting of 4,364,076 independent workers and 502,135 firms tracked over the 2002-2012 period. It is also possible to identify a total of 91,205 different job titles. Table 3 in Appendix A reports summary statistics for both permanent and fixed-term workers. Permanent workers are significantly older than fixed-term workers. Additionally, the proportion of females is slightly higher in the group of fixed-term workers. As expected, individuals working under a permanent contract have higher tenures than their fixed-term counterparts. Regarding education, it seems that permanent workers have fewer years of education when compared to fixed-term counterparts. Moreover, the type of contract used vary according to the sector. Not surprisingly, the manufacturing sector represents the large share of the total permanent contracts, while the use of fixed-term contracts is more relevant in sectors such as construction and hotels and restaurants. Finally, fixed-term workers earn considerably lower hourly wages than those under permanent ones. The raw wage gap is 0.55 euros *per hour* (which represents about 26% of the average permanent hourly wage).

5 Model to Estimate Fixed-term Workers Wage Gap

5.1 A Brief Review on the Empirical Procedures to Estimate the FTC wage gap

There is a variety of empirical studies with the purpose of estimating the wage gap between fixed-term and permanent contracts. As mentioned above, all those research works find a wage penalty for fixed-term workers, regardless of the country under analysis or the employed method; however, two caveats must be mentioned. Firstly, there has been no consensus on the most appropriate empirical strategy to estimate the fixed-term contracts wage gap. Secondly, as in

⁷For a detailed explanation of the concept of “connected group”, please see Torres et. al (2013)

any empirical study, researchers are restricted by the information available in their dataset. Nevertheless, it is possible to identify two major types of procedures.

On the one hand, there are non selection models which rely on a standard Mincerian equation with a control for the type of contract which can be estimated using either cross-sectional or panel data. In reality, even in studies with other preferred specifications, it is considered as a useful parsimonious benchmark model. Naturally, the estimates of the wage differential between fixed-term and regular contracts are quite sensitive to the set of observable controls included in the regression (e.g. Pteifer, 2012) which may reflect the presence of omitted variable bias in some specifications.

However, the main drawback of the above model is that it may also produce biased estimates, if unobserved characteristics of workers and firms are correlated with the included regressors. In this sense, some researchers find the introduction of fixed effects to be an appealing procedure to control for unobserved time-invariant characteristics. Therefore, when longitudinal dataset is available, they tend to resort to another type of models: fixed-effect (FE) estimators (e.g. Mertens et al. al, 2007). To the best of our knowledge, in the existing literature, FE models only control for one fixed-effect: either the firm or the individual fixed-effect.

On the other hand, another relevant bulk of studies try to overcome the selection problem. If fixed-term contracts are a choice variable, its decision may be correlated with the unobservables that influence wages. Then, not controlling for this selection problem might result in biased estimates. Therefore, some researchers include the usual Heckman correction term in the standard OLS wage regression (e.g. Hagen, 2002). Selection models have been criticized for some of their assumptions that are crucial for the identification: at least one regressor has to be assumed to directly influence the fixed-term contract decision, but not the wages and the consistency of this type of model is based on the joint normal distribution of the error terms, which is an arbitrary and maybe too strong assumption.

In addition, there are also other methods which are less common. Some researchers estimate separately wage equations for workers under fixed-term and permanent contracts (e.g. De la Rica, 2004). Mertens et al. (2007) estimates a quantile regression to see if the wage gap varies across the conditional wage distribution. Its main drawback is that it does not allow the inclusion of fixed-effects. Alternatively, Hagen (2002) uses a matching method which main advantage is not assuming functional forms. However, it only allows to control for observable characteristics.

In a nutshell, the empirical procedure to estimate the wage gap between fixed-term and permanent contracts must be carefully chosen since all methods have advantages and drawbacks. Considering only observable characteristics of firms and workers has also been thought-out as a source of concern due to the omitted variable bias problem. Nevertheless, as mentioned above, a wage penalty for individuals working under fixed-term contracts is always found. However, a proper study of the sources of the FTC wage gap is absent from the literature.

5.2 The Proposed Method to Estimate the FTC Wage Gap and to Find its Sources

5.2.1 Statistical Framework: the Role of Worker, Firm and Job-title Fixed-Effects

In this sub-section, we describe the adopted empirical strategy to estimate the wage gap between fixed-term and permanent contracts and the methodology developed by Gelbach (2014) to compute a detailed decomposition of that wage gap. We use the statistical framework of Cardoso et al. (2013) which allows worker, firm and job-title fixed effects to be estimated simultaneously in wage regressions. Thus, the full model constitutes an extended version of the traditional Mincerian wage equation:

$$w_{ifjt} = \alpha_i + \theta_f + \lambda_j + \gamma_t^{full} + \xi^{full} FTC_{it} + \beta^{full} X_{it} + \varepsilon_{ifjt}^{full} \quad (1)$$

where w_{ifjt} represents the natural logarithm of labor real hourly earnings of individual worker i ($i=1, \dots, N$) working at firm f ($f=1, \dots, F$) and holding the job-tittle j ($j=1, \dots, J$) at year t ($t=1, \dots, T_i$).⁸ Note that there are a total of T_i observations for each individual i and therefore the total number of observations is T^* ($T_i * N$). Our variable of interest is FTC_{it} , a dummy variable which takes the value of 1 if the worker is employed under a fixed-term contract and 0 otherwise. The X_{it} is a set of standard individual controls including age, age square, tenure, tenure square and education dummies⁹. The observed and unobserved time-invariant characteristics are captured through the inclusion of worker fixed effect (α_i). By the same reasoning, θ_f is the firm fixed effect which controls for observed and unobserved firm time-invariant characteristics while λ_j is the job-title fixed effect which captures observed and unobserved job-title time-invariant characteristics. Additionally, γ_t represents a set of annual dummies that allows to control for time-specific trends, capturing macroeconomic effects. Finally, it includes an unexplained error term (ε_{ifjt}) which is assumed to follow the conventional assumptions. In the present estimation, we resort to a procedure developed by Guimarães and Portugal (2010) to compute the exact OLS solution for the linear regression with three high-dimensional fixed effects.

Two main advantages can be pointed out of this specification relatively to the standard Mincerian equation. First of all, by including the three fixed effects, we are controlling for time-invariant characteristics of individuals, firms and job-titles, including unobservables. If these unobserved specificities are correlated with the set of controls, the non-inclusion of the three fixed-effects in the regression would result in biased estimates. As stated above, the FE models used in the existing literature of FTC wage gap only control for one fixed-effect: either the firm or the individual

⁸Because the information on earnings is very complete, we are to construct a measure of labor hourly earnings to be used as dependent variable in our estimation equations. Hourly earnings are simply obtained from the ratio of total payroll (the sum of base wages, overtime payments, regular and non-regular payments) over total hours of work (standard plus overtime hours). All compensation variables are deflated using the Consumer Price Index (with base-year 1986).

⁹ Information on age is available in years whereas tenure is measured in months.

fixed-effect. Therefore, we are improving those models, by simultaneously taking into account both workers and firms fixed effects and introducing the job-title fixed effect. Secondly, by controlling for the permanent unobservable heterogeneity of firms and individuals, we are attenuating the problem of the selection bias.¹⁰

However, it also has some handicaps which are in line with the existing literature. First, the model assumes a linear relationship between wages and its set of explanatory variables. Since it is a parametric approach, we are losing some flexibility. Secondly, as it is based on the estimation of fixed-effects, the model requires a detailed microeconomics dataset. In addition, panel datas are also usually associated with problems of measurement which may lead to measurement bias. Therefore, we need a detailed and reliable longitudinal data set which is not commonly available for researchers. Fortunately, in the present treatment, this is not a matter of concern due to the unusual richness of our database.

The estimation of equation (1) can be interpreted as the conditional expectation of hourly labor earnings given the observable characteristics of firms and workers, the year of observation and the identity of individuals, firms and corresponding job titles. In particular, we are able to identify the FTC wage gap that is not explained by observed and time-invariant unobserved characteristics of firms, workers and job-title. However, we can get a better understanding of the FTC wage gap by computing the independent contribution of each fixed effect to the wage gap between fixed-term and permanent contracts. For this purpose, we rely on the decomposition proposed by Gelbach (2014).

The first step of the Gelbach's decomposition requires the estimation of the full model which is represented by equation (1).¹¹ Afterwards, a base model with no fixed effects needs to be estimated:

$$w_{ifjt} = \gamma_t^{base} + \xi^{base} FTC_{it} + \beta^{base} X_{it} + \varepsilon_{ifjt}^{base} \quad (2)$$

Note that this specification corresponds to the standard Mincerian equation. From now on, we will refer to the estimated FTC wage gap in this equation as the conditional wage gap, since we are only controlling for observable characteristics of individuals.¹² It is worth nothing that, by excluding the worker, firm and job-title fixed effects, this specification suffers from omitted variable bias. In reality, the difference between the coefficients of the base specification and the full specification can be represented by the sample version of the omitted variable bias formula. Centering our interest on the coefficient for fixed-term contracts variable, the simple procedure proposed by Gelbach (2014) allows us to compute an unambiguous quantification of the contribution of each fixed-effect to the change in the estimated coefficient for the FTC variable, that is, to the difference $\xi^{base} - \xi^{full}$.

Then, the decomposition proceeds with the estimation of the regressions of the estimates of the fixed effects

¹⁰If the fixed-term contract decision is correlated with unobservable time-varying characteristics, the problem of selection bias will persist. However, when compared to the Heckman correction, this methodology has the advantage of not assuming an *ad-hoc* excluded restriction and the joint normal distribution of both error terms. We also tried to construct possible instruments - some of them are proposed in the existing literature (such as the lag rate of fixed-term contracts by economic sector) - but we were not successful due to the weakness of those instruments.

¹¹See the Appendix B for a detailed explanation of the Gelbach's decomposition.

¹²In addition to the set of controls used in equation (1), the matrix X_{it} also includes gender.

$(\hat{\alpha}_i, \hat{\theta}_i, \hat{\lambda}_i)$ on the explanatory variables included in the base model:

$$\hat{\alpha}_i = \eta^\alpha FTC_{it} + \beta^\alpha X_{ift} + \varepsilon_{ifjt}^\alpha \quad (3a)$$

$$\hat{\theta}_i = \eta^\theta FTC_{it} + \beta^\theta X_{ift} + v_{ifjt}^\theta \quad (3b)$$

$$\hat{\lambda}_i = \eta^\lambda FTC_{it} + \beta^\lambda X_{ift} + v_{ifjt}^\lambda \quad (3c)$$

Finally, the methodology leads to the following identity:

$$\xi^{base} - \xi^{full} = \hat{\eta}^\alpha + \hat{\eta}^\theta + \hat{\eta}^\lambda \quad (4)$$

With the above result, we are able to disentangle the contribution of each excluded variable (each fixed effect) to the wage gap between fixed-term and permanent contracts. For example, if the coefficient $\hat{\eta}^\theta$ is negative, it can be interpreted as the log point reduction in the wage gap between fixed-term and permanent contracts that would occur if workers under fixed-term and permanent contracts were equally distributed across firms, conditional on gender, wage, tenure and education (Cardoso et al., 2013). This result would suggest that workers under fixed-term contracts tend to work for firms that pay, on average, lower wages. A similar interpretation can be given to the other two fixed-effects. Therefore, as stated by Raposo et al. (2014), “the decomposition proposed by Gelbach is a computationally simple and econometrically meaningful procedure”.

5.2.2 Empirical Results Based on the Three High Dimensional Fixed-effects Model

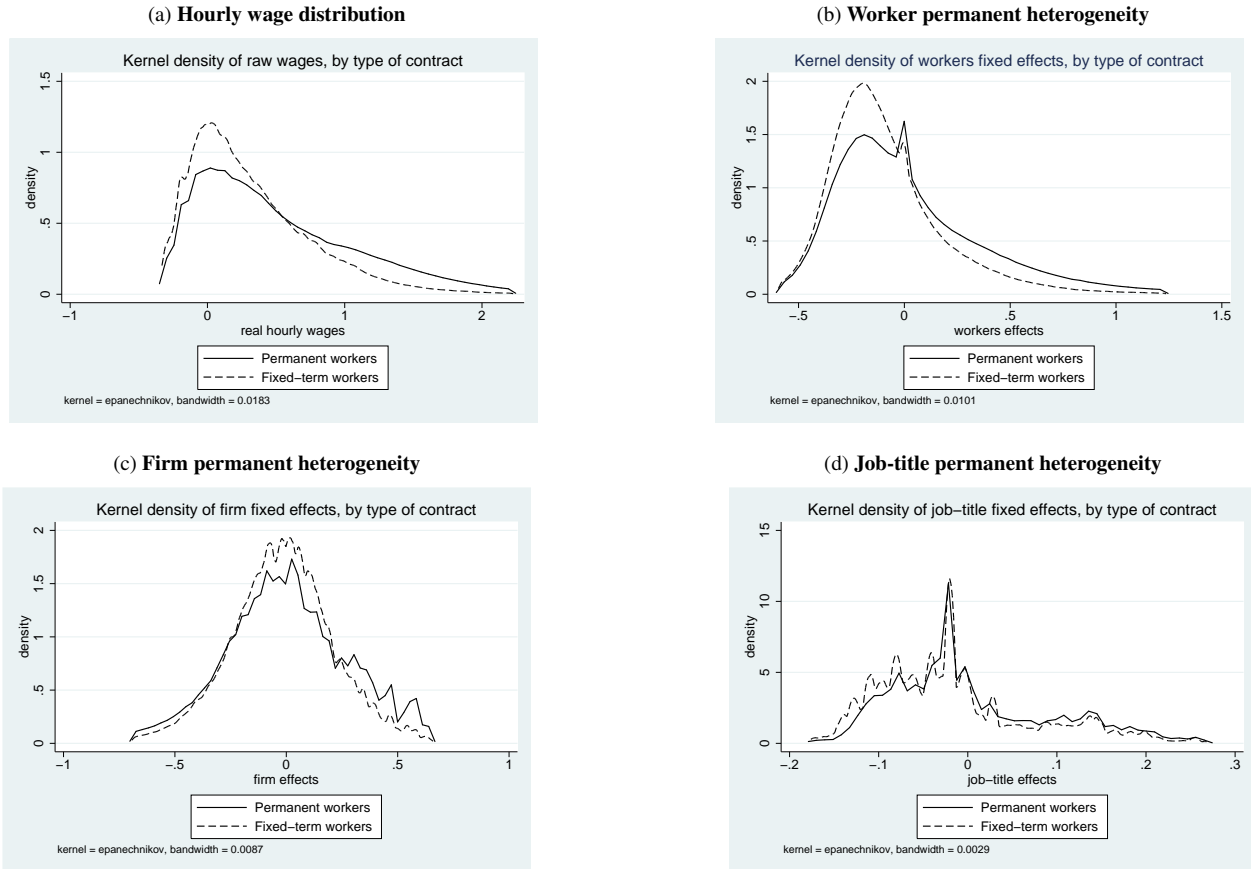
In Portugal, during the 2002-2012 period, individuals working under fixed-term contracts received, on average, hourly wages that were 20.57 log points below those working under permanent contracts. By looking at the empirical wage distributions of raw wage of both fixed-term and permanent workers, which are depicted in Figure 2 (a), we can plainly conclude that wages of fixed-term workers are lower and less dispersed than those of permanent workers.

However, controlling for the observable characteristics (age, tenure, education, gender and time specific effects), the wage penalty is reduced to 1.72 log points. This reduction reflects the fact that workers under fixed-term contracts are, on average, less experienced and have shorter tenure within the firms. When the worker, firm and job-title fixed effects are incorporated in the model, the remaining unexplained wage gap between fixed-term and permanent contracts falls to -1.44 log points. Consequently, the small reduction of about 0.28 log points in the conditional FTC wage gap is due to the inclusion of the three fixed effects.

These results are not surprising since they are consistent with the existing literature. As previously mentioned, all studies found that fixed-term workers earn, on average, less than permanent workers. They also conclude that the

conditional wage gap is always smaller than the raw one. However, the estimates from the three high dimensional specification cannot be compared with previous results since it was never applied for the FTC wage gap. Moreover, we need to be careful when comparing the magnitude of previous estimates for the FTC wage gap since there is no similar study for Portugal.

Figure 2: The empirical distributions of wages and worker, firm and job-titles fixed effects



We can get a better understanding of the shape of the conditional wage distribution by analyzing the distributions of worker, firm and job-title fixed effects. Figure 2 (b) shows the distribution of individual fixed effects for both permanent and fixed-term workers. As stated above, the individual fixed effects are time-invariant, worker-specific component of workers, which can be either observable (such as gender) or unobservable. A worker with a high fixed effect is an individual who receives a hourly wage higher than expected, based on observable time-varying characteristics (such as age) and given the time-invariant characteristics of the corresponding firm and the job-title. Individual worker heterogeneity plays an important role in the wage setting process. The linear correlation between the natural logarithm of real hourly wages and worker fixed effects is 0.80. The shape of worker fixed effects distributions also shows that worker fixed effects of fixed-term workers are, on average, lower and more concentrated compared with those of permanent workers. To sum up, individuals working under fixed-term contracts have, on average, permanent

characteristics which are related to lower wages.

The empirical distribution of firm fixed-effects is presented in Figure 2 (b). By the same reasoning, a firm with a high fixed effect value is a firm with a generous compensation policy (higher than the expected one), given the time-varying characteristics, the heterogeneity of workers and job titles. Again, firm heterogeneity is an important determinant of the wages. In fact, the linear correlation between the natural logarithm of real hourly wages and worker fixed effects is 0.64. According to Figure 2 (c), the empirical distribution of firm fixed effects of fixed-term workers is similar to that of permanent workers, but more concentrated. It is difficult to reach a clear conclusion just by analyzing those empirical distributions since at both (lower and upper) tails permanent workers are more concentrated than fixed-term workers. Therefore, a more careful analysis must be performed.

Finally, Figure 2 (d) depicts the empirical distribution of job-title fixed effects, making the difference between fixed-term and permanent workers. We should note that job-title is defined as the combination between the worker's hierarchical position within the firm and the collective agreement covering the respective firm. As mentioned by Torres et al. (2013), a disaggregated occupational count list would not be sufficient for the identification of job-title, since the same occupation (e.g. top executive) may be governed by different collective agreements, depending on the firm (e.g. the retail trade agreement may define different conditions than the banking industry agreement). So, the job-title notion is just a refinement of the usual notion of occupation. Similarly, a high job effect title means a higher hourly wage than expected given the observable time-varying characteristics, the permanent heterogeneity of workers and firms. By looking at the empirical distribution of job-title fixed effects, it is clear that fixed-term workers filled occupations in which they were, on average, paid below those on permanent contracts.

5.2.3 The Decomposition of FTC Wage Gap

At first sight, it may appear that including the three fixed effects in the base model is not so relevant as we would expect since the wage gap only changes by 0.28 log points. However, this is not the full picture of the story. In order to estimate the independent contribution of each fixed effect on the estimated wage gap, we use the Gelbach's decomposition.

The results of this exercise are reported in Table 1. The decomposition indicates that the worker, firm and job-title fixed effects account, respectively, for -3.92, 4.23 and -0.59 log points of that reduction. This means that the remaining 1.44 log points of the FTC wage penalty are still unexplained even controlling for the observable time-varying characteristics of firms and workers, the date of observation and the permanent characteristics of workers, firms and job-titles.

Table 1: **The FTC Wage Gap and the Gelbach's Decomposition of the Wage Gap**

	Coefficient of Decomposition
Base model - FTC Wage Gap	-1.72
Full model - FTC Wage Gap	-1.44
Base-Full difference	-0.28
Contribution of Worker Fixed Effect	-3.92
Contribution of Firm Fixed Effect	4.23
Contribution of Job Title Fixed Effect	-0.59

Note: All coefficients are indicated in log-points scale and are statistically significant at 1%.

As mentioned earlier, the inclusion of worker fixed effect allows us to control for all the observed and unobserved time-invariant characteristics of an individual which influences his/her total compensation. However, the main reason behind the use of worker fixed effect is to control for unobserved permanent characteristics of the individuals. One simple and economically meaningful interpretation for the unobserved permanent characteristics is that they capture the ability of the worker. Although being unobserved by the researcher, the ability of an individual is directly related with his/her productivity which is in turn detected by the employer. Therefore, the total worker's compensation reflects the feedback of the employer regarding his/her productivity. How can differences in the ability among individuals explain the conditional wage gap? The decomposition suggests that, on average, individuals working under FTC possess permanent characteristics that are associated with a wage penalty when compared to permanent workers. Relating this empirical evidence to the worker's ability explanation, we may conclude that, on average, the abilities of workers on FTC are lower than those working on permanent contracts. Again, this is not an unexpected result. Previous studies found that the estimated FTC wage gap is reduced by including individual-fixed effects in the standard OLS wage equation (e.g. Mertens et al, 2007; Booth et al., 2002).

The above result is also consistent with the screening hypothesis for the use of FTC. As Portugal has a strict EPL, firms might keep new hires, workers with uncertain abilities, or even lower quality workers in fixed term contracts as an extended probation period. Consequently, fixed-term contracts will have an overrepresentation of low ability workers.

The allocation of workers on fixed-term and permanent contracts into different firms plays an important role in the wage variation. Why should workers of apparently equal ability be paid differently on similar jobs, but in different firms? Prior evidence suggested that some firms have non-trivial power in the labor market. As there are different types of market power across firms, they tend to be different in terms of compensation policies (e.g. Webber, 2013). The persistent wage differentials across firms can be explained by some market frictions, such as imperfect information or mobility costs. Even in Portugal, where there is a considerable centralized system of wage bargaining, specific characteristics of firms often lead them to deviate from the agreed mandatory wage floors for each professional category of workers (Cardoso and Portugal, 2005).

The observed and unobserved permanent characteristics of firms which influence the compensation payments are accounted for by including firm fixed-effects (Abowd et al., 1999; Goux and Maurin, 2001). As suggested by Vilares

(2013), the firm fixed-effect can be interpreted as the observed and unobserved human resources and wage policies across firms which influence the worker compensation. Unexpectedly, by using the Gelbach's decomposition, we find that workers on fixed-term contract tend to sort themselves into firms with more generous remuneration policies. A small segment of the literature found that the inclusion of firms fixed-effects (but not worker fixed-effects) in the wage equation contributes to reduce the estimated FTC wage gap relatively to the usual conditional wage gap (e.g., Pteifer, 2012). This suggests that fixed-term workers tend to be sorted into low-paying firms. However, our evidence supports a totally different hypothesis, at least for Portugal.

As a direct consequence of this result, we find evidence against the dual labor market theory which argues that workers on fixed-term contracts are sorted into low-paying firms. What can support this result? Why are fixed-term workers, on average, rewarded by their allocation across firms? From an employer view, it may suggest that high paying firms prefer to establish fixed-term contracts more frequently than low paying ones. In an economic downturn, if it is difficult to fire workers, firms that practice more generous wage policies face higher costs than other firms. Therefore, when there is a strict EPL governing permanent contracts, such as the Portuguese case, we should expect that high paying firms to use more fixed-term workers than low paying firms. In other words, high paying firms are more likely to use FTC as buffer stock than the low-paying firms. Consistently, fixed-term workers would be, on average, more allocated into high paying firms.

Finally, the differences across occupations and the variations across collective agreements with influence on the total compensation are taken into account with the inclusion of job-title fixed effect. The results of the Gelbach's decomposition suggest that workers on FTC suffer a small wage penalty due to the mechanism of sorting among job-titles.

A question which may arise is: why are FTC workers segregated into low-paying job-titles? Contrary to the firm fixed effects, the result is not surprising. In reality, a number of reasons may be behind this outcome. Particularly, two main mechanisms should be underlined. First, it is highly plausible that job promotions are biased in favor of permanent workers. One possibility is that, all other things being equal, employers may prefer to promote workers under permanent contracts rather than fixed-term workers. Obviously, fixed-term jobs have, on average, a lower job duration (e.g. Booth et al., 2002). Therefore, employers may prefer to promote permanent workers since they tend to result into more stable relationships, which may be a positive feature for high hierarchical positions. Additionally, there is evidence that fixed-term contracts are used to facilitate short-term labor adjustment. Employers may prefer to have these flexible stock at lower hierarchical positions. Besides this, as the fixed-term contracts have a maximum duration period, those workers have a limited period to achieve promotions. Probably, before promoting those workers, the firms will convert them into permanent workers and therefore the high hierarchical positions will be held by regular workers. This is also consistent with the screening hypothesis. In reality, the lack of opportunities for career development associated with temporary contracts is well documented in several studies (e.g. Farber, 1999; Booth et al., 2002). A

second credible theoretical explanation for these results is the role of unions. Sometimes workers are allocated into jobs that, by their nature, give them a higher bargaining power (e.g., if they can impose significant losses upon their employers). If unions are able to organize such workers, they will be in a strong bargaining position, resulting in higher wages. Our empirical result may suggest that FTC are not allocated into jobs with these characteristics. Furthermore, the insider-outsider theory states that permanent workers are usually able to create entry barriers to certain occupations for outsiders (that is, temporary workers). The possible set of reasons do not stop here. For example, if FTC are more concentrated into jobs with safe tasks, that are performed under pleasant conditions or that are overcrowded, we should expect a negative wage penalty associated with those jobs (Torres et al., 2013). However, there is a lack of theoretical arguments for supporting those alternative explanations.

In a nutshell, although the reduction on the FTC wage gap due to the inclusion of the three fixed-effects may appear too small, the Gelbach’s decomposition allows us to go deeper, achieving a quite interesting conclusion. The results suggest that both worker and firm fixed-effects are two important factors driving the wage penalty for fixed-term workers. Their contributions to the reduction on the FTC wage gap have almost the same magnitude but they go on opposite directions. On one hand, fixed-term workers have characteristics which are associated with a wage penalty when comparing to permanent workers. On the other hand, workers under fixed-term contracts are, on average, more allocated into firms with generous compensation policies. The role of job-title appears to be less important than those two factors.

5.3 The Role of Worker-firm Match Quality

5.3.1 Statistical Framework: including the Role of Worker-firm Match Quality

In this sub-section, we analyze the relevance of the worker-firm match quality to explain the wage gap between fixed-term and permanent contracts. Woodcock (2007) shows that the estimates obtained with equation (1) may be subject to a substantial bias if the worker-firm match characteristics constitute an important determinant of wage variability. Thus, in this section, we consider an alternative empirical framework by including a worker-firm match specific fixed-effect (ψ_{if}) that accounts for worker-firm match heterogeneity. The economic interpretation of the variable is quite simple: it measures the returns to unobserved time-invariant characteristics of the matches between a worker and a firm. Thus, by accounting for the match effect, the model becomes:

$$w_{ifjt} = \alpha_i + \theta_f + \psi_{if} + \lambda_j + \gamma_t + \xi FTC_{it} + X_{ifjt}\beta + \varepsilon_{ifjt} \quad (5a)$$

However, this specification is overparameterized, meaning that we are unable to disentangle the three effects (worker, firm and worker-firm match fixed effects). As discussed by Figueiredo et al (2014), “in this model a good match may be indistinguishable from a good worker working in a good firm”. In other words, worker-firm specific

fixed effect (ψ_{if}) captures the effect of both individual (α_i) and firm (θ_f) fixed effects. Therefore, a specification with a single worker-firm interaction term (ω_{if}) absorbs the three mentioned fixed-effects and leads to the identical estimates for the parameters λ_j , γ_t , ξ and β as equation (5a). The matching model can be represented as follows:

$$w_{ifjt} = \omega_{if} + \lambda_j + \gamma_t + \xi FTC_{it} + X_{ifjt}\beta + \varepsilon_{ifjt} \quad (5b)$$

It is worth noting that, the fact that we cannot estimate ψ_{if} does not constitute a reason for concern if we are not interested in the match effect, *per se*, but in its relation with the parameter of interest (ξ), after controlling for the other explanatory variables. This detail is notably discussed by Figueiredo et al. (2014) who show that the coefficients in a regression of the estimated ψ_{if} in all the other explanatory variables included in the specification (5a) can be simply obtained from the subtraction between the estimated coefficients in (5b) and those estimated in (1). More precisely, the effect of ψ_{if} on the FTC wage gap can be directly obtained from the comparison between the coefficient ξ estimated in equation (5b) from that in (1).

As in the previous specification, we are able to apply the Gelbach's estimation to compute the exact contribution of each fixed effect to the conditional wage gap. However, we must be aware that we can only disentangle the contribution to the FTC wage gap of the job-title fixed effect from the jointly contribution of the worker, firm and worker-firm match permanent characteristics. In other words, as the worker-firm interaction term (ω_{if}) absorbs those three effects, we lose track to their independent contributions.

5.3.2 Empirical Results

The estimation of the matching model reduces the FTC wage penalty to -0.79 log points. As in the previous sub-section, an interesting exercise is to perform Gelbach's decomposition. Note that the base model remains exactly the same as before, that is, it is represented by the standard Mincerian equation controlling for gender, age, tenure and education levels.

The results of the composition proposed by Gelbach are now described in the Table 2. The four fixed effects (worker, firm, job-title and worker-firm match fixed effects) are responsible for a non-negligible part of the conditional FTC wage gap. In reality, they account for -0.93 log points of the difference between the wage of FTC and PC, where a penalty of -0.52 log points is due to the jointly effect of the worker, firm and worker-firm match qualities while the other -0.41 log points are accounted for by the job-title fixed effect.

Comparing with the results presented in Table 1, we can see that the contribution of the job-title heterogeneity to the wage gap remains roughly the same. Unfortunately, we are not able to distinguish the contribution of worker, firm and worker-firm match fixed effect. Additionally, their joint contribution is small (such as the one of job-title fixed effect). However, this is not surprising. By analyzing the results of Table 1, we concluded that the contribution of

Table 2: The FTC Wage Gap and the Gelbach’s Decomposition of the Wage Gap - Matching model

	Coefficient of Decomposition
Base model - FTC Wage Gap	-1.72
Matching model - FTC Wage Gap	-0.79
Base-Full difference	-0.93
Joint Contribution of Worker, Firm and Worker-Firm Match Fixed Effects	-0.52
Contribution of Job Title Fixed Effect	-0.41

Note: All coefficients are indicated in log-points scale and are statistically significant at 1%.

firm and worker fixed effects have almost the same magnitude, but different signals. Therefore, as the iteration term captures both effects, they are possibly canceling out each other. Nevertheless, the joint contribution also depends on the worker-firm match heterogeneity.

In order to assess the role of match quality, we follow the procedure proposed by Figueiredo et. al (2014). By subtracting the estimated coefficient of interest in equation (5b) from that in equation (1), we can conclude that the worker-firm match fixed effect is responsible for 0.65 log points of the wage penalty.

We found that permanent workers receive a wage premium due to the fact they are usually allocated into jobs where the worker-firm match quality is higher. Why are fixed-term contracts segmented into low quality worker-firm pairs? Once again, the result is not surprising, but it has a meaningful economic interpretation. The quality of worker-firm match is not observable until the creation and “experimentation” over time of that match. In other words, a fixed-term contract may be used to screen either the quality of the match or the quality of the worker. Employers may use fixed-term contract to screen at a lower cost the quality of the match (and of the worker): if they satisfy some standard requirements, they will be converted into permanent contracts (Silva, 2014). Thus, we should expect that permanent worker-firm pairs result, on average, in a higher quality match.

6 Conclusion

The Portuguese labor market is characterized by a large employment protection gap between permanent and fixed-term workers. As a consequence, fixed-term contracts have become an important segment of dependent employment, representing about 19.8% of total employment in 2012.

Since there is no theoretical consensus about the wage effects of using fixed-term contracts, it becomes essentially an empirical question. In this paper, besides estimating the wage gap between fixed-term and permanent workers, we looked at the sources of that wage gap. Firstly, estimating a wage regression with three high dimensional fixed effects, we obtained the worker, firm and job-title fixed effects. Then, resorting to the Gelbach’s decomposition, we compute the unambiguous and independent contribution of each fixed effect for the wage gap between fixed-term contracts. Our results show evidence that there is a small wage penalty of about 1.72 log points for fixed-term workers.

We found that worker heterogeneity is an important source of the wage penalty, accounting for -3.92 log points of the wage gap. In fact, the decomposition showed that, on average, fixed-term workers possess characteristics that are related with lower wages when compared with permanent workers. This result is broadly in line with the screening hypothesis for the use of fixed-term contracts. If fixed-term contracts are used to screen unobserved abilities of workers, fixed-term contracts will have a higher proportion of low ability individuals when compared to permanent workers.

The decomposition also indicates that allocation of fixed-term workers into lower paid job titles is responsible for a modest of the FTC wage penalty (-0.59 log points). Since the job-title is defined as the combination between the worker's occupation and the collective agreement covering the firm, this evidence may be due to two possible reasons: relatively higher hierarchical positions tend to be occupied more frequently by permanent workers; or workers with fixed-term contracts are more concentrated in sectors in which unions have a lower bargaining power.

Contrarily, sorting into firms attenuates the existence of the FTC wage penalty, with the conditional contribution of 4.23 log points in favor of fixed term workers. Compensation policies differ across firms due to the application of efficiency wages or the exercise of monopoly power. We found that individuals working under a fixed-term contract tend to be allocated into firms with more generous wage policies. This contradicts the dual labor market theory, which argues that fixed-term workers are allocated into low-paying firms. Alternatively, it suggest that firms with more suitable wage offers may use fixed-term workers more as a buffer stock than permanent counterparts.

Furthermore, relying on the methodology proposed by Figueiredo et al. (2014), we obtained that worker-firm match characteristics are also responsible for just -0.65 log points of the FTC wage gap. Again, since fixed-term contracts are used as a screening device to search for good matches (besides high ability workers), they have an overrepresentation of low quality worker-firm matches.

Regarding the self-selection problem, further research is needed. Introducing the four fixed-effects is an unprecedented methodology that helps mitigating the problem but it may not be enough if unobserved, time-variant characteristics of worker, firm, job-title and worker-firm match are correlated with the error term.

Finally, some academic experts have been arguing in favor of introducing of a single labor contract by highlighting the negative effects of the coexistence of permanent and temporary contracts. Among those policy initiatives are, for example, those of Blanchard and Tirole (2003) for France and a manifesto subscribed by 100 economists for Spain (Andrés et al., 2008). Despite not refusing the negative effects of fixed-term contracts on other dimensions (such as higher job turnover or lower productivity), our results suggest that the single labor contract should not be advocated on the basis of wage discrimination since we only find a small wage penalty for fixed-term workers.

7 Appendix

Appendix A - Descriptive statistics for the 2002-2012 period

Table 3: Summary statistics for the 2002-2012 period

	Fixed-term workers	Permanent Workers
Hourly wage (1986 euros)	1.57	2.12
Minimum hourly wage (1986 euros)	0.55	0.56
Maximum hourly wage (1986 euros)	1803.11	1886.65
Age (in years)	33.00	38.61
Tenure (number of months in current firm)	24.45	116.50
Female (%)	45.08	43.46
Education (%)		
Less than basic school	1.39	1.10
1st stage of basic school	15.80	21.50
2nd stage of basic school	18.82	20.23
3rd stage of basic school	27.22	21.67
Secondary education	23.50	21.55
Post-secondary but not higher education	0.32	0.21
Higher education - Bachelor	1.93	2.46
Higher education - Undergraduate	10.41	10.75
Higher education - Masters	0.52	0.46
Higher education - PhD	0.10	0.08
Industry (%)		
Manufacturing	19.71	28.40
Construction	14.52	9.80
Wholesale and retail trade	19.82	21.72
Hotels and restaurants	10.77	6.35
Transports	5.63	6.74
Finance and business services	13.15	14.10
Education, health and public administration	11.73	9.26
Other activities of collective, social and personal services	4.67	3.62
No. observations	4,569,043	16,065,441

Note: This reports summary statistics (mean) for the 2002-2012 period. The units are explained in front of the variables. Compensation variables expressed in euros are deflated using the Consumer Price Index (with the reference year of 1986). Education, female and industry are shown as percentage.

Appendix B - Gelbach's Conditional Decomposition (2014)

As a first step, the reference model for the decomposition has to be estimated. Note that, during our study, we resort to this methodology twice. Therefore, we need to define two full specifications: the three high dimensional fixed effects model and the matching model. However, for simplicity, we will describe this decomposition considering our first full model: worker, firm and job-title FE model.

Then, the extended Mincerian wage equation, accounting for the worker, firm and job-title fixed effects, has to be

estimated:

$$w_{ifjt} = \alpha_i + \theta_f + \lambda_j + X_{it}\beta^{full} + \varepsilon_{ifjt}^{full} \quad (6)$$

This specification is the same considered in equation (1), but the variable of interest (FTC dummy) is now included in the matrix X_{ifjt} . Secondly, we considered as a base model the one that excludes the three fixed effects and therefore the model becomes:

$$w_{ifjt} = X_{it}\beta^{base} + \varepsilon_{ifjt}^{base} \quad (7)$$

As usual, the OLS estimator for the full vector of coefficients is given by:

$$\hat{\beta}^{base} = (X_{it}'X_{it})^{-1}X_{it}'w_{ifjt} \quad (8)$$

Defining $P_X = (X_{it}'X_{it})^{-1}X_{it}'$ and replacing w_{ifjt} by the full specification, we have:

$$\hat{\beta}^{base} = P_X(\alpha_i + \theta_f + \lambda_j + X_{it}\beta^{full} + \varepsilon_{ifjt}^{full}) \quad (9)$$

$$\hat{\beta}^{base} - \hat{\beta}^{full} = P_X\hat{\alpha}_i + P_X\hat{\theta}_f + P_X\hat{\lambda}_j \quad (10)$$

Note that the terms on the right side of equation (10) are the coefficients of the estimates of fixed-effects on the regressors included in the base model. Then, we have to run the regressions of the estimated fixed effects on each explanatory variable:

$$\hat{\alpha}_i = X_{it}\delta_\alpha + v_\alpha \quad (11a)$$

$$\hat{\theta}_f = X_{it}\delta_\theta + v_\theta \quad (11b)$$

$$\hat{\lambda}_j = X_{it}\delta_\lambda + v_\lambda \quad (11c)$$

Where v_α , v_θ and v_λ are the corresponding error terms. Thus, centering our interest on the coefficient for the FTC dummy variable, we have the identity:

$$\hat{\xi}^{base} - \hat{\xi}^{full} = \hat{\delta}_{FTC}\alpha + \hat{\delta}_{FTC}\theta + \hat{\delta}_{FTC}\lambda \quad (12)$$

In the above equation $\hat{\xi}^{full}$ and $\hat{\xi}^{base}$ represent the estimates for the coefficients associated with the FTC dummy in equations (6) and (7), respectively. Additionally, $\hat{\delta}_{FTC\alpha}$, $\hat{\delta}_{FTC\theta}$ and $\hat{\delta}_{FTC\lambda}$ are the coefficients estimates associated with the FTC dummy variable on equations (11a)-(11c). This is our final result allowing to decompose the change in the coefficient estimates associated with FTC variable by worker, firm and job-title fixed effect.

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