Temporary Contracts and Monopsony Power in the UK Labour Market*

Domenico Tabasso†

April 17, 2008

Abstract

The aim of this paper consists in studying the relationship between the presence of monopsony power and the use of temporary contracts in the UK labour market. Both the existing literature and the simple descriptive analysis conducted in this paper on a LFS-based dataset suggest the existence of patterns that cannot be easily reconciled with the hypothesis of perfect competition in the labour market and with the assumption of compensating differentials as implied by Rosen (1987). In particular, temporary workers seem to face worse job conditions in terms of wage and travel-to-work distance as compared to their permanent counterparts. A simple theoretical model, in which commuting time is used as a proxy for monopsony power, is developed in order to fully capture the extent of the previously mentioned relationship. The empirical analysis tends to confirm several of the hypotheses suggested by the model and emphasizes how the results for the workers who have experienced a change in their job status appear to be in line with the main theories on compensating differentials. In particular, a shift from a temporary to a permanent contract leads to a reduction in the wage and a simultaneous increase in travel-to-work distance, while the wage dynamic related to the workers shifting from a temporary contract to another temporary one is less clear.

JEL Classification: J22, J24, J41, J42, L13.
Key Words: Temporary Contracts, Monopsony Power, Commuting Time.

*I am strongly indebted to my supervisor, Marco Francesconi, for his unvaluable support and help. I would like to thank Michéle Belot, Tim Hatton and Gerhard Riener for helpful conversations on the topic. I also thank the seminar partecipants at Essex University for their comments and suggestions. All mistakes are of course my full responsibility.

†University of Essex - Department of Economics, Colchester, CO4 3SQ, UK. dtabas@essex.ac.uk

Contents

Introduction

The aim of this paper consists in empirically estimating the extent of the presence of monopsony power in the UK labour market. Particular emphasis is posed on the analysis of the relationship between monopsony power and the use of temporary contracts. The motivation behind this kind of study relies on the simple observation that, *coeteris paribus*, temporary workers still seem to face drastically different working conditions comparing to those characterising their permanent colleagues, in terms of salary, working hours, benefits, etc[1]. This fact casts some shadows on the hypothesis that the labour market is perfectly competitive, leaving therefore some room for an analysis of the bargaining power of employers and employees. Furthermore, with respect to this particular segment of the market, the theory of equalizing differences (Rosen (1987)) appears to be questionable.

Of course, the fact that the labour market can not be seen as a perfectly competitive one does not represent an original twist in economic studies[2], and several approaches has been proposed in order to consistently study this kind of framework[3]. My study relies on some of the most recent contributions to the relevant literature. In particular, I try to study the size and the scope of monopsony power through the investigation of the commuting time which relates to different kinds of workers. Although not completely new[4], this approach has not been fully exploited, and, at least to my knowledge, has not been used yet in studying the differences between the temporary and permanent segments of the labour market. My aim is to implement this kind of analysis mainly following some already existent models, but correcting them by differentiating between permanent and temporary contracts. I hence develop my own, simple theoretical model which I then empirically test making use of an *ad hoc* built dataset based on several waves of the Quarterly Labour Force Survey.

The remaining of this paper is organised as follows. In the next section I discuss the institutional framework in which I will include my study and some of the existing literature in the relevant fields,

[1] Obviously such a statement will be tested and proved later in the paper. For a first reference with respect to what stated so far, VV.AA. (2002), pp. 5-6.

[2] The term 'monopsony' with respect to labour market was first used in 1969 by Joan Robinson, see Boal and Ransom (1997), p.86.

[3] One of the most comprehensive studies in this field is certainly Manning (2003). For a shorter review of literature see also Boal and Ransom (1997) and Bhaskar, A.Manning, and To (2002).

[4] For an analisys of the impact of commuting time on monopsony power see Bhaskar, A.Manning, and To (2002), pp.159-164, and Manning (2004).

including the analysis of those models which my study is mostly based on. In section 2 I try to sketch what my theoretical contribution will be. Section 3 will describe the data which I will make use of in this first part of my research while the empirical results I have achieved are presented in section 4. Section 5 concludes.

1 Institutional Framework and Literature Review

From the introductory part is clear that I try to merge in a unique paper the contributions arising from three different strands of the economic literature. I am referring to studies related to temporary contracts, monopsony power and commuting time. As stated before, such an attempt appears to be relatively innovative with respect to the previously established literature [5]. Hence, in order to fully depict the framework within which I will try to operate, a brief introduction to each of these strands is needed.

The first segment of literature I would like to focus my attention on studies temporary contracts and atypical jobs in general. It is a generally accepted statement that temporary employment in the United Kingdom is characterized by a certain degree of stability in terms of the proportion of fixed-term workers on the total number of employees. Table 1, which shows the percentage of temporary employees, with reference to male workers aged 16 to 65 years, confirms this claim. Comparing UK percentages with those of other European countries and the European average in the last ten years, it is evident that the dynamics of the percentage of temporary workers in the UK is relatively small.

The characteristics of these employees have been effectively studied by Booth, Francesconi, and Frank (2000a) and Booth, Francesconi, and Frank (2000b). Using data from the British Household Panel Survey, the authors study from both a descriptive and an empirical point of view the structure of temporary workers' careers. Their findings depict temporary workers as young, poorly experienced, low trained employees. Interestingly, temporary workers are generally less satisfied than permanents about their job. Furthermore, the bulk of the research reveals that holding a temporary contract can constitute a stepping stone to permanent work, but male workers who start work in a fixed-term employment tend to experience a relevant wage penalty when move to a

[5] Cahuc and Postel-Vinay (2002) provide an important theoretical framework within which the concentration of firm ownership plays an important role in explaining labor market regulations, and, therefore, the percentage of temporary workers in the market.

permanent one. In fact this penalty can be quantified in 8.5% for men with one year of full time experience and in 5% for those with ten years of full time experience[6].

It is useful to enlarge our prospective so as to include studies related to other countries' experiences. Until recently most of the economic literature which refers to temporary workers, in fact, has been largely concentrated on those countries in which the presence of temporary employees constitutes one of the most striking feature of the labour market (the typical example being that of Spain, i.e. that of a market characterised by a proportion of temporary workers constantly above 30 percent in the last ten years). Nonetheless, the emergence of a "two tier system"in several European labour markets (i.e. a market in which temporary and permanent contracts co-exist), as led to a growing number of papers devoted to the analysis of this phenomenon. The contributions of Blanchard and Landier (2001), Berton and Garibaldi (2006), Boeri and Garibaldi (2007) represent relevant examples of this literature, mainly based on the search approach.

One of the most influential study related to the Spanish case and in particular to is that of Bentolila and Dolado (1994). After having studied the variables that characterize temporary employees' behaviours with respect to their relations with employers, trade unions and other workers, the authors suggest that the impact of the more recent Spanish reforms can not be overestimated. These reforms, in fact, have not interfered with the whole distribution of temporary jobs, but have been targeted toward some marginal aspects, slightly changing the duration of contracts and addressing only the needs a few categories of temporary workers. Dolado, Garcia-Serrano, and Jimeno (2001) address the issue of why the percentage of temporary workers in Spain remained stubbornly high

[6]Booth, Francesconi, and Frank (2000b) pp. 14-15. The corresponding figures for women reveal a consistently lower penalty.

	EU15	**Spain**	**France**	**Germany**	**Nether.**	**Italy**	**UK**
1995	-	33.3	11.3	9.9	8.5	6	6.1
1996	*11.1*	32.0	11.4	11.0	9.0	6.5	5.9
1997	*11.5*	32.4	12.0	11.5	8.7	6.9	6.3
1998	*12.1*	32.1	12.9	12.1	9.9	7.4	5.8
1999	*12.6*	31.6	13.2	12.8	9.2	8.5	6.0
2000	*12.8*	30.9	14.6	12.5	11.3	8.8	5.7
2001	*12.6*	30.5	13.6	12.2	11.7	8.2	5.8
2002	*12.3*	30.1	12.5	11.8	12.0	8.3	5.3
2003	*12.1*	30.0	11.4	12.2	12.6	7.9	4.9
2004	*12.6*	30.2	11.7	12.7	13.0	9.7	5.0

Table 1: Percentage of Temporary Workers *(Source: Eurostat)*

after the implementation of several restrictive reforms. In their article, they used panel regression techniques on the ECHP datasets in order to isolate several factors that might have played a role in the resilience of temporary job after 1997 (year in which the last reform was introduced). After having noticed that a consistent share of temporary workers was employed in the public sector, they control for the effect of the reform in that particular segment of the economic system. Their results indicate that the interaction between national and European regulations (with particular stress to the rules of allocation of social funds) has led to an increase in the hiring of fixed-term employees in public activities, which has (almost) overruled the reduction in the private sector. In fact, a 1% increase in social funds leads to an increase of temporary employment in public sector by 0.2%. Kugler, Jimeno, and Hernanz (2002) focused on the same issue using data from the Spanish Labour Force Survey. Their finding is slightly different, suggesting that the legislative change has led to an increase of permanent contracts for young people, with an increment in the probability of getting a job of 2.5% for young (16-29 year old) men and of 6% for young women. This effect disappears when focusing on older (above 45 years) workers. Furthermore, they stress the opportunity of studying the introduction of reforms in order to perform a "natural experiment"in an economic environment.

A different focus is suggested by Guell and Petrongolo (2000) and by Garcia-Perez and Bullon (2007); In particular in the first contribution the aim of the authors is to study the duration pattern of fixed-term contracts and the determinants of their conversion into permanent ones[7]. Their approach, which is also tested with respect to the Spanish experience, consists in constructing a discrete time hazard function so as to identify the transition patterns from one state to another one and, more importantly, the timing of transition. The empirical results are two-folded. They suggest that the probability of getting a permanent contract is certainly affected by a set of personal characteristics of the workers, but that these effects contributes in a way which is consistent with previous findings. More interestingly, conversion rates appear to be positively influenced by employees' bargaining power. Furthermore, conversion is much more likely to happen when the contract is approaching the end of the legal limit.

A second branch of economic literature which I refer to is related to the study of the emergence of monopsonistic positions in labour markets. Apart from those contributions that I have already cited in the introductory part, there are several other articles which are worth to be mentioned. For

[7]Guell and Petrongolo (2000), p. 1.

example Ransom, Boal, and Beck (2000), in which the authors focus on the employment and pay patterns of public school teachers in Missouri. Their contribution is characterised by the attempt to empirically address the issue of monopsony power in labour market basing their analysis on two different theoretical models. On the one hand, in fact, their approach is based on a traditional model in which teachers' pay is related to several measures of job concentration; at a second stage of analysis they present an estimation based on the idea of *spatial differentiation*. Such an approach relates monopsony power to the fact that not all the school districts may be seen as "perfect substitutes"by the teachers[8]. Interestingly enough, the two approaches seem to lead to a similar conclusion: the market power enjoyed by school districts appear to be only a short-run feature, while in the long run no evidence of monopsony power can be detected[9]. Furthermore, the results appear to be extremely sensitive to changes in the ways the variables used as regressors are specified.

Similar, and perhaps more robust, results are those found by Boal (1995), which tested employer monopsony in coal mining in West Virginia in the period between 1897 and 1936.

Staiger, Spetz, and Phibbs (1999), in their attempt to analyse monopsony power in the US nurse labour market focusing again on the percentage difference between MRP and wage, try to measure employers' market power estimating the elasticity of labour supply to a change in wage[10]. Yet differently from the previously cited papers, in this case the author do find a significant degree of monopsony power in the market. In fact, they find that a change in wage has a significant impact on labour supply faced by the individual hospital and by the market as a whole.
Dewit and Leahy (2005) suggest a different approach to the study of oligopsony. In particular, they base their analysis on the taxonomy of business strategy proposed by Fudenberg and Tirole (1984), suggesting the possibility to study the behaviour of 2 competing firms in the labour market form a strategic point of view. The autors show the strategic implications and differences led by the decisions of the firms to compete on wages or employment.

The possibility to study monopsony power through its linkages with commuting time has not been extensively analysed in the economic literature. One of the main contributions in this respect is certainly constituted by the work of Manning, which will be extensively investigated in the next

[8] Ransom, Boal, and Beck (2000), pp. 2-7.
[9] *Ibid.*, pp. 10-18.
[10] The estimation of the elasticity of labour supply is also at the base of other contributions; see, as an example, Ransom and Oaxaca (2005).

section. A more recent attempt to introduce travel-to-work time as a relevant variable in the study of monopsony power can be found in Falch and Stroem (2005), in their study of wage flexibility in the Norwegian public sector. Their idea is quite straightforward: The monopsony power each municipality enjoys with respect to local workers should be viewed as negatively related to the possibility of workers to commute to another municipality. In order to define the level of bargaining power in each municipality, Falch and Stroem suggested the use of an *index of monopsony power* (IMP) which can be summarised through the following equation:

$$(IMP)_k = \frac{1}{2}\left(\frac{E^r_{kk}}{\sum_{j=1}^{J} E^r_{jk}} + \frac{E^w_{kk}}{\sum_{j=1}^{J} E^w_{jk}}\right) \tag{1}$$

where E^r_{jk} (E^w_{jk}) is the number of employees residing (working) in municipality j and working (residing) in municipality k. Unfortunately this kind of indexes, although extremely appealing from a theoretical point of view, often risk to be of small empirical momentum. The availability of reliable data on both area of residence and area of working, possibly at a high level of regional detail and for a relevant length of time can constitute a sensitive issue and can represent a serious stumbling block in the correct computation of the index.

The study of the impact of travel-to-work time on the implementation of public policies aimed at increasing the employment rate is the aim of a recent paper by group of researcher of the University of Wales Swansea (Latreille, Blackaby, Murphy, O'Leary, and Sloane (2006)); the core of the paper is targeted at the definition of the relationship between wages and commuting distance. As we will see in the next section, this kind of relation can be considered as a corner stone in the literature on travel-to-work time.

Finally it is worth to mention that most of the relevant literature focusing on the role played by commuting time in the labour market, can be reconducted to the branch of economics known as *urban economics*. A relevant example is given by Brueckner, Thisse, and Zenou (2002). Their model (which is presented at pure theoretical level, without any empirical analysis) tries to link workers' skill with physical space of cities. Such an approach is based on the idea that: "the force inducing the formation of local labor markets finds its origin in the skill and geographical heterogeneity of workers"[11]. For our purposes the interesting feature of this model consists in the fact that the labour market is seen as an oligopsony, in which each firm is considered as company town attracting

[11] Brueckner, Thisse, and Zenou (2002), p.156.

workers that also choose to reside nearby. The possibility introduced by this approach to study commuting time as a measure of *skill distance* between the the firm and the worker represents an interesting theoretical twists. The conclusion reached by the authors is particularly strong:"people who have low skills are those who live far away from jobs"[12], which leads to the to emergence of "socioeconomics ghettos (...) as workers with poor skill matches are also those who incur the highest commuting costs"[13].

1.1 Manning's Contribution

As already stated in the previous paragraph, models of monopsony power do not represent a particularly new feature in the economic literature. In past years several theories have been developed in order to link monopsony power to spatial distances, and therefore commuting time. The first, almost intuitive model we can refer to is that proposed by Hotelling (1929).

This theory represents an extremely simple framework that has often been used as a stepping stone toward more complicated analyses. The model I would like to take as the main reference for my first chapter is included in this category. I am referring to the theoretical approach proposed by Manning (2003). In the first part of his paper, in fact, the author tries to measure the extent of the bargaining power through the implementation of a model of worker search in geographical space.

In the paper there is no distinction between temporary and permanent workers. Manning explicitly specifies a utility function [14], which presents a linear trade off between wage and commuting time. As in Hotelling (1929), the model assumes that workers are uniformly distributed in any point in space. This allows for the wage offer distribution to be thought as an function F(w) independent of the employer's location. A second, strong, assumption is that workers are assumed to be unable to change their residential location [15]. As previously stated, the model is one of job search, so that in order to close it the inclusion of the equations defining the dynamics of job offers arrivals is needed. Defining the (independent of whether the worker is currently working or not) rate of arrival of job offers as λ, the arrival rate of job offers characterised by a utility v must satisfy:

[12] *Ibidem*, p. 157.
[13] *Ibidem*, p. 166.
[14] Stutzer and Frey (2004) in analysing the loss of utility linked to commuting time in the German market also specify a utility function. Their approach, nonetheless, can be questionable, for their decision of making use of the variable "How satisfied are you with your job" as the dependent variable to be regressed on a set of variables (including commuting time) capturing job characteristics appearing to be a fragile construction.
[15] Manning (2003), p. 7.

$$\lambda(v) = \lambda \int_0^{\infty} f(v + \alpha t)dt \tag{2}$$

which can be written in a more compact way as:

$$\lambda(v) = \frac{\lambda}{\alpha} \int_v^{\infty} f(w)dw = \lambda_A[1 - F(w)] \tag{3}$$

where the term $\lambda_A = (\lambda/\alpha)$ plays a pivotal role in the definition of the degree of "thickness" of the market: the higher α and (or) the lower λ, the thinner the market. It is reasonable to fix a reservation wage. Including this element (b) the arrival rate of job offers (above b) can be more credibly defined as:

$$\mu = \lambda_A \int_b [1 - F(v)]dv = \lambda_A S(b) \tag{4}$$

It can be proved[16] that the equations previously sketched define a framework in which the wage distribution across workers is increasing in commuting time, as long as $ln[1 - F(w)]$ is concave in w and the distribution of utility across workers is decreasing in commute as long as $ln[f(w)]$ is concave in w. The author subsequently focuses his attention on the empirical testing of the validity of such a proposition. His main idea can be summarised as follows: Given the (theoretically shown) inverse relationship between wages and commuting, it would be expected to observe a perfect wage compensation for those workers facing a longer commuting time. The empirical observation of the lack of such a perfect compensation should suggest the existence of consistent degree of monopsony power. Making use of the data from the BHPS dataset and from those of the LFS in the period 1991-2001 Manning first studies the correlation between hourly wages and commutes applying several specifications and constantly introducing a higher number of control variables. The second step of the analysis consists in the construction of an empirical counterparts of equation (2), so as to be able to measure the dimension of the monopsony power. The suggested specification is:

$$dv \propto dw - \frac{1}{H}dt \tag{5}$$

But such a result implies that $v_L/v_y = W$, which is equivalent to assume that the ratio between the

[16]Manning (2003), pp. 36-42, offers a detailed proof of the validity of his assumptions. A detail analysis of this proof would go beyond the scope of the present paper.

derivative of the utility function with respect to L and the derivative with respect to y is equal to W. That is, this means that the marginal rate of substitution between leisure and income is equal to the hourly wage. And the justification for such an hypothesis relies on the idea that hours of work are a free choice for the worker.

The remaining part of the section is the devoted to the empirical estimation of such a relationship leading to the following main result: Commuting is only partially compensated by higher wages. Several of Manning's assumptions will be used in the following pages.

2 The Model

The model studies the market during two periods of a potentially infinite horizon. The labour market is a duopoly and can be spatially represented as a mile long line. There are two identical firms (A and B) in the market, respectively located at each end of the line, so that the distance between the two is equal to 1. Differently from most of the relevant literature (see, among several others, Hotelling (1929), Bhaskar and To (1999), Bhaskar and To (2003), Bhaskar, A.Manning, and To (2002)[17]) I will not rely on the hypothesis that workers are uniformly distributed along the line. Yet, in the present framework workers are pooled in a city (c), located between the two firms. The city is closer to firm A than to firm B. For the moment, this is the only asymmetry between the two firms. Following Manning (2004), I will also assume that workers can not change their residential location [18]. The market is represented in Fig. 1.

Firms produce an identical, homogeneous good making use of labour only. Each worker i is characterized by a certain ability level θ_i. At the beginning of period $t = 0$ the ability of the workers is not observable by the firms. Firms rank workers' expected ability on the base of same uninformative prior so that the ability is initially assumed to be uniformly distributed in an interval

[17] For a general discussion on Hotelling's model and its extensions, see Tirole (1988), chapters 2 and 7

[18] See Manning (2004), pag.7. As suggested by the same author, it can be interesting to introduce the possibility of a change in residential location, including some fixed moving costs. Glaeser and Kohlhase (2003) show some evidence on the fragility of such assumption, at least with respect to the American metropolitan regions.

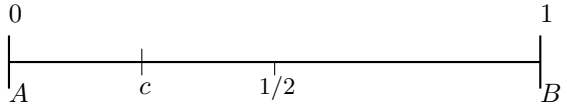

Figure 1: The Market

between 0 and 1[19]: $\theta \rightarrow U(0,1)$. When the economy starts, at $t = 0$, both firms need to employ H_j, $j = A, B$, workers. As we will shortly see, workers can be hired either on temporary or on permanent basis. I make here two assumption:

1. Workers' supply is limited, and the closer to 1 their (expected) ability, the better for the firm in terms of productivity;

2. Wages are sticky. A worker employed on a permanent position will not change her wage according to every change in her productivity, but only through to the internal bargaining process which may take place within the firm. In particular, I will assume that in every period the wage of worker i will be increased by a factor $\delta\tau_{i,j}$ where $\tau_{i,j}$ indicates the number of periods worker i has already worked for firm j. In some sense, $\delta\tau_i$ can be seen as a premium for experience. Of course, at $t = 0$, $\delta\tau_{i,j} = 0$ for all workers and firms. I also assume that $\delta\tau_{i,A} = \delta\tau_{i,B}$, for every i.

Workers are characterized by a utility function which depends on wage and commuting distance. In line with Manning (2003) I hypothesize the following linear relation:

$$U_i(w, d) = w_i - \alpha d_i \tag{6}$$

where d_i is the distance between worker i's residential location and the firm and $\alpha \in [0, 1]$ measures the cost of commuting .
I assume:

$$\frac{\partial U}{\partial w} > 0; \quad \frac{\partial U}{\partial d} < 0. \tag{7}$$

When unemployed, workers have a reservation wage $r = 0$.

2.1 Firms' Strategy in the First Period: Competition or Collusion

At $t = 0$, firms enter the market and observe a mass of workers. The firms know that:

1. Workers will not accept a job leading toward a negative utility. According to eq. (6), this means that for accepting a job from firm A, the worker must be offered at least $w = \alpha c$;

[19] For a statistical analysis of Bayesian models with uninformative priors, see Strachan and van Dijk (2004)

2. If a worker is characterized by an expected productivity at least equal to $\theta \geq \alpha - \alpha c$, then firm B will find profitable to offer her a contract.

Figure 2 illustrates the ability scale for workers. Workers with an ability $\theta < \alpha c$ will not get any offer. Those with a ability $\theta \geq \alpha - \alpha c$ will have some offers from both firms. Workers with an ability $\alpha c \leq \theta \leq \alpha - \alpha c$ will get offers from firm A only.

Both firms produce according to the following production function:

$$Y_j(\bar{\theta}, H) = \bar{\theta}_j H_j^{\beta}, \quad j = A, B \tag{8}$$

where H_j is the number of workers hired by firm j and $\bar{\theta}_j$ indicates their average ability. Of course the higher this average quality, the bigger the output. Firms' production is characterised by decreasing returns to scale.

Firms' problem consists in correctly identifying the "quantity"of H that guarantees profits maximisation in each period. Firms' strategy is given by a contract which specifies the wage and the length of the employment period. The duration of the contract can be either infinite, in case of a permanent contract, or equal to one period of time in case of a temporary one[20]. Given the impossibility for the firms to observe the actual ability of the workers, at the beginning of period 0 all the workers are hired with a temporary contract [21]. Firms can offer the same worker a temporary contract only once. If a worker is to be kept for more than one period he must be offered a permanent contract at the beginning of period 1.

Each firm would like to hire the best workers on the market. The two firms, having the same prior, may compete in order to guarantee themselves the best H individuals. Such a competition process starts with both firms offering workers the wage that make them indifferent between working or remaining unemployed, i.e. $w = \alpha c$ for firm A and $w = \alpha(1 - c)$ for firm B. Nonetheless, each firm has an incentive to deviate from this strategy, offering each of the top workers a small amount

[20]For a similar assumption, see Berton and Garibaldi (2006).
[21]This assumption mimics what suggested by Blanchard and Landier (2001), p. 5

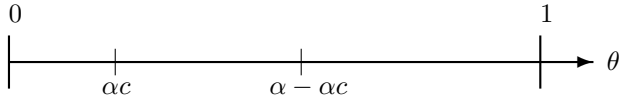

Figure 2: Marginal Productivity

of money above the "indifference" wage so as to attract them toward itself. It is evident that none of the firms can make losses when hiring these workers. Hence the maximum wage the firms can offer will be bounded above by worker's ability. We can summarize this concept through the following equation, which shows worker i offer:

$$w^j_{H,i} = \theta_i - \alpha d_i \tag{9}$$

with $j = A, B$

This competition "á la Bertrand" can only lead to a unique outcome: Firm A will hire the best H workers. The difference in the commuting time workers have to face can be exploited by firm A in order to systematically offer workers a slightly higher wage comparing to firm B. Hence, denoting the productivity of the best worker as $\tilde{\theta}$, the maximum wage firm B will be able to offer will be:

$$w^B_H = \tilde{\theta} - \alpha(1 - c) \tag{10}$$

and it will be always overcame by firm A's offer:

$$w^A_H = \tilde{\theta} - \alpha(1 - c) + \epsilon \tag{11}$$

with A finding such a strategy profitable as long as: $\epsilon < \alpha(1 - 2c)$.

If we define as $\underline{\theta}$ the threshold value which indicates the productivity level of the less productive worker among the H hired by A we can rewrite A's production function as:

$$Y_A = \left(\frac{1 + \underline{\theta}}{2}\right) H^\beta_A \tag{12}$$

where we make use of the fact that :

$$\bar{\theta} = \int_{\underline{\theta}}^{1} x f(x) dx \tag{13}$$

which can obviously be solved as:

$$\bar{\theta} = \frac{1 + \underline{\theta}}{2} \tag{14}$$

Applying a similar reasoning to firm B we get:

$$Y_B = \left(\frac{\underline{\theta} + \alpha(1-c)}{2} \right) H_B^{\beta} \tag{15}$$

with $\alpha(1-c)$ being the lowest level of productivity reached among those employed by firm B. Hence, the two firms can be characterised by the following profit functions:

$$\Pi_{0,A}^{Comp} = p \left(\frac{1+\underline{\theta}}{2} \right) H_A^{\beta} - \left(\frac{1+\underline{\theta}}{2} - \alpha(1-c) + \epsilon \right) H_A \tag{16}$$

$$\Pi_{0,B}^{Comp} = p \left(\frac{\underline{\theta} + \alpha(1-c)}{2} \right) H_B^{\beta} - \alpha(1-c) H_B \tag{17}$$

where the difference in the wages paid by the two firms is due to the fact that once firm A has cleared the market from the top workers, firm B is able to hire the "second best"group of workers. But differently from firm A, firm B can pay its H workers the indifference wage, exploiting its oligopsonistic power.

****

The outlined framework illustrates but one of the two options faced by the firms. In fact, firms can find profitable to refrain from competing on the best H workers. In particular firm A may decide to opt out of the competition in case the cost in terms of wages overcomes the benefit due to a higher productivity level. If this is the case, both firms will find optimal to offer the top quality workers a wage equal to the indifference one. Hence, in such a case the profit function of firm A will be:

$$\Pi_{0,A}^{Coll} = p \left(\frac{1+\alpha(1-c)}{2} \right) H_A^{\beta} - \alpha c H_A \tag{18}$$

in this case perfectly resembling firm B's one:

$$\Pi_{0,B}^{Coll} = p \left(\frac{1+\alpha(1-c)}{2} \right) H_B^{\beta} - \alpha(1-c) H_B \tag{19}$$

Firm B certainly benefits from such a strategy, for $\Pi_{0,B}^{Coll}$ being always larger than $\Pi_{0,B}^{Comp}$ as long as $\underline{\theta} < 1$. On the other hand firm A will always stick in the first option (i.e., in setting a

competitive process in motion) if $\Pi_{0,A}^{Comp} > \Pi_{0,A}^{Coll}$. In order to check under which conditions such an inequality holds we need to maximize the two profit functions, obtain the value functions and find the parameters satisfying the inequality. From the maximization of (16), neglecting all the terms involving ϵ, we obtain:

$$H_{0,A}^{Comp} = \left(\frac{F-g}{\beta\ p\ F}\right)^{\frac{1}{\beta-1}} \tag{20}$$

while the optimization value of (18) is:

$$H_{0,B}^{Coll} = \left(\frac{2\alpha c}{\beta\ p\ (1+g)}\right)^{\frac{1}{\beta-1}} \tag{21}$$

where:

$F = \frac{1+\theta}{2}$ and $g = \alpha(1-c)$.

Plugging these values into the objective functions we can check that firm A will decide to compete if the following condition is satisfied:

Condition 1

$$\left(\frac{1+\underline{\theta}}{1+g}\right) > \left(\frac{F-g}{\alpha c}\right)^{\beta} \tag{22}$$

The economic interpretation of the above condition is straightforward. The ratio on the left hand side of the equation can be actually seen as the benefit the firm gets in terms of productivity from hiring "first best workers"instead of workers which might lie on any point of the ability line. Conversely, the term on the right hand side is the ratio between the marginal cost of hiring the top workers under competition and the marginal cost in case of collusion. Firm A will opt for competition as long as the benefit of such a choice overcomes its cost. Rewriting eq. (22) in a different way, we can define a new function ϕ as the benefit A gets from competition and interpret the role played by each variable in shaping firm A's decisions.

$$\phi = \left(\frac{1+\underline{\theta}}{1+g}\right) - \left(\frac{F-g}{\alpha c}\right)^{\beta} \tag{23}$$

From equation (23) we can easily detect that the term raised at the power of β is larger than 1 if $F > \alpha$. In this case the function ϕ is monotonically decreasing in β, while exactly the opposite

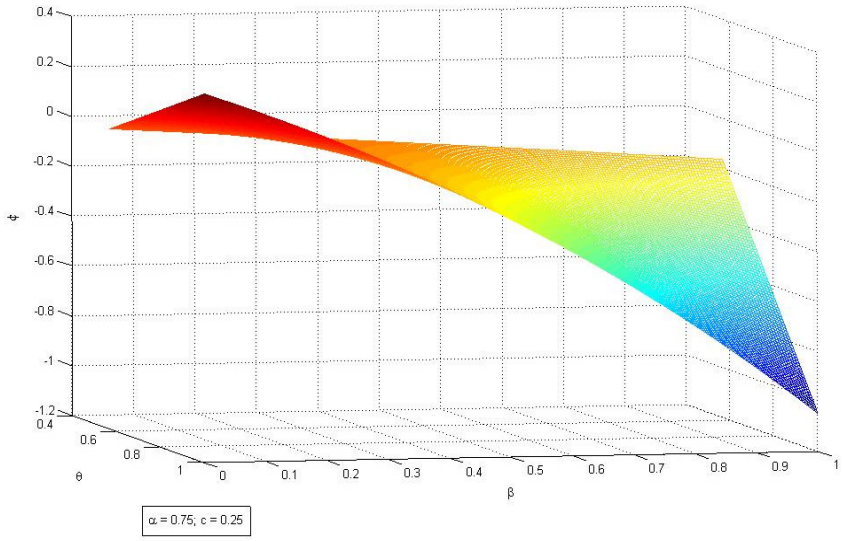

Figure 3: ϕ as β and $\underline{\theta}$ Vary

situation occurs in case $F < \alpha$. If we focus on the first case, this result implies that a higher marginal productivity of the workers reduces the scope for competition. According to the first derivative of ϕ with respect to θ, the function is increasing in the ability level of the best workers as long as the following condition holds:

$$F > g + \left[\frac{2(\alpha - g)^{\beta}}{\beta(1+g)}\right]^{\frac{1}{\beta-1}}. \tag{24}$$

Hence competition is worth only if the difference in the ability level between the best workers and the others is relatively large. In the previous equation the difference between the LHS and the RHS is decreasing in β, confirming that if the marginal productivity of the workers is high, it compensates the difference in ability, making competition less attractive. Figures 3 and 4 show the behaviour of ϕ when we let some of the relevant elements of the functions vary and we fix the other parameters.

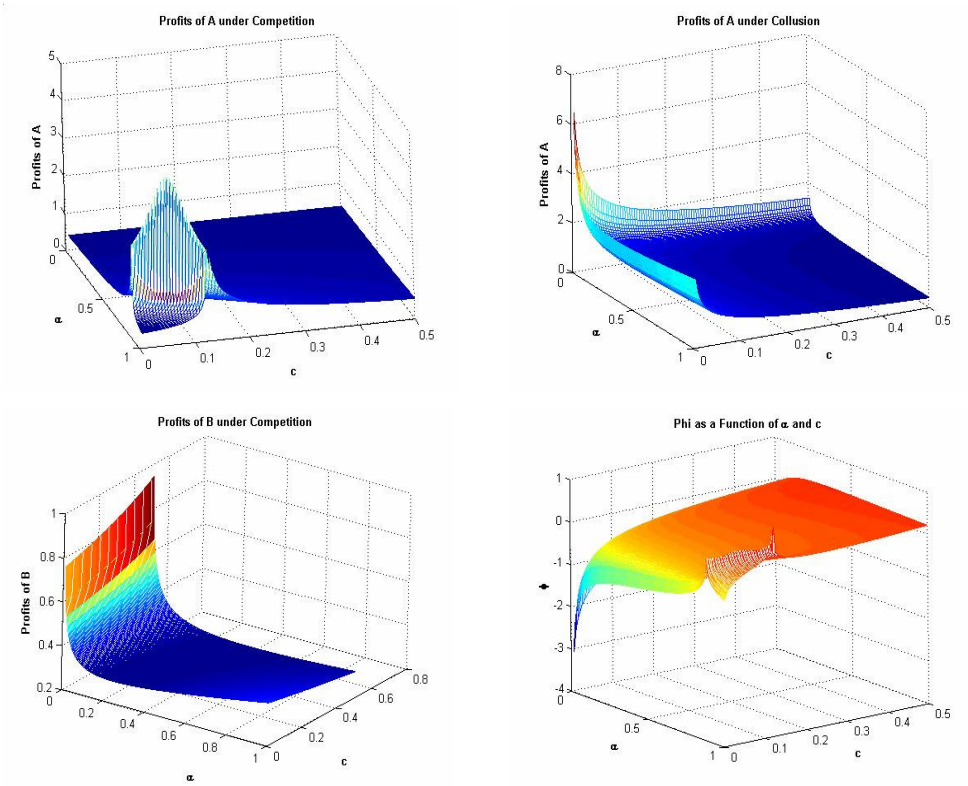

Figure 4: Profits and ϕ as α and c Vary

2.2 Second Period

According to the sign of equation (22), firms can behave in two opposite ways. In case ϕ happens to be negative, then the optimal strategy for both firms is to cooperate, agreeing on offering all workers a wage equal to the reservation wage. Of course, we are more interested in studying the situation in which firm A opts for entering a competition stage with firm B in order to guarantee itself the best H workers. As already shown, this happens only if ϕ can be proved to be larger than 0. Assuming this is the case, we observe that at the end of the first period, firm A hires the best H_A^* workers at a wage equal to $\left(\frac{1+\theta}{2} - \alpha(1-c)\right)$, while B can hire the "second best"group H_B^* at a wage equal to $\alpha(1-c)$.

With respect to the previous period, we observe a main difference. The ability of the workers

hired by firm j in period $t = 0$ is now perfectly observed by the firm j (but not from the other). Furthermore, for a certain share of workers, the actual ability level can be different from the expected one, and such a difference leads to a certain degree of dynamic within the model. For example, a worker which reveals an unexpected low ability level (below the firm's critical threshold) can be made redundant, while a worker initially employed by firm B can actually reveal an ability level such that she can be hired by firm A [22]. The rest of the paragraph will be devoted to the analysis of these dynamics.

2.2.1 Workers' Transition between Firms

A worker i originally employed with a temporary contract by firm A is by definition characterised by an expected ability level $\theta_i \geq \underline{\theta}$. I will now consider two possible realizations of the ability (I will denote the realized ability level as $\hat{\theta}_i$).

- $\underline{\theta} \leq \hat{\theta}_i \leq 1$:

  If the realized ability is included within the initially expected ability interval $[\underline{\theta}, 1]$, the outcome in terms of contract can be uniquely determined. The worker will be offered a *permanent* contract from firm A;

- $\alpha(1-c) \leq \hat{\theta}_i < \underline{\theta}$:

  The worker reveals an ability level below the critical threshold $\underline{\theta}$. Given this finding, firm A prefers not to offer this worker any kind of contract and substitute her with a newly entrant[23]. Nonetheless this worker is now of interest for firm B. It is therefore necessary to specify how the actual ability level of worker i is perceived by firm B. In particular I assume that firm B can not perfectly observe the actual ability of a worker previously hired by A. Firm B observes two different ability levels: on the one hand firm B can attribute to worker i the same prior which was originally indicated by firm A (θ_i). Yet firm B also observes a different signal: The ability level that the worker (or firm A on her behalf) claims to be the real one ($\hat{\theta}_i$). The firm can therefore identify the ability level of the worker on the base of the expected ability, given these two values. If firm B gives to the prior a weight equal to λ_B, the expected

[22] In a more explicit way, we can imagine that the realization of the ability is equal to the expected one plus or minus a small difference. Nonetheless, in the rest of the paper we will not formalize this hypothesis.

[23] This particular assumption can be also found, for example, in Loh (1994)

ability level ($\tilde{\theta}_{i,B}$) for worker i can be summarised as:

$$\tilde{\theta}_{i,B} = \lambda_B * \theta_i + (1 - \lambda_B) * \hat{\theta}_i \tag{25}$$

A similar dynamics can be outlined for workers originally employed by B. In particular we can hypothesize the two following situations:

- $\alpha(1-c) \leq \hat{\theta}_i \leq \underline{\theta}$:

  Worker i, with an expected ability level $\theta_i \in [\alpha(1-c), \underline{\theta}]$, reveals an actual ability level $\hat{\theta}_i$ included in the same interval. Such a worker is not of interest for firm A, and will therefore get a *permanent* contract from firm B.

- $\hat{\theta}_i \geq \underline{\theta}$:

  The actual ability level of worker i is above $\underline{\theta}$. In such a case, worker i can look for a (better paid) job at firm A. Just as in the case discussed in the previous paragraph, there might be some differences in the way the discrepancy between actual and expected ability is perceived by the two firms. On the one, in fact, firm B is perfectly aware of the actual ability level of i. Hence, firm B would indeed be willing to offer i a *permanent* position. Nonetheless, B can not prevent the worker from looking for a job at firm A. On the other hand, A can not perfectly observe the ability of worker i. Again, I will here assume that A will take its decision on the base of an expected value of i's ability ($\tilde{\theta}_i$) with this expected value being given by a weighted average of the initial prior and the new ability level signaled by i.

$$\tilde{\theta}_i = \lambda_A * \theta_i + (1 - \lambda_A) * \hat{\theta}_i \tag{26}$$

I define the proportion of workers originally hired by A which might be now hired by B as $h_A H_{0,A}$, with $h_A \in [0, 1]$ and I will denote that the amount of workers for which a transition from B to A is to be considered feasible as $h_B H_{0,B}$.

2.2.2 From A to B

Firm B's strategy (i.e.,wage and duration of the contract to offer worker i) will depend on the value of λ_B. In case $\lambda_B \to 0$, B perceives the ability of the worker in (almost) the same way as A, implying an ability level $\hat{\theta} < \underline{\theta}$. B can therefore assume that A will never be interested in i again and will be able to hire i under the standard conditions which already applied to all its workers when first employed: it will offer i a *temporary* contract with a wage equal to the indifference one, $w_{1,B} = \alpha(1-c)$.

In case $\lambda_B \to 1$, B needs to implement a different strategy. B assigns i an ability level equal to the prior, $\theta_i \geq \underline{\theta}$, considering A's decision to make the worker redundant a mistake. B is interested in hiring i since her expected ability level is such to increase B profits. On the other hand, B is also aware that in future periods A may reconsider its decision and post a new offer for i. Hence, B's optimal strategy will consist in offering i a contract such that i will not reconsider her choice. From this point of view, the optimal contract is a *permanent* one (including in the wage the term δ, the tenure premium i could expect if hired by A) [24]. Such a strategy will be implemented as long as considered profitable, i.e. as long as the expected profits from permanently hiring i are higher than those firm B can obtain from refraining from employing the worker. In particular, at the beginning of period $t = 1$ the profit function in case B decide not to hire any new worker is[25]:

$$\Pi^n_{1,B} = \begin{array}{c} p\left(\frac{\sum_{i=1}^{H_{0,B}(1-\lambda_A h_B)} \hat{\theta}_i}{H_{0,B}(1-\lambda_A h_B)}\right)(H_{0,B}(1-\lambda_A h_B))^{\beta} + \\ -(\alpha(1-c)+\delta)(H_{0,B}(1-\lambda_A h_B) \end{array} \tag{27}$$

or, more simply:

$$\Pi^n_{1,B} = p\ \Psi X^{\beta}_{0,B} - d\ X_{0,B} \tag{28}$$

Assuming that firm B can employ any worker at the reservation wage $\alpha(1-c)$, the profit function in case B decides to hire all the workers characterised, as i, by an ability level $\theta_i > \underline{\theta}$ can be written as:

[24] Offering a permanent contract at this stage is convenient for B in terms of ability given that, in case i reveals an ability level equal to the one observed by A this would be in any case $\alpha(1-c) \leq \hat{\theta}_i \leq \underline{\theta}$

[25] In what follows, I will always assume that all the functions are calculated with respect to the case in which the to firms prefers to compete for the best workers.

$$\begin{aligned}\Pi^h_{1,B} =&\lambda_B\Bigg\{p\left(\frac{\sum_{i=1}^{H_{0,B}(1-\lambda_A h_B)}\hat{\theta}_i}{H_{0,B}(1-\lambda_A h_B)}+\frac{\sum_{i=1}^{h_A H_{0,A}}\theta_i}{h_A H_{0,A}}\right)\left(H_{0,B}(1-\lambda_A h_B)+h_A H_{0,A}\right)^{\beta}+\\&-\left(\alpha(1-c)+\delta\right)\left(H_{0,B}(1-\lambda_A h_B)+h_A H_{0,A}\right)\Bigg\}+\\&+(1-\lambda_B)\Bigg\{p\left(\frac{\sum_{i=1}^{H_{0,B}(1-\lambda_A h_B)}\hat{\theta}_i}{H_{0,B}(1-\lambda_A h_B)}+\frac{\sum_{i=1}^{h_A H_{0,A}}\hat{\theta}_i}{h_A H_{0,A}}\right)\left(H_{0,B}(1-\lambda_A h_B)+h_A H_{0,A}\right)^{\beta}+\\&-\left(\alpha(1-c)+\delta\right)\left(H_{0,B}(1-\lambda_A h_B)\right)-\alpha(1-c)h_A H_{0,A}\Bigg\}\end{aligned} \tag{29}$$

or, in a more compact way:

$$\begin{aligned}\Pi^h_{1,B} &= \lambda_B\left\{p\left(\Psi_B+\Gamma_B\right)\left(X_{0,B}+N_{0,A}\right)^{\beta}-d\left(X_{0,B}+N_{0,A}\right)\right\}\\&+(1-\lambda_B)\left\{p\left(\Psi_B+\Lambda_B\right)\left(X_{0,B}+N_{0,A}\right)^{\beta}-dX_{0,B}-\alpha(1-c)N_{0,A}\right\}.\end{aligned} \tag{30}$$

If we summarise the previous equation as:

$$\Pi^h_{1,B} = \lambda_B Z_1 + (1-\lambda_B)Z_2 \tag{31}$$

and we compare it with eq. (27), we obtain that firm B will opt for hiring the $hH_{0,A}$ workers coming from firm A as long as the following condition holds:

Condition 2

$$\lambda_B \geq \frac{\Pi^n_{1,B}-Z_2}{Z_1-Z_2}. \tag{32}$$

In the Appendix I prove that the above inequality can be satisfied under some general conditions. For instance, if δ is small enough (and the difference between the ability level predicted by the prior and that one observed by firm A is large), the term on the RHS of eq.(32) is negative, so that the previous inequality is satisfied and firm B always hire the workers coming from A [26]. On the other hand, it can be proved that for $0 < RHS < 1$ only new temporary workers can be hired with B not incurring in any losses.

[26]The assumption that the return of seniority is relatively small is not particularly disturbing taking into account some of the results empirically obtained in the relevant literature. In particular the reference here is to Altonji and Shakotko (1987) and Altonji and Williams (1997). Nonetheless, for a partly different result see also Topel (1991).

2.2.3 From B to A

With comparison to the situation discussed in the previous paragraph, the potential changes in employment status and employer for the the individuals employed by B in $t = 0$ are characterised by a slightly different dynamics. The wage offered by firm A cannot simply be equal to the reservation one, but it needs to be linked to the ability of the worker, as analysed in the previous paragraph. At the beginning of period $t = 1$, firm A lays off a share $h_A H_{0,A}$ of the previously hired workers, whose observed ability is below the initial threshold $\underline{\theta}$. The workers whose observed ability is confirmed to be within the interval $\theta \in [\underline{\theta}, 1]$ get a *permanent* contact, enjoying the "tenure premium" δ. A's profit function at the beginning of period $t = 1$ is the following:

$$\Pi_A^n = \begin{array}{c} p\frac{\sum_{i=1}^{H_{0,A}(1-h_A)} \hat{\theta}_i}{H_{0,A}(1-h_A)}(H_{0,A}(1-h_A))^{\beta} + \\ -\left(\frac{\sum_{i=1}^{H_{0,A}(1-h_A)} \hat{\theta}_i}{H_{0,A}(1-h_A)} - \alpha(1-c) + \delta\right)(H_{0,A}(1-h_A)) \end{array} \tag{33}$$

where the term $\hat{\theta}_i$ indicates the observed ability level of worker i. We can rewrite the above equation as:

$$\Pi_A^n = p\ \Omega_{0,A} X_{0,A}^{\beta} - (\Omega_{0,A} - \alpha(1-c) + \delta)\, X_{0,A}. \tag{34}$$

Firm A can change this profit function by hiring the share of workers previously employed by B and which have revealed an ability $\hat{\theta} \geq \underline{\theta}$. Similarly to what already seen in the case of firm B, firm A can not perfectly observe the ability of workers previously employed by B. Hence, if worker i reveals an ability $\hat{\theta}_i \geq \underline{\theta}$, firm A will perceive an ability:

$$\tilde{\theta}_i = \lambda_A * \theta_i + (1 - \lambda_A) * \hat{\theta}_i. \tag{35}$$

Yet, differently from the previous case, if firm A believes that worker i is actually characterised by an ability level equal to the prior will refrain from hiring her, so that the the profit function will remain the one outlined in equations (33) and (34). The profit function in case A decides to hire the $h_B H_B$ workers can then be expressed as:

$$\Pi_A^h = \begin{array}{c} p\left(\frac{\sum_{i=1}^{H_A(1-h_A)}\hat{\theta}_i}{(1-h_A)H_A} + \frac{\sum_{i=1}^{h_BH_B}\hat{\theta}_i}{h_BH_B}\right)(H_A(1-h_A)+h_BH_B)^{\beta}+ \\ -\left(\frac{\sum_{i=1}^{H_A(1-h_A)}\hat{\theta}_i}{(1-h_A)H_A} - \alpha(1-c)+\delta\right)(H_A(1-h_A)) - \left(\frac{\sum_{i=1}^{h_BH_B}\hat{\theta}_i}{h_BH_B} - \alpha(1-c)\right)h_BH_B \end{array} \tag{36}$$

which I will rewrite as:

$$\Pi_A^h = p(\Omega_{0,A}+\Xi_{0,A})(X_{0,A}+N_{0,B})^{\beta} - (\Omega_{0,A} - \alpha(1-c)+\delta)X_{0,A} - (\Xi_{0,A}-\alpha(1-c))N_{0,B}. \tag{37}$$

Comparing the above expression with its counterpart for firm B, eq. (30), we can immediately notice that the wage potentially offered to h_BH_B depends on the ability of these workers. If firm A decides to employ these individuals, it will have to guarantee them a wage which takes into account the ability revealed by these workers to firm B. On the other hand, the fact that a wage competition for these workers would always end with firm A's offer prevailing on firm B's one, given the difference in commuting time the workers have to incur, firm A can hire the the $N_{0,B}$ workers with a *temporary* contract, in order not to keep them in case they reveal an ability which is actually below the original A's threshold $\underline{\theta}$. Of course such a strategy will be implemented as long as the profit function outlined in eq. (37) overcomes the one presented in eq. (34), i.e as long as $\lambda_A\Pi_A^h \geq (1-\lambda_A)\Pi_A^n$.

Rewriting the last condition for λ_A we obtain that firm A will employ the workers from firm B iff:

Condition 3

$$\lambda_A \geq \frac{\Pi_A^n}{\Pi_A^h + \Pi_A^n}. \tag{38}$$

Given $\lambda_A \in [0,1]$, it is evident that the higher the value of the denominator, the wider the range of values for which the above inequality is satisfied. Of course, for the denominator to be greater than the numerator, we simply need $\Pi_{0,A}^h \geq 0$, while a situation in which $RHS > 1$ which would automatically rule out any new hiring from A can only be observed in the case $\Pi_{0,A}^h < 0$. Summarising, we can say that for any value of $\Pi_{0,A}^h \geq 0$ firm A will always find profitable to hire the new temporary workers.

2.2.4 Effects of a Change in the Employer

The dynamics outlined in the previous sections affect wages and commuting times of those workers that may experience a change in the employer. Tables 2 and 3 summarise the outcomes of these changes in term of contracts and utility. In particular, table 2 shows the importance of the values of the probabilities λ_A and λ_B in determining the set of new contracts in period $t = 1$.

	Initial Ability	Ability in t=1	Ability Perceived by A	Ability Perceived by B	Contract in t=0	Contract in t=1
1	$\underline{\theta} \leq \theta_i \leq 1$	$\underline{\theta} \leq \hat{\theta}_i \leq 1$	$\hat{\theta}_i$	irrelevant	Temp. at A	Perm. at A
2	$\underline{\theta} \leq \theta_i \leq 1$	$\alpha(1-c) \leq \hat{\theta}_i \leq \underline{\theta}$	$\hat{\theta}_i$	Prob. λ_B: $\tilde{\theta}_i > \underline{\theta}$	Temp. at A	Perm. at B
3	$\underline{\theta} \leq \theta_i \leq 1$	$\alpha(1-c) \leq \hat{\theta}_i \leq \underline{\theta}$	$\hat{\theta}_i$	Prob $(1-\lambda_B)$: $\alpha(1-c) \leq \tilde{\theta}_i \leq \underline{\theta}$	Temp. at A	Temp. at B
4	$\alpha(1-c) \leq \theta_i \leq \underline{\theta}$	$\alpha(1-c) \leq \hat{\theta}_i \leq \underline{\theta}$	irrelevant	$\hat{\theta}_i$	Temp. at B	Perm. at B
5	$\alpha(1-c) \leq \theta_i \leq \underline{\theta}$	$\underline{\theta} \leq \hat{\theta}_i \leq 1$	Prob. $(1-\lambda_A)$: $\tilde{\theta} \leq \underline{\theta}$	$\hat{\theta}_i$	Temp. at B	Perm. at B
6	$\alpha(1-c) \leq \theta_i \leq \underline{\theta}$	$\underline{\theta} \leq \hat{\theta}_i \leq 1$	Prob. λ_A: $\tilde{\theta} \geq \underline{\theta}$	$\hat{\theta}_i$	Temp. at B	Temp. at A

Table 2: Changes of Contract from t=0 to t=1

Those workers which experience a change in their employment status are subject to a change in their wages and commuting times. Taking into account the analysis of these elements that was outlined in the previous paragraphs and the utility function presented in equation (6) we can summarise these changes in terms of changes in the utility of the workers, along with the changes in utility experienced by the workers that have not changed employer. Table (3) illustrate these changes.

Evidently, workers moving from B to A experience a positive change in their utility, while those moving from A to B are subject to a negative change (by construction it must be true that $\alpha \leq \theta_i$). Furthermore a worker hired by B at time $t = 0$ only moves to A if the premium he gets in terms of ability related wage overcomes the loss of the permanent premium i.e., if $\hat{\theta}_i - \alpha \geq \delta$. This implies that the actual ability level of worker i needs to be $\hat{\theta}_i \geq \alpha + \delta$. Similarly, for the model to be in equilibrium in period $t = 0$ we need that if i is hired by A it must be true that $\theta_i \geq \alpha$, otherwise i would prefer getting a job from B [27].

[27]The production function proposed in eq.(8) implies labour as the only input. Workers are characterised only by

	Initial Contract	Final Contract	Initial Utility	Final Utility	Total Change	Net Effect
1	Temp. at A	Perm. at A	$\theta_i - \alpha(1-c) - \alpha c$	$\hat{\theta}_i - \alpha(1-c)$ $+\delta - \alpha c$	$\hat{\theta}_i - \theta_i + \delta$	Unknown
2	Temp. at A	Temp. at B	$\theta_i - \alpha(1-c) - \alpha c$	$\alpha(1-c)$ $-\alpha(1-c)$	$-\theta_i + \alpha$	Negative
3	Temp. at A	Perm. at B	$\theta_i - \alpha(1-c) - \alpha c$	$\alpha(1-c)$ $-\alpha(1-c) + \delta$	$-\theta_i + \alpha + \delta$	Negative
4	Temp. at B	Perm. at B	$\alpha(1-c) - \alpha(1-c)$	$\alpha(1-c) + \delta$ $-\alpha(1-c)$	δ	Positive
5	Temp. at B	Temp. at A	$\alpha(1-c) - \alpha(1-c)$	$\hat{\theta}_i - \alpha(1-c)$ $-\alpha c$	$\hat{\theta}_i - \alpha$	Positive

Table 3: Changes in the Utility Function

3 The Dataset and Some Basic Facts

The dataset I used is based on the UK Labour Force Survey and covers an eleven-year period, from 1994 to 2004. The Quarterly Labour Force Survey (LFS) is a quarterly sample survey of households living in the UK. Its purpose is to provide researcher with periodical statistics on the UK labour market. The LFS is based on a random sampling procedure which makes it representative of the whole population of United Kingdom. Each quarter's LFS sample of 60,000 private households is made up of 5 'waves', each of approximately 12,000 households. This means that every individual in the sample is generally interviewed for 5 quarters in a row before leaving the sample. Furthermore

their ability level. A simple extension of the model would imply the introduction of a higher degree of differentiation within the labour force. In particular, if we define the high ability workers, i.e those individuals whose ability is above a certain, endogenously determined threshold and for which firms can effectively compete as H_i, $i = A, B$, we can characterise the remaining share of the labour force as L_i. These "low ability"workers are always offered their reservation wage and firms do not compete for them (an example of a similar characterisation, although in a different context can be found in Mookherjee and Ray (2005)). The production function becomes:$Y_i(\bar{\theta}, H, L) = \bar{\theta}_i H_i^{\beta} L_i^{\gamma}$, $i = A, B$ where the term $\bar{\theta}$ still refers to the average ability level of the H workers. The L workers are necessary for the firm, but the production level is not affected by their ability. The introduction of this new source of differentiation among workers leads to a few changes in the formulation of the equilibrium conditions characterising firms' decisions to collude or compete during period $t = 0$. The main difference is given by the introduction of a new parameter, θ_m which indicates the lowest ability value achieved by the workers hired by firm B. By construction $\theta_m \geq \alpha(1-c)$. All the workers with an ability $\theta_i < \theta_m$ will be considered as L. It is still true that workers with a productivity $\theta < \alpha c$ will not get any offer. Those with a productivity $\theta \geq \alpha - \alpha c$ will be have some offers from both firms. Workers with a productivity $\alpha c \leq \theta \leq \alpha - \alpha c$ will get offers from firm A only. With respect to the dynamics outlined in section §2.2, it can be noticed that as long as we do not allow for the possibility for any L worker to actually reveal an ability above any of the critical threshold θ_m or $\underline{\theta}$, nor for the H individuals to prove to have a θ below θ_m, none of the results obtained in the preceding paragraph and summarised in tables 3 and 4 changes. Furthermore, the extension of the previous model in order to include these possibilities would simply imply a replication of equilibria. This case would lead us beyond the scope of the present paper and will therefore be neglected.

it is of particular relevance for our purposes to note that it is possible to identify individuals across different quarters[28]. All the data I used refer to the September-November quarters. In those surveys all the standard variables on worker's life (such as age, sex, education, type of employment and so on) are complemented with other sets of information on worker's activity which proved to be of particular interest for our purposes and generally not available in other quarter surveys. This is the case, for example, for the variables which refer to commuting time. I focused on individuals in their first and fifth quarters, merging the two waves in a unique file, so that every individual (and every variable referring to him) is observed twice, with a one-year lag between the first and the second interview. The creation of this unique dataset constitutes an innovation from the point of view of the availability of data. It is in fact true that the UK Data Archive regularly provides, along with the quarterly data, several longitudinal files merging the first and fifth waves of interview of the individuals. Nonetheless, these latter files can not be consider satisfactory for our purposes, for the lack of the relevant variables on travel to work time. Making use of a set of variables included in each quarter it was possible to create a personal identification number for each individual and to use this newly created variable as a pivot in the merging procedure between different files. I built up the dataset focusing on male workers, aged from 16 to 65 years. In total, the dataset is composed by 66,843 individuals, with an average of 6,500 individuals per year. The total percentage of temporary workers is 5.48, corresponding to 2,228 workers. Inside this figure, five different kinds of workers are included. In fact, I use the term temporary workers to indicate seasonal workers, people under contract for a fixed period, workers on agency tempting, workers employed in a casual type of work in the reference week and any other not permanent employee. In all the years under analysis, workers under contract for a fixed period account for half of the temporary share, with casual work being the second most common kind of employment (around 20% of temporary workers belong to this category). Table 4 summarizes most of the relevant information on the personal characteristics of the individuals included in the sample.

Given these characteristics, which suggest a definition of temporary worker in line with what found in the relevant literature in terms of age, education and job characteristics, it should not been surprising to observe that the wage distribution of temporary workers significantly differs from that of permanent ones. In order to isolate the pure effect on hourly wages of holding a different type

[28]Detailed information about the UK Labour Force Survey can be found in the web sites: http://www.statistics.gov.uk/ and http://www.data-archive.ac.uk/.

Sample Composition 1994-2004			
		Permanent	**Temporary**
Commuting Time		27.19 *24.54*	29.94 *39.43*
Log of Hourly Wage		2.08 *0.597*	1.74 *0.739*
Age Groups	**15-25**	12.23	34.04
	25-35	21.79	21.51
	35-45	22.72	27.08
	45-55	24.61	24.23
	55-65	13.65	15.78
Pers. Character.	**White**	95.21	91.80
	Not Married	35.63	55.88
Education	**Univ. Degree**	15.30	17.39
	High Educ.	11.38	11.02
	A-level	7.48	9.90
	O-level	28.19	32.73
	Basic Educ.	27.14	19.71
	No Educ	10.51	9.25
Work Character.	**Part-Time**	6.54	32.61
	Union Memb.	34.35	19.14
Firm Size	**1-10**	15.50	15.53
	11-19	8.03	6.07
	20-24	5.30	6.03
	more than 25	71.16	72.37

Table 4: Sample Descriptive Statistics *(Source: LFS, 1994-2004, std. dev. in italics)*

of contract it has been necessary to implement a propensity score matching procedure[29]. Thanks to this procedure, in fact, we can take into account the differences which characterise the two subsamples of workers in terms of individual and job characteristics[30]. The result of this analysis is shown in Fig.5.

It can been easily seen that, even after controlling for a large set of characteristics[31] the wage distribution (red line) of temporary workers appear to significantly differ from that of the permanent ones. This result is two-folded. On the one hand, it is generally in line with most of the relevant

[29]The propensity score matching procedure has been implemented according to Leuven and Sianesi (2003).

[30]For a theoretical discussion on propensity score matching see Caliendo and Kopeinig (2005) and Caliendo and Hujer (2005). An introduction to PS estimators with continuous variables can be found in Angrist and Krueger (1999), pp. 1319-1320.

[31]The set of variables included in the propensity score matching regressions consists on: age, race, marital status, number of children, education, region of work, union membership, managerial duties, sector and whether the contract is full-time or part-time.

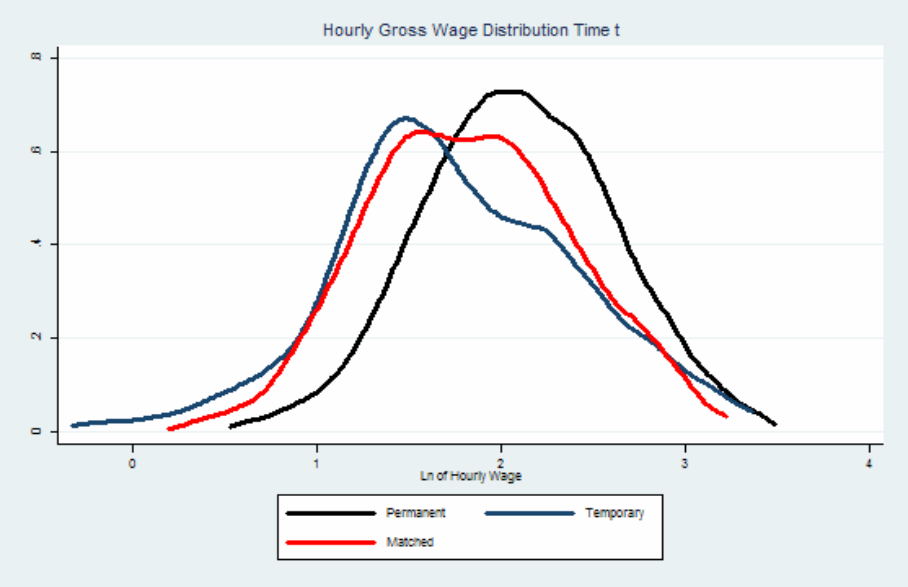

Figure 5: Hourly Gross Wage per Type of Contract

literature on the economic of temporary contracts; on the other, it certainly leads to question the degree of competitiveness of the labour market and the opportunity to rely on the theory of equalizing differences [32].

With particular respect to the relation between wages and commuting time, a few aspects are worth to be noticed from the analysis of the previous tables:

1. On average commuting time is shorter for permanent workers than for temporary ones. The average for permanents is: 27.19 mins per day, while for temporaries is 29.94. The difference is statistically significant at 95% level of confidence;

2. If we focus on wage, the difference between the wages of temporary workers and permanent ones is statistically significant, as it is the one between permanent and matched;

Furthermore, table 5 provides us with some descriptive statistics on the two variables under analysis, summarising the patterns in wage and commuting time characterising the workers who have experienced a change in employment status and/or in employer between time $t-1$ and time t.

[32] Although in my analysis I will try to avoid to take any "qualitative" variable into consideration, it is interesting to note that 45% of the temporary workers included in my dataset declares to work temporarily because was not able to find a permanent employment.

Table 5:

Hourly Wage Pattern per Type of Worker

		Wage at time t-1 (1)	Wage at time t (2)	t-test (1)=(2)
Same Employer	From Temp to Perm	1.7651 *(0.6679)*	1.8865 *(0.5270)*	-2.1958
	From Perm to Temp	1.948 *(0.7733)*	2.0779 *(0.7777)*	-0.9567
Different Employer	From Temp to Perm	1.6555 *(0.6692)*	1.8053 *(0.6170)*	-2.9389
	From Perm to Temp	1.9313 *(0.5319)*	1.8258 *(0.6998)*	2.0966
	From Temp to Temp	1.8770 *(0.7444)*	1.8533 *(0.6919)*	0.3466
	From Perm to Perm	2.0777 *(0.5948)*	2.0909 *(0.6011)*	-1.1903

Commuting Time Pattern per Type of Worker

		Comm. Time at t-1 (1)	Comm. Time at t (2)	t-test (1)=(2)
Same Employer	From Temp to Perm	26.24 *(27.80)*	24.69 *(22.12)*	0.8045
	From Perm to Temp	24.89 *(21.69)*	26.82 *(20.92)*	-0.8273
Different Employer	From Temp to Perm	28.99 *(29.45)*	28.88 *(27.17)*	0.0623
	From Perm to Temp	27.59 *(27.02)*	32.37 *(33.12)*	-2.3979
	From Temp to Temp	30.92 *(32.08)*	33.38 *(36.97)*	-0.9064
	From Perm to Perm	30.22 *(28.03)*	31.33 *(29.45)*	-2.5561

Standard deviations into brackets

With respect to what shown in the table we can notice that:

1. Focusing on wage we observe:
   (a) A change in the employment status within the same firm is characterised by an increase in the hourly wage;
   (b) In the case of a change of employer, the evidence is mixed. A change of employer along with a change toward a permanent contract would on average imply an increase in the wage;

(c) A change of employer and status toward a temporary contract leads on average to a reduction in wage, but this change appear not to be statistically significant.

2. Focusing on commuting time it can be notice that:

   (a) A change of contract leading to a temporary one is on average always linked to an increase in commuting time, independently on the employer;

   (b) This kind of change is statistically different from 0 only when goes with a change in employer;

   (c) A change from temporary to permanent contract leads to a reduction in the commuting time, but in this case as well the test for significance does not lead to a rejection of the hypothesis that the change is equal to 0.

4 Empirical Results

The model presented in section 3 and the descriptive statistics outlined in the previous section suggest a number of hypothesis that need to be tested. In particular, I am interested in studying the dynamics of wages and commuting times for those workers that experience a change in employment status and/or in employer during the two periods of analysis. Focusing first our attention on wages we can note that the model predicts a negative change in wage for workers moving from firm A to firm B and a positive one for those experiencing the opposite shift. Furthermore, it also suggest that a simultaneous change of employer and contractual status can only be achieved by (some of the) workers moving from A to B, for an individual moving from B to A being always offered a temporary contract.

As a first step I try to identify the variables that may affect the probability of observing a change in the working situation of an individual. The first column of Table 6 shows the result of a probit regression, where the dependent variable is a dummy which takes value 1 in case the individual has experienced a change from a temporary job to a permanent one between period 0 and period 1. Columns 2 refers to the same kind of analysis with respect to a dummy variable which takes value 1 in case the individual has experienced a change in employer in two subsequent periods of time. In the last column the dependent variable is given by the interaction term identifying workers which have experienced a change from a temporary to a permanent employment with a

Table 6: Probit analysis, Probability of Observing a Change in the Job

Dependent Variable:	From Temporary to Permanent	Different Employer	Interaction Term
Variable	**Coefficient** (Std. Err.)	**Coefficient** (Std. Err.)	**Coefficient** (Std. Err.)
Log of Hourly Wage at t-1	-0.237*** (0.052)	-0.101*** (0.025)	-0.359*** (0.065)
Commuting Time at t-1	0.002** (0.001)	0.003*** (0.000)	0.001 (0.002)
Age	-0.025* (0.014)	-0.052*** (0.006)	0.007 (0.018)
Age^2	0.000** (0.000)	0.001*** (0.000)	0.000 (0.000)
Education	-0.048*** (0.018)	0.000 (0.008)	-0.048** (0.025)
Experience	-0.181*** (0.013)	-0.047*** (0.004)	-0.165*** (0.019)
$Experience^2$	0.004*** (0.000)	0.001*** (0.000)	0.004*** (0.001)
Marital Status	-0.207*** (0.063)	-0.037 (0.026)	-0.187** (0.087)
Managerial Duties	-0.276*** (0.089)	-0.061** (0.029)	-0.266** (0.129)
Union Member	-0.046 (0.064)	0.112*** (0.026)	-0.012 (0.089)
Full-time / Part-time	0.469*** (0.072)	0.220*** (0.043)	0.360*** (0.096)
Firm Size	0.079*** (0.024)	-0.022** (0.010)	0.039 (0.031)
Intercept	-0.668 (0.505)	0.438* (0.265)	-0.586 (0.651)
N	17905	19257	17700
Log-likelihood	-1478.763	-9175.792	-763.974
χ^2	882.123	1123.228	417.653

Significance levels : * : 10% ** : 5% *** : 1%

Other controls are: 7 race dummies, 10 sector dummies,14 regional dummies, 10 year dummies

different employer. All the variable used as regressors refers to time $t-1$ and the coefficients are to interpreted as marginal effects to the probability of observing the dependent variable achieving value 1.

The table does not present particularly surprising results. The probability to observe a change in job status (in terms of contract length and/or employer) is negatively related to the wage level achieved in $t-1$ and positively (but not for the interaction term) with commuting time. Changes are negatively related to age and tenure, while having held a part-time contract strongly increases the probability of a shift in the employment status.

As stressed since the introductory part to this paper, the relation between commuting time and wage plays a key role in the understanding of the dynamics of job changes suggested by the model. Table 7 present the results of a first level of investigation on this relation. The four columns presents the results of a standard OLS procedure in which the logarithm of the gross hourly wage is regressed against several variables including commuting time. The analysis is conducted including a set of dummy variables and is performed on the whole set of workers in the sample and on temporary workers only. Focusing on the coefficients related to travel-to-work time, the positive relation between this variable and the dependent one is in line with what already found Manning (2004) in terms of sign and significance. The relative size of the coefficient appears to be smaller comparing to what suggested by Manning, but in this case the choice of the set of control variables may be the main source of differentiation among results. All the coefficients of the other variables show the expected signs and (with some exceptions in the last column) they are all significantly different from 0.

Understanding the effects of commuting time and of holding a temporary contract on the hourly wage is pivotal for the sake of our empirical analysis. Deepening the knowledge of these relations is the aim of table 8. The rest of the analysis will be based on the study of a linear model in which the log of hourly wage is regressed against the same control variables presented in the previous table but the set of regressors is augmented by some new terms. The specific aim of these new variables consists in capturing the changes on wage related to the changes in the employment status suggested by the proposed model. This approach can of course present some weaknesses. In particular, it

Table 7: OLS Relation Wage and Commuting Time

	All Workers		Temporary Workers	
Variable	**Coefficient** (Std. Err.)	**Coefficient** (Std. Err.)	**Coefficient** (Std. Err.)	**Coefficient** (Std. Err.)
Commuting Time	0.003*** (0.000)	0.002*** (0.000)	0.002*** (0.000)	0.001 (0.001)
Age	0.068*** (0.002)	0.063*** (0.002)	0.071*** (0.007)	0.066*** (0.007)
Age^2	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Education	0.101*** (0.002)	0.094*** (0.002)	0.089*** (0.010)	0.088*** (0.011)
Experience	0.013*** (0.001)	0.014*** (0.001)	0.038*** (0.009)	0.038*** (0.009)
$Experience^2$	0.000*** (0.000)	0.000*** (0.000)	-0.001** (0.000)	0.038*** (0.000)
Marital Status	0.082*** (0.006)	0.098*** (0.006)	0.067* (0.039)	0.084** (0.040)
Managerial Duties	0.303*** (0.007)	0.293*** (0.006)	0.105*** (0.056)	0.294*** (0.059)
Union Member	0.024*** (0.006)	0.045*** (0.006)	0.105*** (0.038)	0.125*** (0.039)
Full-time Part-time	-0.137*** (0.011)	-0.079*** (0.011)	-0.061* (0.034)	-0.045 (0.036)
Intercept	-0.034 (0.035)	0.816*** (0.206)	-0.301** (0.141)	-0.452 (0.343)
N	29848	29635	1556	1523
R^2	0.448	0.494	0.367	0.407
F	2198.272	600.913	81.231	21.052
Other Controls	No	Yes	No	Yes

Significance levels : $*$: 10% $**$: 5% $***$: 1%

Other controls are: 7 race dummies, 10 sector dummies, 10 year dummies

can be noticed that the bulk of the analysis is focused on the parameters referring to those workers who have experienced a change in their employment status. Taking this fact into account would suggest the need for an investigation of the presence of sample selection bias and the application of complicated econometric procedures to correct for this possible source of distortion (the reference in this case is of course to the procedure suggested by Heckman (1979)). Nonetheless, at this stage of analysis, a simpler approach can be preferable. The model sketched in section 2 is characterized by a high level of simplicity, so that its main findings can be easily manipulated and tested making use of basic econometric tools. Furthermore, the size of the dataset described in the previous section should help us in avoiding the occurrence of relevant bias in the estimated coefficients [33].

In the first column of table 8 an interaction term between the dummy indicating the possess of a temporary contract and the commuting time is introduced. The coefficient of this new regressor proves to be (statistically significantly) negative suggesting that for those employed on a temporary base an increase in commuting time relates to a decrease in the hourly wage. This result appears to have strong implications, in particular if related to what suggested by the theory of compensating differentials. The next step consists in completing this kind of study according to some other implications suggested by the theory presented in section 3. In this respect, the model outlined the possibility of observing the following changes in term of employment status and employer:

1. From temporary to permanent, for some of the workers going from A to B;
2. From temporary to permanent, within the same firm (A or B);
3. From temporary to temporary, with such a change a change being possible for workers moving from A to B and from B to A.

Focusing on the first and the third sub-points, the we can try model the way wages and commuting times change in relation to the change in the job status. In particular the linear relation (that is here outlined with respect to wages) for individual i at time t can be defined in the following way:

$$ln(w_{i,t}) = \alpha + \beta_1 TEMP/PERM_i + \beta_2 TEMP/TEMP_i + \gamma X_{i,t} + \epsilon_{i,t} \tag{39}$$

[33] For a critical approach to Heckman's procedure see Johnston and DiNardo (1999), §13.12.2. A good review of applied methods in labour economics is given by Picchio (2006).

where our dependent variable is given by the logarithms of wage at time t. The set of regressors consists on several standard variables (age of the individual, some other personal characteristics, several sector, regional and year dummies etc.[34]) among which we can isolate the dummy TEMP/PERM, that takes value 1 for those workers having experienced a change from a temporary contract to a permanent one, 0 otherwise and the dummy TEMP/TEMP which on the other hand takes value 1 for workers hired with a temporary contract in both periods of time[35]. Macroeconomic aspects that can somehow affect the dependent variable are meant to be captured by the annual, regional and sector dummies. Given this specification, it is possible to include in this framework the effect of a change in employer, simply adding a new term to the previous ones. Formally, our equation would now become:

$$ln(w_{i,t}) = \alpha + \beta_1 TEMP/PERM_i + \beta_2 TEMP/TEMP_i + \beta_3 DIFF\ EMPL_i + \gamma X_{i,t} + \epsilon_{i,t} \quad (40)$$

where the term β_3 gives us the impact on the wage of the dummy variable DIFF EMPL, which takes value 1 for those workers who have been hired by two different employers in the two subsequent periods. The complete specification of the model can obtained noticing that in order to isolate the influence of the simultaneous change of contractual status and employer we can create two interaction variables. For instance, combining the dummy variables TEMP-PERM and TEMP-TEMP with the dummy DIFF EMPL and introducing this new dummies into our equation we obtain the following, final specification:

$$\begin{aligned} ln(w_{i,t}) = \alpha + \beta_1 TEMP/PERM_i + \beta_2 TEMP/TEMP + \beta_3 DIFF\ EMPL_i + \\ + \beta_4 TEMP/PERM\ DIFF\ EMPL_i + \beta_5 TEMP/TEMP\ DIFF\ EMPL_i + \gamma X_{i,t} + \epsilon_{i,t} \end{aligned} \quad (41)$$

The second column of table 8 reports the results of the OLS regression performed on eq. 41. A change in employer is associated with an increase in hourly wage, but the coefficient is not statistically different from 0. Furthermore this result is overruled when change in employer is also

[34]The entire set of regressors is outlined in Appendix 2.

[35]Ideally it would be particularly interesting to perform the same kind of analysis on the first differences of the variables under analysis. Nonetheless, it must be taken into account that such a procedure would in this case lead to extremely fragile results, for the panel dimension of the dataset being extremely limited.

Table 8: OLS Relation Wage Interaction Terms

Variable	**Coefficient** (Std. Err.)	**Coefficient** (Std. Err.)	**Coefficient** (Std. Err.)	**Coefficient** (Std. Err.)
Temporary Contract	-0.036**		-0.029	-0.031
	(0.017)		(0.025)	(0.025)
Commuting Time	0.002***		0.002***	0.002***
	(0.000)		(0.000)	(0.000)
Interaction Temp - Comm. Time	-0.001**		0.000	0.000
	(0.000)		(0.000)	(0.000)
Different Employer		0.012	0.004	0.007
		(0.008)	(0.008)	(0.009)
From Temp to Perm.		0.045**	0.028	0.044**
		(0.022)	(0.021)	(0.022)
From Temp to Temp		-0.001	0.021	0.030
		(0.024)	(0.030)	(0.031)
Inter. Temp-Perm Diff. Employer		-0.149***		-0.140**
		(0.036)		(0.031)
Inter. Temp-Temp Diff. Employer		-0.026		-0.073
		(0.041)		(0.071)
Inter. Temp-Perm Diff. Employer			-0.157***	-0.036
With Positive Change in Comm. Time			(0.045)	(0.073)
Inter. Temp-Perm Diff. Employer			-0.099*	0.023
With Negative Change in Comm. Time			(0.052)	(0.078)
Inter. Temp-Temp Diff. Employer			-0.022	0.040
With Positive Change in Comm. Time			(0.060)	(0.087)
Inter. Temp-Temp Diff. Employer			-0.019	0.043
With Negative Change in Comm. Time			(0.059)	(0.086)
Intercept	-0.027	-0.307***	0.678***	0.436**
	(0.068)	(0.072)	(0.201)	(0.200)
N	29627	28472	26528	27045
R^2	0.494	0.443	0.465	0.463
F	577.859	434.842	403.19	422.94

Significance levels : $*$: 10% $**$: 5% $***$: 1%

Other controls are: 10 individual variables, 7 race dummies, 10 sector dummies, 10 year dummies

associated to a change in contract length (from temporary to permanent). The parameter related to this variable tends to confirm the theoretical finding suggested in §2.3.2 and summarised as point 3 of table 3: a worker moving from one firm to another also shifting from a temporary to a permanent contract should observe a reduction in her net utility, due to a decrease in the wage. With respect to to the parameter characterising those workers keeping a temporary job although with a different employer, the theory does not suggest us a well defined expectation. In the model, the net result of such a change in terms of worker utility, in fact, depends on the direction of the change of employer, whether toward or from the firm closer to the city. The possibility to empirically investigate these shifts is the aim of columns 3 and 4 of table 8. In the former, the interaction terms between changes in contracts and changes in employers are substituted by four new variables obtained interacting the dropped variables with two dummies indicating a positive or a negative change in the commuting time between periods t and $t-1$. The analysis of the parameters of the new variables allows us to be more precise on estimating the changes theoretically suggested by table 3. In particular, the results previously presented with respect to workers which have experienced a shift from a temporary to a permanent contract tend to be reinforced. Changes from temporary to permanent with a simultaneous increase in commuting time are still related to a decrease in wage, implying an overall reduction in workers' utility. With respect to those workers which have changed employer but still work under temporary contracts, the proposed regression does not suggest a clearcut pattern of changes in terms of wage. The coefficients of these terms are in fact not statistically different from 0 and shew a negative sign, while the coefficient of the dummy for a simple change from a temporary contract to another temporary is positive, although also not significant.

The final column of table 8 presents the result of regression in which all the possible interaction terms and variables are included in the set of regressors. The results of the analysis based on this "kitchen-sink"approach once more confirm the main findings of the previous stages: Hourly wage appear to be positively correlated to an increase in commuting time and with a shift from temporary to permanent jobs, in line with what suggested by the theory of compensated differentials on the one hand and by a consistent amount of literature on temporary contracts on the other [36]. Nonetheless, also in this specification the parameter relating wages to a simultaneous change in employer and from temporary to permanent status is negative and statistically significant. Once more the pattern

[36] See, for example, Bentolila and Dolado (1994), Guell and Petrongolo (2000), Booth, Francesconi, and Frank (2000b).

suggested by the model, in which a firm is able to attract workers from the other even if changing job implies a decrease in the utility of the workers tends to be confirmed. It is important to underline that several of the implications suggested by the model, including the one discussed above directly come from the strong assumption of a "duopsonistic"market. The consequences of the introduction of this hypothesis, leading toward a framework in which the best (in terms of commuting time) firm can easily attract all the best workers while the other firm can still pay its employees the reservation wage only, appear to be at least partially confirmed by the empirical analysis presented in this section. In particular the effects of a change of employer and contract duration on worker's utility move in the direction predicted by the theory and give the hypothesis of the existence of a non-competitive labour market some momentum.

5 Conclusions

The aim of this paper consisted in empirically estimating the presence and the extent of monopsony power in the UK labour market. Particular emphasis was posed on the analysis of the relationship between monopsony power and the use of temporary contracts. I try to study the size and the scope of monopsony power through the investigation of the commuting time which relates to different kinds of workers. Using a dataset based on the UK Labour Force Survey and covering an eleven-year period, 1994 to 2004, I was able to deeply investigate the relation between wages and commuting time among workers using the separation between temporary and permanent contracts as an additional degree of differentiation among individuals.

The simple descriptive analysis conducted in section 3 suggested the existence of some interesting patterns that can not be easily reconciled with the hypothesis of perfect competition in the labour market and with the assumption of compensating differentials as implied by Rosen (1987). In particular, temporary workers seem to face worse job condition in terms of wage and travel-to-work distance with respect to their permanent counterparts. This mere observation was taken as a starting point for the development of a simple two-period model based on the assumption of a duopsonistic labour market, in which firms can offer either temporary or permanent contracts, workers are characterised by a certain ability level and the only original source of asymmetry between the employers is given by the difference in commuting time workers have to face in order to reach the

firm. Letting firms compete for the best (in terms of ability) workers on a two-period time base leads to the definition of a number of equilibria. In particular, the model suggests that workers which have been employed on a temporary base for a firm can subsequently get a permanent job from the other employer under the condition of a lower wage and a longer travel-to-work distance. The opposite patterns in terms of salary and commuting time characterise the individuals that happen to change employer but still stick in a temporary employment.

The last section of the paper is devoted to an empirical analysis of the data, aimed at testing the findings previously sketched. After having studied the determinants of the emergence of temporary contracts, the focus is on the dynamics of wages and commuting time with respect to those individuals which have experienced a change in their labour condition during the two periods of analysis. The results of the study, conducted via the inclusion of several interaction terms in the set of regressors explaining the dynamic of wages, tend to confirm some of the conclusions suggested by the model. In particular, for those individuals which change employer, shifting from a temporary to a permanent contract the results of the proposed regressions suggest a well defined pattern characterised by a reduction in the wage corresponding to a simultaneous increase in travel-to-work distance. The dynamic related to those workers which shifts from a temporary contract to another temporary one is less clear. The results of the model are not rejected by the empirical analysis but certainly need further investigation and stronger support. This last remark suggests a first area of further research from both a theoretical and empirical point of view. The extension of the model briefly discussed in the footnote 27 represents another stepping stone toward a more complete analysis of the labour market.

Appendix 1

Proof of Condition 1

The condition in eq.(22) is based on the comparison of the two following two profit functions:

$$\Pi_{0,A}^{Comp} = p\left(\frac{1+\underline{\theta}}{2}\right)H_{0,A}^{\beta} - \left(\frac{1+\underline{\theta}}{2} - \alpha(1-c) + \epsilon\right)H_{0,A}$$

$$\Pi_{0,A}^{Coll} = p\left(\frac{1+\alpha(1-c)}{2}\right)H_{0,A}^{\beta} - \alpha c H_{0,A}$$

that we can more simply rewrite as:

$$\Pi_{0,A}^{Comp} = pFH^{\beta} - (F-g)H \tag{42}$$

$$\Pi_{0,A}^{Coll} = pDH^{\beta} - \alpha c H \tag{43}$$

Maximizing the two functions we obtain: $H_{Comp}^{*} = \left(\frac{F-g}{p\beta F}\right)^{\frac{1}{\beta-1}}$ and $H_{Coll}^{*} = \left(\frac{\alpha c}{p\beta D}\right)^{\frac{1}{\beta-1}}$ which imply:

$$\Pi_{0,A}^{*,Comp} = pF\left(\frac{F-g}{p\beta F}\right)^{\frac{\beta}{\beta-1}} - (F-g)\left(\frac{F-g}{p\beta F}\right)^{\frac{1}{\beta-1}} \tag{44}$$

$$\Pi_{0,A}^{*,Coll} = pD\left(\frac{\alpha c}{p\beta D}\right)^{\frac{\beta}{\beta-1}} - \alpha c\left(\frac{\alpha c}{p\beta D}\right)^{\frac{1}{\beta-1}} \tag{45}$$

Firm A will opt for competition when $\Pi_{0,A}^{*,Comp} > \Pi_{0,A}^{*,Coll}$ which means:

$$pF\left(\frac{F-g}{p\beta F}\right)^{\frac{\beta}{\beta-1}}-(F-g)\left(\frac{F-g}{p\beta F}\right)^{\frac{1}{\beta-1}}>pD\left(\frac{\alpha c}{p\beta D}\right)^{\frac{\beta}{\beta-1}}-\alpha c\left(\frac{\alpha c}{p\beta D}\right)^{\frac{1}{\beta-1}};$$

$$\left(\frac{F-g}{pF\beta}\right)^{\frac{1}{\beta-1}}\left[pF\left(\frac{F-g}{pF\beta}\right)-(F-g)\right]>\left(\frac{\alpha c}{pD\beta}\right)^{\frac{1}{\beta-1}}\left[pD\left(\frac{\alpha c}{pD\beta}\right)-\alpha c\right];$$

$$\left(\frac{F-g}{pF\beta}\right)^{\frac{1}{\beta-1}}\left[\frac{F-g}{\beta}-(F-g)\right]>\left(\frac{\alpha c}{pD\beta}\right)^{\frac{1}{\beta-1}}\left[\frac{\alpha c}{\beta}-\alpha c\right];$$

$$\left(\frac{F-g}{pF\beta}\right)^{\frac{1}{\beta-1}}\left[\frac{(F-g)(1-\beta)}{\beta}\right]>\left(\frac{\alpha c}{pD\beta}\right)^{\frac{1}{\beta-1}}\left[\frac{\alpha c(1-\beta)}{\beta}\right];$$

$$\left(\frac{F-g}{pF\beta}\right)^{\frac{1}{\beta-1}}(F-g)>\left(\frac{\alpha c}{pD\beta}\right)^{\frac{1}{\beta-1}}(\alpha c);$$

$$(F-g)^{\frac{\beta}{\beta-1}}(pF\beta)^{-\frac{1}{\beta-1}}>(\alpha c)^{\frac{\beta}{\beta-1}}(pD\beta)^{-\frac{1}{\beta-1}};$$

$$(F-g)^{\beta}\frac{1}{pF\beta}<(\alpha c)^{\beta}\frac{1}{pD\beta};$$

$$\frac{(F-g)^{\beta}}{(\alpha c)^{\beta}}<\frac{F}{D}.$$

as stated in eq.(22)

Proof of Condition 2

Equation (36) stated:

$$\lambda_B \geq \frac{\Pi^n_{1,B}-Z_2}{Z_1-Z_2}.$$

which can be explicitly rewritten as:

$$\lambda_B \geq \frac{\begin{array}{c} p\ \Psi X^{\beta}_{0,B}-dX_{0,B}+ \\ -p\ (\Psi_B+\Lambda_B)\ (X_{0,B}+N_{0,A})^{\beta}-dX_{0,B}-\alpha(1-c)N_{0,A} \end{array}}{\begin{array}{c} p\ (\Psi_B+\Gamma_B)\ (X_{0,B}+N_{0,A})^{\beta}-d\,(X_{0,B}+N_{0,A})+ \\ -p\ (\Psi_B+\Lambda_B)\ (X_{0,B}+N_{0,A})^{\beta}-dX_{0,B}-\alpha(1-c)N_{0,A} \end{array}} \tag{46}$$

and simplified into:

$$\lambda_B \geq \frac{p[\Psi X_{0,B}^{\beta} - (\Psi + \Lambda)(X_{0,B} + N_{0,A})^{\beta}] + \alpha(1-c)N_{0,A}}{p(\Gamma - \Lambda)(X_{0,B} + N_{0,A})^{\beta} - \delta N_{0,A}} \tag{47}$$

Taking into account the fact that λ_B is to be interpreted as a probability, it must be true that $\lambda_B \in [0, 1]$. The RHS, on the other hand can achieve different values according to the specifications of the parameters affecting it. Of course observing $RHS < 0$ would imply that the inequality presented in eq.(47) is always satisfied, while a value above 1 would automatically rule out the possibility that firm B will hire the $N_{0,A} = h_A H_{0,A}$. This last case is very simple to analyze. $RHS > 1$ implies:

$$\frac{p[\Psi X_{0,B}^{\beta} - (\Psi + \Lambda)(X_{0,B} + N_{0,A})^{\beta}] + \alpha(1-c)N_{0,A}}{p(\Gamma - \Lambda)(X_{0,B} + N_{0,A})^{\beta} - \delta N_{0,A}} > 1$$

or

$$p[\Psi X_{0,B}^{\beta} - (\Psi + \Lambda)(X_{0,B} + N_{0,A})^{\beta}] + \alpha(1-c)N_{0,A} > p(\Gamma - \Lambda)(X_{0,B} + N_{0,A})^{\beta} - \delta N_{0,A}$$

which can be finally rewritten as

$$p[(\Psi + \Gamma)(X_{0,B} + N_{0,A})^{\beta} - (\Psi X_{0,B})^{\beta}] < dN_{0,A}$$

whose interpretation is straightforward: Firm B will never hire any worker from A in case the total cost of hiring the new employees overcomes the revenues firm B will make in the event the workers are believed to be highly productive.

The case $RHS < 0$ is satisfied under the condition that the numerator $\mathcal{N}$ and the denominator $\mathcal{D}$ show a different sign. In particular, noting that:

$$\Psi X_{0,B}^{\beta} - (\Psi + \Lambda)(X_{0,B} + N_{0,A})^{\beta} < 0$$
$$(\Gamma - \Lambda)(X_{0,B} + N_{0,A})^{\beta} > 0$$

by construction, then the following conditions must hold:

$$p\ [(\Psi + \Lambda)(X_{0,B} + N_{0,A})^{\beta} - \Psi X_{0,B}^{\beta}] > \alpha(1-c)N$$
$$p\ [(\Gamma - \Lambda)(X_{0,B} + N_{0,A})^{\beta}] > \delta N$$

which banally imply that as long as the additional costs of the new temporary workers ($\alpha(1-c)$) are below the corresponding revenue gains obtained by B, and as long as the gain from hiring permanent workers instead of temporary ones overcomes the additional costs (δ) implied by this choice, the inequality in eq.(47) is always satisfied and B always hires the workers from firm A. Of course $RHS < 0$ can also be the outcome of a positive numerator and a negative denominator. Nonetheless, if we rely on the notation introduced in section 2.2.2, this case could be simply rewritten as $\Pi_{1,B}^{n} > Z2 > Z_1$; Were this case, λ_B would simply collapse to 0 and no more workers would be hired by B.

Finally, we can also observe $0 < RHS < 1$. This case corresponds on imposing some constraints on the difference in the ability of the newly hired and the workers B employed in period 1. In case both $\mathcal{N}$ and $\mathcal{D}$ are positive, hiring workers on the base of the ability signaled by the prior is more convenient than hiring them on the base of the ability observed by A, since $\mathcal{D} > \prime$ implies $p\ [(\Gamma - \Lambda)(X_{0,B} + N_{0,A})^{\beta}] > \delta N$. On the other hand, since $\mathcal{N} > \prime$ the gain in revenues from hiring the workers is smaller than its cost, $a(1-c)N$. Hence for both $\mathcal{N}$ and $\mathcal{D}$ positive, firm B should only hire new permanent workers. Nonetheless, tis result is not feasible, since $RHS < 1$ leads to:

$$p\ [(\Psi + \Gamma)(X_{0,B} + N_{0,A})^{\beta} - \Psi X_{0,B}^{\beta}] < (\alpha(1-c) + \delta)N$$

which implies that the cost of hiring the new permanent workers overcomes the corresponding gain in revenues.

Applying a similar reasoning, we can see that, on the other hand, both $\mathcal{N}$ and $\mathcal{D}$ being negative represents a condition for B for only hiring new temporary workers. In this case the fact that

$RHS > 1$ does not introduce any binding constraint.

Appendix 2

Qualitative variables included in the regressions.

Table 9: List of Regressors

Variable	**Num. of Observations**	**Mean**	**St. Dev.**	**Min.**	**Max**
Log of Hourly Wage, Time t	33274	2.05612	0.6217671	-3.83	5.62795
Log of Hourly Wage, Time t-1	21362	2.09112	0.5912545	-3.76	5.24215
Commuting Time, Time t	39958	27.2028	25.243	0	180
Commuting Time, Time t-1	41837	26.4898	24.65485	0	180
Age	66841	41.0535	14.39455	14	67
Degree of Education	59527	3.09574	1.598796	1	6
Years of Experience	40899	8.82183	9.370027	0	49

Dummy variables included as regressors are:

1. Marital status (0: not married, 1 married or cohabiting), Managerial Status (0: no managerial duties, 1: managerial duties), Union Member (0: no member, 1: union member), Full-time / Part-time (0: full-time, 1: part-time);

2. Race: White, Black Caribbean, Black African, Indian, Pakistani / Bangladeshi, Chinese, Other Races;

3. Region: Northern Regions, Yorkshire, East Midlands, East Anglia, Great London, Rest of South East, South West, West Midlands, Great Manchester, North West, Wales, Scotland, Northern Ireland, Out of UK;

4. Sector: Agriculture and Fishing, Energy and Water, Manufacturing, Construction, Distribution, Hotels and Restaurants, Transport and Communication, Banking and Finance and Insurance, Public administration or Education and Health, Other Services;

5. Year dummies.

References

Altonji, J. G., and R. A. Shakotko (1987): "Do Wages Rise with Job Seniority?," *Review of Economic Studies*, 54(3), 437–59.

Altonji, J. G., and N. Williams (1997): "Do Wages Rise with Job Seniority? A Reassessment," NBER Working Papers 6010, National Bureau of Economic Research, Inc.

Angrist, J. D., and A. B. Krueger (1999): "Empirical strategies in labor economics," in *Handbook of Labor Economics*, ed. by O. Ashenfelter, and D. Card, vol. 3 of *Handbook of Labor Economics*, chap. 23, pp. 1277–1366. Elsevier.

Bentolila, S., and J. Dolado (1994): "Labour Flexibility and Wages: Lessons from Spain," *Economic Policy*, 9(18), 53–99.

Berton, F., and P. Garibaldi (2006): "Workers and Firms Sorting into Temporary Jobs," LABORatorio R. Revelli Working Papers Series 51, LABORatorio R. Revelli, Centre for Employment Studies.

Bhaskar, V., A.Manning, and T. To (2002): "Oligopsony and Monopsonistic Competition in Labour Markets," *Journal of Economic Perspectives*, 16(2), 155–174.

Bhaskar, V., and T. To (1999): "Minimum Wages for Ronald McDonald Monopsonies: A Theory of Monopsonistic Competition," *Economic Journal*, 109(455), 190–203.

Bhaskar, V., and T. To (2003): "Oligopsony and the distribution of wages," *European Economic Review*, 47(2), 371–399.

Blanchard, O., and A. Landier (2001): "The Perverse Effects of Partial Labor Market Reform: Fixed Duration Contracts in France," NBER Working Papers 8219, National Bureau of Economic Research, Inc.

Boal, W. (1995): "Testing for Employer Monopsony in Turn-of-the-Century Coal Mining," *The RAND Journal of Economics*, 26(3), 519–536.

Boal, W. M., and M. R. Ransom (1997): "Monopsony in the Labor Market," *Journal of Economic Literature*, 35(1), 86–112.

Boeri, T., and P. Garibaldi (2007): "Two Tier Reforms of Employment Protection: A Honeymoon Effect?," Carlo Alberto Notebooks 37, Collegio Carlo Alberto.

Booth, A. L., M. Francesconi, and J. Frank (2000a): "Temporary Jobs: Who gets them, what are they worth, and do they lead anywhere?," ILR working papers 054, Institute for Labour Research.

——— (2000b): "Temporary Jobs: Stepping Stones or Dead Ends?," IZA Discussion Papers 205, Institute for the Study of Labor (IZA).

Brueckner, J. K., J.-F. Thisse, and Y. Zenou (2002): "Local Labor Markets, Job Matching, and Urban Location," *International Economic Review*, 43(1), 155–171.

Cahuc, P., and F. Postel-Vinay (2002): "Temporary jobs, employment protection and labor market performance," *Labour Economics*, 9(1), 63–91.

Caliendo, M., and R. Hujer (2005): "The Microeconometric Estimation of Treatment Effects - An Overview," IZA Discussion Papers 1653, Institute for the Study of Labor (IZA).

Caliendo, M., and S. Kopeinig (2005): "Some Practical Guidance for the Implementation of Propensity Score Matching," IZA Discussion Papers 1588, Institute for the Study of Labor (IZA).

Dewit, G., and D. Leahy (2005): "Oligopsonistic Cats and Dogs," Economics Department Working Paper Series n1590905, Department of Economics, National University of Ireland - Maynooth.

Dolado, J. J., C. Garcia-Serrano, and J. F. Jimeno (2001): "Drawing Lessons From the Boom of Temporary Jobs in Spain," CEPR Discussion Papers 2884, C.E.P.R. Discussion Papers.

Falch, T., and B. Stroem (2005): "Local Flexibility in Wage Setting: evidence from the Norwegian Local Public Sector," Norwegian University of Science and Technology, Department of Economics.

Fudenberg, D., and J. Tirole (1984): "The Fat-Cat Effect, the Puppy-Dog Ploy, and the Lean and Hungry Look," *American Economic Review*, 74(2), 361–66.

Garcia-Perez, J. I., and F. M. Bullon (2007): "Transitions into permanent employment in Spain : an empirical analysis for young workers," Business Economics Working Papers wb073808, Universidad Carlos III, Departamento de Economa de la Empresa.

Glaeser, E. L., and J. E. Kohlhase (2003): "Cities, Regions and the Decline of Transport Costs," Harvard Institute of Economic Research Working Papers 2014, Harvard - Institute of Economic Research.

Guell, M., and B. Petrongolo (2000): "Workers' Transition from Temporary to Permanent Employment: The Spanish Case," CEP Discussion Paper 438, C.E.P.

Heckman, J. J. (1979): "Sample Selection Bias as a Specification Error," *Econometrica*, 47(1), 153–61.

Hotelling, H. (1929): "Stability in Competition," *Economic Journal*, 39, 41–59.

Johnston, J., and J. DiNardo (1999): *Econometric Methods*. McGraw-Hill, 4 edn.

Kugler, A., J. Jimeno, and V. Hernanz (2002): "Employment Consequences of Restrictive Permanent Contracts: Evidence From Spanish Labor Market reforms," IZA Discussion Paper 657, Institute for the Study of Labor (IZA).

Latreille, P., D. H. Blackaby, P. D. Murphy, N. O'Leary, and P. J. Sloane (2006): "How Far and For How Much? Evidence on Wages and Potential Travel-to-Work Distances from a Survey of the Economically Inactive," IZA Discussion Papers 1976, Institute for the Study of Labor (IZA).

Leuven, E., and B. Sianesi (2003): "PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing," Statistical Software Components, Boston College Department of Economics.

Loh, E. S. (1994): "Employment Probation as a Sorting Mechanism," *Industrial and Labor Relations Review*, 47(3), 471–486.

Manning, A. (2003): *Monopsony in Motion: Imperfect Competition in Labour Markets*. New York: Princeton University Press.

——— (2004): "The Real Thin Theory: Monopsony in Modern Labour Markets," *Labour Economics*, 10(2), 105–131.

Mookherjee, D., and D. Ray (2005): "Occupational Diversity and Endogenous Inequality," Boston University - Department of Economics - The Institute for Economic Development Working Papers dp-142, Boston University - Department of Economics.

Picchio, M. (2006): "Wage Differentials between Temporary and Permanent Workers in Italy," Working Papers 257, Universita' Politecnica delle Marche (I), Dipartimento di Economia.

Ransom, M., W. Boal, and P. Beck (2000): "Empirical Tests of Labor Monopsony: School Teachers in Missouri," .

Ransom, M. R., and R. L. Oaxaca (2005): "Sex Differences in Pay in a "New Monopsony" Model of the Labor Market," IZA Discussion Papers 1870, Institute for the Study of Labor (IZA).

Rosen, S. (1987): "The theory of equalizing differences," in *Handbook of Labor Economics*, ed. by O. Ashenfelter, and R. Layard, vol. 1 of *Handbook of Labor Economics*, chap. 12, pp. 641–692. Elsevier.

Staiger, D., J. Spetz, and C. Phibbs (1999): "Is There Monopsony in the Labor Market? Evidence from a Natural Experiment," Working Paper 7528, National Bureau of Economic Research.

Strachan, R. W., and H. K. van Dijk (2004): "Bayesian Model Selection with an Uninformative Prior," Keele Economics Research Papers KERP 2004/01, Centre for Economic Research, Keele University.

Stutzer, A., and B. S. Frey (2004): "Stress That Doesn't Pay: The Commuting Paradox," IEW - Working Papers iewwp151, Institute for Empirical Research in Economics - IEW.

Tirole, J. (1988): *The Theory of Industrial Organization*. Cambridge: The MIT Press.

Topel, R. H. (1991): "Specific Capital, Mobility, and Wages: Wages Rise with Job Seniority," *Journal of Political Economy*, 99(1), 145–76.

VV.AA. (2002): "Department of Trade and Industry, Fixed Term Employees (Prevention of Less Favourable Treatment) Regulations 2002 Regulatory Impact Assessment," .