ISSN 1755-5361

University of Essex

Department of Economics

Discussion Paper Series

No. 675 October 2009

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October 21, 2009

Abstract

This paper addresses the issue of the presence and the extent of equalizing differences between temporary and permanent workers. The assumption of perfect competition in the labour market is directly questioned and a simple duopsonistic model is developed with the aim of capturing the main sources of differentiation among workers. The empirical analysis, based on several waves of the UK Labour Force Data, tends to confirm several of the hypotheses suggested by the model and emphasizes how in the short run workers who have experienced a change in their job status can expect a career trajectory in line with the theory on compensating differentials. In particular, shifts from temporary to permanent contracts tend to relate to a reduction in 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 position appears to be directly linked to individual characteristics.

JEL Classification: J22, J24, J41, J42, L13.
Key Words: Atypical Contracts, Oligopsony, Compensating Differentials, 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. Alan Manning and Giovanni Sulis provided me with a number of suggestions. I also thank the participants of the seminars at Essex University, IZA Summer School, ESPE Conference 2008, WPEG Conference 2009 and CRENoS for their comments. All mistakes are of course my full responsibility.

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Introduction

The aim of this paper consists in studying the relationship between monopsony power and the use of temporary contracts in the UK labour market. 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 characterizing their permanent colleagues in terms of salary, working hours, benefits, etc[1]. This fact not only casts some shadows on the hypothesis that the labour market is perfectly competitive but also leads to question the applicability of the theory of equalizing differences (Rosen (1987)) to the temporary employees.

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 have been proposed in order to consistently study this kind of framework[3]. This paper relies on some of the most recent contributions to the relevant literature. In particular, monopsony power is here studied through the investigation of the commuting time which relates to different kinds of workers. Although not completely new[4], this approach has not been used yet in studying the differences between the temporary and permanent segments of the labour market. The analysis of the link between temporary contracts and monopsony is performed by developing a simple duopsonistic model in which heterogeneous workers are explicitly differentiated on the base of the duration of their contracts. The theoretical implications of this approach are then empirically tested making use of an *ad hoc* built dataset based on several waves of the UK Quarterly Labour Force Survey.

As the proposed model focuses on the way wages and other job features may change as workers experience shifts in terms of employers and contract duration, all the changes in the job status are characterized in terms of subsequent modifications of wage and commuting time. In particular, one of the main predictions relates to the occurrence of a simultaneous change in both the employer and the job status, with the worker switching from a temporary to a permanent position. The suggested theoretical framework leads to the conclusion that this kind of shift should be associated with a reduction in the wage and a relative deterioration of the overall job characteristics. The empirical

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

analysis conducted in the second part of the paper tends to confirm this conclusion, implying a short run confirmation of the theory of compensating differentials. Of course this particular career profile only represents one outcome out of a set of possible work trajectories that a temporary worker can experience in a strictly non-competitive labour market. The proposed model allows for a number of these different employment profiles, with the analytical results focusing on the short-run features of each career pattern. As several of the theoretical implications are confirmed in the empirical analysis, nonetheless the implementation of different econometric techniques leads to results that are not completely free of controversy. Resolving these issues is left for further research.

The remaining of this paper is organized as follows. The next section discusses the institutional framework in which the present study is included and some of the existing literature in the relevant fields. Section 2 presents the theoretical contribution of the paper. Section 3 will describe the data while the empirical results are presented in section 4. Section 5 concludes.

1 Institutional Framework and Literature Review

This paper is related to a number of studies which analyze temporary contracts, monopsony power and commuting time. With respect to the studies on temporary contracts and atypical jobs it is a generally accepted statement that temporary employment in the United Kingdom is characterized by a relevant 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 (2002). 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 permanent one.

It is useful to enlarge our prospective so as to include studies related to other countries' expe-

riences. The emergence of a "two tier system"in several European labour markets (i.e. a market in which temporary and permanent contracts co-exist), has in fact 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), which suggests 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 (2002) address the issue of why the percentage of temporary workers in Spain remained stubbornly high after the implementation of several restrictive reforms. 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. Kugler, Jimeno, and Hernanz (2002) focused on the same issue using data from the Spanish Labour Force Survey with slightly different findings, 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.

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

	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)*

of fixed-term contracts and the determinants of their conversion into permanent ones[5]. According to their findings conversion rates appear to be positively influenced by employees' bargaining power and conversion is much more likely to happen when the contract is approaching the end of the legal limit.

The literature on the emergence of monopsonistic positions in labour markets is equally rich. Among several papers that empirically studied the phenomenon of monopsony we can mention Ransom, Boal, and Beck (2000), in which the authors focus on the employment and pay patterns of public school teachers in Missouri and 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[6]. 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. Finally, 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 authors 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 analyzed in the economic literature. One of the main contributions in this respect is certainly constituted by the work of Manning, which, starting from the work of Hotelling (1929), develops a model that explicitly takes monopsony into account, by specifying a linear utility function of workers [7] which presents a trade off between wage and commuting time. As in Hotelling (1929),

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

[6]The estimation of the elasticity of labour supply is also at the base of other contributions; see, as an example, Ransom and Oaxaca (2005).

[7]Stutzer and Frey (2004) in analyzing 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. for a critical approach to the use of job and life satisfaction variables in economic research see Conti and Pudney (2008)

the model assumes that workers are uniformly distributed in any point in space. 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 empirically measure the magnitude of the monopsony power. The main result of Manning is relatively surprising, but rich of economic consequences: Commuting is only partially compensated by higher wages. This results strongly questions the validity of theories base on perfect competition in labour markets and is therefore worth to be investigated. Several of Manning's assumptions will be used in the following pages in order to construct a model in which the relation between wages and commuting time is studied with respect to a market in which workers can be offered temporary or permanent contracts.

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 (2006), 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 and the level of bargaining power in each municipality is given by an *index of monopsony power*. Nonetheless, 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 linked 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"[8]. 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 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"[9], which leads to the to emergence of "socioeconomics ghettos (...) as workers with poor skill matches are also those who incur the highest commuting costs"[10].

2 The Model

As suggested in the introductory part of this work, the literature outlined in the previous section does not account for a number of controversial issues related to the emergence of a dual labour market, in which workers can be differently categorized according to the predicted length of their contract. In particular, most of the literature does not support the theoretical predictions of Rosen (1987). Permanent workers appear to enjoy better wages and working conditions than temporary ones, so that not only the choice to accept a limited duration contract seems to be related more to a lack of alternatives than to a deliberate decision within a competitive environment but such a choice is not compensated in terms of working related benefits as should be expected in a perfectly competitive environment. The proposed model aims at reconcile the theory with the empirical results proposed in the literature, by explicitly focusing on a framework where the level of competition among firms is limited and workers can be offered both temporary and permanent contracts.

The labour market is analyzed for the first 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

[8] Brueckner, Thisse, and Zenou (2002), p.156.
[9] *Ibidem*, p. 157.
[10] *Ibidem*, p. 166.

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), Kaas and Madden (2008) [11]) 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 [12]. The market is represented in Fig. 1.

Firms produce an identical, homogeneous good making use of labour only. 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:

$$U_i(w, d) = w_i^{net} = w_i - \alpha d_i \tag{1}$$

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. When unemployed, workers have a reservation wage $r = \alpha d_i$. Workers are heterogeneous as each of them is endowed with a certain ability level θ_i. At the beginning of period $t = 0$ the ability of the workers is not observable. 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 between $\alpha(1 - c)$ and 1[13]: $\theta \to U(0, 1)$. When the economy starts, at $t = 0$, both firms need to employ L_j, $j = A, B$, workers. I assumes that wages are sticky. A worker employed on a permanent position will change her wage only through to the internal bargaining process which may take place within the firm. In particular, I will assume that in every period the

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

[12] 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.

[13] For a statistical analysis of Bayesian models with uninformative priors, see Strachan and Dijk (2003)

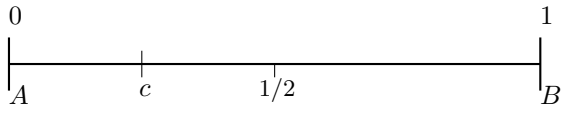


Figure 1: The Market

wage of worker i will be increased by a factor δt. Of course, at $t = 0$, $\delta t = 0$ for all workers and firms.

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

Both firms produce according to the following production function:

$$Y_j(\bar{\theta}, L) = \bar{\theta}_j L_j^{\beta}, \quad j = A, B \tag{2}$$

where L_j is the number of workers hired by firm j and $\bar{\theta}_j$ indicates their average ability. Firms' production is characterized by decreasing returns to scale. The term $\bar{\theta}_j$ operates as a magnifying factor, so that the total level of productivity of the firm directly depends on the ability of its employees.

Firms' problem consists in correctly identifying the "quantity" of L that guarantees profit maximization in each period. Firms' strategy is defined 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[14]. 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 [15]. Firms can offer a 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 L 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

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

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:

$$w_i^j = \theta_i - \alpha d_i \tag{3}$$

with $j = A, B$

This competition "á la Bertrand" can only lead to a unique outcome: Firm A will hire the best L workers [16]. The difference in the commuting time workers have to face can be exploited by firm A in order to systematically offer potential employers 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 is:

$$w^B = \tilde{\theta} - \alpha(1-c) \tag{4}$$

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

$$w^A = \tilde{\theta} - \alpha(1-c) + \epsilon \tag{5}$$

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 L hired by A we can rewrite A's production function as:

$$Y_A = \left(\frac{1+\underline{\theta}}{2}\right) L_A^{\beta} \tag{6}$$

while applying a similar reasoning to firm B we get:

$$Y_B = \left(\frac{\underline{\theta} + \alpha(1-c)}{2}\right) L_B^{\beta} \tag{7}$$

with $\alpha(1-c)$ being the lowest level of productivity reached among those employed by firm B.

Hence, the two firms can be characterized by the following profit functions:

[16] The described mechanism can only work if the two firms perfectly observe the offers received by the worker. In this respect, see Postel-Vinay and Robin (2002).

$$\Pi_{0,A}^{Comp} = p\left(\frac{1+\underline{\theta}}{2}\right) L_A^{\beta} - \left(\frac{1+\underline{\theta}}{2} - \alpha(1-c) + \epsilon\right) L_A \tag{8}$$

$$\Pi_{0,B}^{Comp} = p\left(\frac{\underline{\theta} + \alpha(1-c)}{2}\right) L_B^{\beta} - \alpha(1-c) L_B \tag{9}$$

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 L workers the indifference wage, exploiting its oligopsonistic power.

The outlined framework illustrates but one of the two options faced by the firms. They can in fact find profitable to refrain from competing on the best L 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:

$$\Pi_{0,A}^{Coll} = p\left(\frac{1+\alpha(1-c)}{2}\right) L_A^{\beta} - \alpha c L_A \tag{10}$$

in this case perfectly resembling firm B's one:

$$\Pi_{0,B}^{Coll} = p\left(\frac{1+\alpha(1-c)}{2}\right) L_B^{\beta} - \alpha(1-c) L_B \tag{11}$$

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 8, neglecting all the terms involving ϵ, we obtain:

$$L_{0,A}^{Comp} = \left(\frac{F-g}{\beta\ p\ F}\right)^{\frac{1}{\beta-1}} \tag{12}$$

while the optimization value of 10 is:

$$L_{0,A}^{Coll} = \left(\frac{2\alpha c}{\beta \; p \; (1+g)} \right)^{\frac{1}{\beta - 1}} \tag{13}$$

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

$$\left(\frac{1+\underline{\theta}}{1+g} \right) > \left(\frac{F-g}{\alpha c} \right)^{\beta} \tag{14}$$

The economic interpretation of the above condition is straightforward. The ratio on the left hand side of the equation can be 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. 14 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.

$$\phi = \left(\frac{1+\underline{\theta}}{1+g} \right) - \left(\frac{F-g}{\alpha c} \right)^{\beta} \tag{15}$$

From equation 15 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 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:

$$F > g + \left[\frac{2(\alpha - g)^{\beta}}{\beta(1+g)} \right]^{\frac{1}{\beta - 1}} . \tag{16}$$

Hence competition is worth only if the difference in the ability level between the best workers

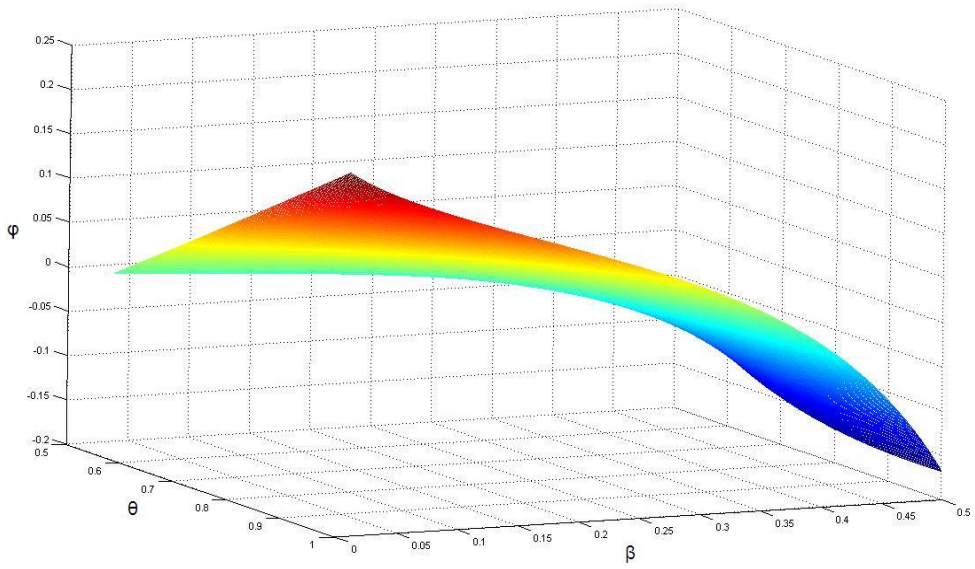


Figure 2: ϕ as β and $\underline{\theta}$ Vary

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. Figure 2.1 shows the behaviour of ϕ as a function of θ and β.

2.2 Second Period

According to the sign of equation 14, firms can behave in two opposite ways. In case ϕ 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, studying the situation in which firm A opts for entering a competition stage with firm B in order to guarantee itself the best L workers is more interesting within the present context. 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 L_A^* workers at a wage equal to $\left(\frac{1+\underline{\theta}}{2} - \alpha(1-c)\right)$, while B can hire the "second best" group L_B^* at a wage equal to $\alpha(1-c)$.

Differently from the previous period, 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 some 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 [17]. Defining the realized ability level as $\hat{\theta}_i$, this value can only be included within two ranges: $\hat{\theta}_i \in (\underline{\theta}, 1)$ or $\hat{\theta}_i \in (\alpha(1-c), \underline{\theta}]$. This ability will be perfectly observed by the employer at time $t=0$ but imperfectly by the other firm, so that for a worker initially employed by firm j, $(j = A,\ B)$, firm k $(k = A,\ B)$ will observe:

$$\tilde{\theta}_{i,\ k} = \lambda_k \times \theta_i + (1-\lambda_k) \times \hat{\theta}_i, \qquad \lambda \in (0,1) \tag{17}$$

so that the perceived ability can be seen as a linear combination of the prior and the observed ability with weights equal to λ. Given this assumption the employemnt dynamics between the two firms in period $t=1$ can now be studied.

2.2.1 Workers' Transition between Firms: From Firm A to Firm B

The analysis initially focuses on firm B. Assume that a share $l_B L_B$ $(0 \leq l \leq 1)$ of workers reveal an ability level $\hat{\theta}_i > \underline{\theta}_i$. A fraction $(1-\lambda_A)$ of these workers can be hired by firm A, as their perceived ability is higher than the critical threshold $\underline{\theta}$. The remaining $(1-(1-\lambda_A)l_B)L_B$ workers are kept by firm B, under a permanent contract, with a wage $w_{1,B} = \alpha(1-c) + \delta$.

Simultaneously, firm B will also (imperfectly) observe the ability of the workers hired by A in period $t=0$. Assuming that a share $l_A L_A$ of these workers reveal a true ability level $\hat{\theta}_i < \underline{\theta}$, firm A will make them redundant. All these workers are now employable by B which, nonetheless, may still presume an ability above the threshold for a share λ_B of them. Given this belief, the best strategy for B consists in offering a proportion $\lambda_B l_A L_A$ of the new workers a permanent contract, in order to

[17] 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.

prevent them from possibly rejoin firm A in period $t = 2$. For simplicity, I will assume that the wage offered to this workers is going to be identical to the one offered to the other permanent employees, including the tenure premium, δ. It is important to note that firm B has basically nothing to lose from this strategy: in case the actual ability of the worker matches the expected one, B has gained in productivity by having hired a worker whose ability is above $\underline{\theta}$ and therefore above the average ability of B's workers. In case the ability is proven to be different from the expected one and below $\underline{\theta}$ (as it should be, given the performance of these workers in firm A), firm B still gains, as it pays the reservation wage to workers whose ability is still above $\alpha(1-c)$. The remaining $\lambda_B l_A L_A$ workers laid out by A can by hired by B according to the usual "temporary and then permanent" scheme, guaranteeing them the reservation wage.

B's problem consists now in deciding whether or not hiring the workers made redundant by A. If B decides not to hire these workers, its profit function in period $t = 1$ can be summarized by the following equation:

$$\Pi^n_{1,B} = \begin{array}{c} p\left(\frac{\sum_{i=1}^{L_{0,B}(1-(1-\lambda_A)l_B)}\hat{\theta}_i}{L_{0,B}(1-(1-\lambda_A)l_B)}\right)(L_{0,B}(1-(1-\lambda_A)l_B))^\beta + \\ -(\alpha(1-c)+\delta)(L_{0,B}(1-(1-\lambda_A)l_B) \end{array} \tag{18}$$

or, more simply:

$$\Pi^n_{1,B} = p\ \Psi X^\beta_{0,B} - d\ X_{0,B}. \tag{19}$$

Conversely, the profit function in case B decides to hire all the workers characterized, as i, by an ability level $\theta_i > \underline{\theta}$ can be written as:

$$\begin{aligned} \Pi^h_{1,B} =& \lambda_B \Bigg\{ p\left(\frac{\sum_{i=1}^{L_{0,B}(1-(1-\lambda_A)l_B)}\hat{\theta}_i}{L_{0,B}(1-(1-\lambda_A)l_B)} + \frac{\sum_{i=1}^{l_A L_{0,A}}\theta_i}{l_A L_{0,A}}\right)(L_{0,B}(1-(1-\lambda_A)l_B) + l_A L_{0,A})^\beta + \\ & - (\alpha(1-c)+\delta)\left(L_{0,B}(1-(1-\lambda_A)l_B) + l_A L_{0,A}\right)\Bigg\} + \\ & + (1-\lambda_B)\Bigg\{ p\left(\frac{\sum_{i=1}^{L_{0,B}(1-(1-\lambda_A)l_B)}\hat{\theta}_i}{L_{0,B}(1-(1-\lambda_A)l_B)} + \frac{\sum_{i=1}^{l_A L_{0,A}}\hat{\theta}_i}{l_A L_{0,A}}\right)(L_{0,B}(1-(1-\lambda_A)l_B) + l_A L_{0,A})^\beta + \\ & - (\alpha(1-c)+\delta)\left(L_{0,B}(1-(1-\lambda_A)l_B)\right) - \alpha(1-c)l_A L_{0,A}\Bigg\} \end{aligned} \tag{20}$$

or, in a more compact way:

$$\Pi^h_{1,B} = \lambda_B \left\{ p \left(\Psi_B + \Gamma_B \right) \left(X_{0,B} + N_{0,A} \right)^\beta - d \left(X_{0,B} + N_{0,A} \right) \right\} \\ +(1-\lambda_B) \left\{ p \left(\Psi_B + \Lambda_B \right) \left(X_{0,B} + N_{0,A} \right)^\beta - d X_{0,B} - \alpha(1-c) N_{0,A} \right\}. \tag{21}$$

If we summarize the previous equation as:

$$\Pi^h_{1,B} = \lambda_B Z_1 + (1-\lambda_B) Z_2 \tag{22}$$

and we compare it with eq. 19, we obtain that firm B will opt for hiring the $lL_{0,A}$ workers coming from firm A as long as the following condition holds:

Condition 2

$$\lambda_B \geq \frac{\Pi^n_{1,B} - Z_2}{Z_1 - Z_2}. \tag{23}$$

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 23 is negative, so that the previous inequality is satisfied and firm B always hire the workers coming from A [18]. 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.

2.2.2 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 characterized 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 analyzed in the previous paragraph. At the beginning of period $t = 1$, firm A lays off a share $l_A L_{0,A}$ 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

[18] 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 (2005). Nonetheless, for a partly different result see also Topel (1991).

profit function at the beginning of period $t = 1$ is the following:

$$\Pi_A^n = \begin{array}{c} p\frac{\sum_{i=1}^{L_{0,A}(1-l_A)}\hat{\theta}_i}{L_{0,A}(1-l_A)}(L_{0,A}(1-l_A))^{\beta}+ \\ -\left(\frac{\sum_{i=1}^{L_{0,A}(1-l_A)}\hat{\theta}_i}{L_{0,A}(1-l_A)} - \alpha(1-c)+\delta\right)(L_{0,A}(1-l_A)) \end{array} \tag{24}$$

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

$$\Pi_A^n = p\ \Omega_{0,A} X_{0,A}^{\beta} - (\Omega_{0,A} - \alpha(1-c) + \delta)\, X_{0,A}. \tag{25}$$

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:

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

Yet, differently from the previous case, if firm A believes that worker i is actually characterized by an ability level equal to the prior will refrain from hiring her, so that the profit function will remain the one outlined in equations 24 and 25. The profit function in case A decides to hire the $l_B L_B$ workers can then be expressed as:

$$\Pi_A^h = \begin{array}{c} p\left(\frac{\sum_{i=1}^{L_A(1-l_A)}\hat{\theta}_i}{(1-l_A)L_A} + \frac{\sum_{i=1}^{l_B L_B}\hat{\theta}_i}{l_B L_B}\right)(L_A(1-l_A)+l_B L_B)^{\beta}+ \\ -\left(\frac{\sum_{i=1}^{L_A(1-l_A)}\hat{\theta}_i}{(1-l_A)L_A} - \alpha(1-c)+\delta\right)(L_A(1-l_A)) - \left(\frac{\sum_{i=1}^{l_B L_B}\hat{\theta}_i}{l_B L_B} - \alpha(1-c)\right) l_B L_B \end{array} \tag{27}$$

which I will rewrite as:

$$\Pi_A^h = p(\Omega_{0,A} + \Xi_{0,A})(X_{0,A} + N_{0,B})^{\beta} - (\Omega_{0,A} - \alpha(1-c) + \delta)X_{0,A} - (\Xi_{0,A} - \alpha(1-c))N_{0,B}. \tag{28}$$

Comparing the above expression with its counterpart for firm B, eq. 21, we can immediately notice that the wage potentially offered to $l_B L_B$ 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 $N_{0,B}$ 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. 28 overcomes the one presented in eq. eq:pnA2, 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

$$\lambda_A \geq \frac{\Pi_A^n}{\Pi_A^h + \Pi_A^n}. \tag{29}$$

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 $\Pi_{0,A}^h < 0$. Summarizing, 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.

2.2.3 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 $t = 1$.

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 1 we can summarise these changes in terms of changes in the utility of the workers, along with the changes

	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

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

Table 3: Changes in the Utility Function

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 [19].

[19]The production function proposed in eq. 2 implies labour as the only input. Workers are characterised only by their ability level. A simple extension of the model would imply the introduction of a higher degree of differentiation

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. 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 it is of particular relevance for our purposes to note that it is possible to identify individuals across different quarters[20]. All the data I used refer to the September-November quarters. In those surveys 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. this procedure is strictly necessary in order to obtain a relevant dataset: Even if 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, but these files can not be consider satisfactory for our purposes, as they do not include the relevant variables on travel to work time. 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

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.

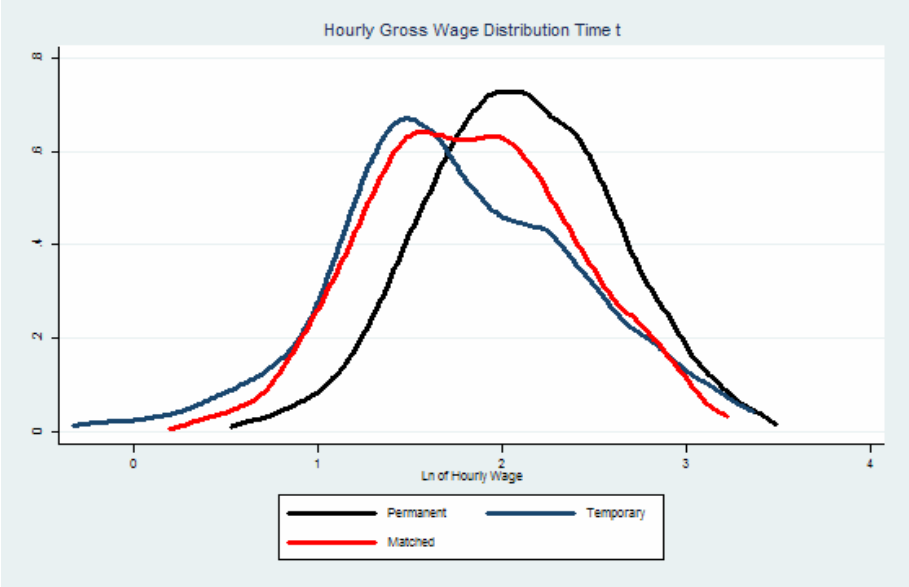
[20]Detailed information about the UK Labour Force Survey can be found in the web sites: http://www.statistics.gov.uk/ and http://www.data-archive.ac.uk/.

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)*

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, the term temporary workers is used 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 of contract it has been necessary to implement a propensity score matching procedure[21]. 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[22]. 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[23] the wage distribution (red line) of temporary workers appears 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 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.

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

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

[22]For a theoretical discussion on propensity score matching see Caliendo and Kopeinig (2008) and Caliendo and Hujer (2006). An introduction to PS estimators with continuous variables can be found in Angrist and Krueger (1999), pp. 1319-1320.

[23]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.

Hourly Wage 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
Comm. Time 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

Table 5: Average Values for Wages and Commuting Times

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.

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 hypotheses 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 suggests 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 might be related to the probability of observing a change in the working situation of an individual. The first column of Table 6 shows the result

Dependent Variable:	From Temporary to Permanent	Different Employer	Interaction Term
Variable	**Coefficient**	**Coefficient**	**Coefficient**
Log of Hourly Wage at t-1	-0.237***	-0.101***	-0.359***
	(0.052)	(0.025)	(0.065)
Commuting Time at t-1	0.002**	0.003***	0.001
	(0.001)	(0.000)	(0.002)
Age	-0.025*	-0.052***	0.007
	(0.014)	(0.006)	(0.018)
Age^2	0.000**	0.001***	0.000
	(0.000)	(0.000)	(0.000)
Education	-0.048***	0.000	-0.048**
	(0.018)	(0.008)	(0.025)
Experience	-0.181***	-0.047***	-0.165***
	(0.013)	(0.004)	(0.019)
$Experience^2$	0.004***	0.001***	0.004***
	(0.000)	(0.000)	(0.001)
Marital Status	-0.207***	-0.037	-0.187**
	(0.063)	(0.026)	(0.087)
Managerial Duties	-0.276***	-0.061**	-0.266**
	(0.089)	(0.029)	(0.129)
Union Member	-0.046	0.112***	-0.012
	(0.064)	(0.026)	(0.089)
Full-time / Part-time	0.469***	0.220***	0.360***
	(0.072)	(0.043)	(0.096)
Firm Size	0.079***	-0.022**	0.039
	(0.024)	(0.010)	(0.031)
Intercept	-0.668	0.438*	-0.586
	(0.505)	(0.265)	(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% ;
Standard Errors into brackets
Other controls are: 7 race dummies, 10 sector dummies, 14 regional dummies, 10 year dummies

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

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 different employer. All the variables used as regressors refer to time $t-1$ and the coefficients are to be 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 already stressed in the previous sections, 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. Column 1 presents the results of a standard OLS procedure in which the logarithm of the gross hourly wage is regressed against several variables controlling for personal and work related characteristics, including commuting time. The analysis is performed on the whole set of workers in the sample. In the second column the set of regressors is augmented by a number of dummy variables in order to control for race of the individual, sector and year fixed effects (a complete list of the regressors is presented in Appendix 2). The analysis is then repeated in columns three and four 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 main point of interest is certainly given by the lack of a statistically significant relation between wage and commuting time for temporary workers, when the whole set of controls is included. At first sight, the estimated parameter goes against the theory of compensating differentials. As noted in the previous section, non permanent employees earn significantly less than their permanent

counterparts, but no evidence of compensation in terms of other working characteristics can be detected at this basic level of investigation. In all, 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 the results. The lack of a statistical link between wage and commuting time for temporary workers is made more evident by the fact that no other relevant difference can be highlighted with respect to the relation between wage and the other explanatory variables between the two samples.

	All Workers		Temporary Workers	
Variable	**(1)**	**(2)**	**(3)**	**(4)**
Commuting Time	0.003***	0.002***	0.002***	0.001
	(0.000)	(0.000)	(0.000)	(0.001)
Age	0.068***	0.063***	0.071***	0.066***
	(0.002)	(0.002)	(0.007)	(0.007)
Age^2	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Education	0.101***	0.094***	0.089***	0.088***
	(0.002)	(0.002)	(0.010)	(0.011)
Experience	0.013***	0.014***	0.038***	0.038***
	(0.001)	(0.001)	(0.009)	(0.009)
$Experience^2$	0.000***	0.000***	-0.001**	0.038***
	(0.000)	(0.000)	(0.000)	(0.000)
Marital Status	0.082***	0.098***	0.067*	0.084**
	(0.006)	(0.006)	(0.039)	(0.040)
Managerial Duties	0.303***	0.293***	0.105***	0.294***
	(0.007)	(0.006)	(0.056)	(0.059)
Union Member	0.024***	0.045***	0.105***	0.125***
	(0.006)	(0.006)	(0.038)	(0.039)
Full-time Part-time	-0.137***	-0.079***	-0.061*	-0.045
	(0.011)	(0.011)	(0.034)	(0.036)
Intercept	-0.034	0.816***	-0.301**	-0.452
	(0.035)	(0.206)	(0.141)	(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
Standard errors into brackets

Table 7: OLS Relation Wage and Commuting Time

The analysis presented in table 7, although very basic, provides some evidence of the links between wage, commuting time and employment under a temporary contract. 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 set of regressors presented in the previous table augmented by some interaction terms, whose aim consists in capturing the changes on wage related to the changes in the employment status suggested by the proposed model and summarised in table 3.

The specification under analysis can be summarized by the following equation which is initially estimated through OLS:

$$ln(w_{i,t}) = \alpha + \beta I_{i,t} + \gamma X_{i,t} + \delta D_{i,t} + \epsilon_{i,t} \tag{30}$$

where X and D respectively are the matrices of covariates and dummy variables already presented in table 7, while I includes a number of interaction terms aimed at capturing the multiplicity of changes related to job characteristics. In this respect, the model outlined the possibility of observing the following shifts in terms 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 being possible for workers moving from A to B and from B to A.

The four columns of table 8 present the estimated results based on different specifications of equation 30, depending on the interaction variables included in the set of regressors.

The first row of the table show that the basic evidence presented in the previous section of a relevant penalty in terms of wage for temporary workers tends to loose momentum as more variables are taken under considerations. In all the four suggested specifications, in fact, no statically significant relation can be found between the salary obtained by a worker and her being employed under a non-permanent scheme (although the sign of the estimated parameters is consistently negative across the different columns). On the contrary, commuting time appears to be systematically compensated. The relevance of the explanatory power of the variable related to holding a temporary contract comes again into question observing the lack of any statistical importance of the

Variable	(1)	(2)	(3)	(4)
Temporary Contract	-0.0298	-0.0328	-0.0293	-0.0307
	(-0.88)	(-0.96)	(-0.86)	(-0.89)
Commuting Time	0.0018***	0.0018***	0.0018***	0.0018***
	(13.01)	(13.00)	(12.57)	(12.55)
Interaction Temp - Comm. Time	-0.0003	-0.0003	-0.0003	-0.0003
	(-0.34)	(-0.36)	(-0.36)	(-0.36)
Different Employer	-0.0005	0.0080	0.0035	0.0066
	(-0.06)	(0.89)	(0.39)	(0.73)
From Temp to Perm.	-0.0132	0.0446**	0.0280	0.0440**
	(-0.75)	(2.06)	(1.35)	(2.01)
From Temp to Temp	0.0171	0.0293	0.0209	0.0305
	(0.49)	(0.75)	(0.54)	(0.78)
Inter. Temp-Perm Diff. Employer		-0.148***		-0.140**
		(-4.13)		(-2.23)
Inter. Temp-Temp Diff. Employer		-0.0280		-0.0726
		(-0.54)		(-0.68)
Inter. Temp-Perm Diff. Employer With Positive Change in Comm. Time			-0.157***	-0.0356
			(-3.27)	(-0.49)
Inter. Temp-Perm Diff. Employer With Negative Change in Comm. Time			-0.0988*	0.0231
			(-1.88)	(0.31)
Inter. Temp-Temp Diff. Employer With Positive Change in Comm. Time			-0.0216	0.0405
			(-0.35)	(0.35)
Inter. Temp-Temp Diff. Employer With Negative Change in Comm. Time			-0.0189	0.0432
			(-0.24)	(0.35)
Constant	0.0560	0.0578	0.678***	0.679***
	(0.63)	(0.65)	(2.63)	(2.63)
R^2	0.463	0.463	0.465	0.465
Adjusted R^2	0.461	0.462	0.464	0.464
Observations	26863	26863	26528	26528

Significance levels: $*$: 10% $**$: 5% $***$: 1%; t-statistics into brackets

Table 8: OLS Relation Wage Interaction Terms

interaction term between the temporary contract dummy and the amount of time-to-work faced by the sampled individuals.

Having noted that a change in employer is associated with an increase in hourly wage, but with a coefficient which is not statistically different from 0, the analysis can be focused on the role played by the interaction terms explicitly introduced in eq. 30. Given the already commented results related to the variable "Temporary contract" it is interesting to note that in the second and in the fourth specification (which can be seen as the reduced form of a "kitchen-sink model") the change from temporary to permanent goes together with an increase in the wage. This particular result appears to question once again the theory of compensating differentials, and confirms the need for a further level of investigation. In this sense it of extreme empirical relevance the fact that this last result is overruled when the change in contract length (from temporary to permanent) is also associated to a change in employer. The parameter related to this variable tends to confirm the theoretical finding suggested in §2.2.3 and summarized as point 3 of table 3: a worker moving from one firm to another which shifts 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 the parameter characterizing those workers keeping a temporary job although with a different employer, the model suggests that the net result of such a change in terms of worker utility 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 show 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 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 [24]. 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 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 relations between a change of employer and of contract duration and 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.

It can also be noticed that the bulk of the proposed 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[25]. The remaining of this section is devoted to this kind of analysis. In order to evaluate the extent of the presence of selection bias in the data under investigation, two different empirical strategies are implemented. First of all, table 9 presents the results obtained by performing a propensity score matching procedure on the data employed for the OLS regressions presented in the previous pages.

The proposed estimates summarized the average treatment effects on the treated individuals on

[24] See, for example, Bentolila and Dolado (1994), Guell and Petrongolo (2000), Booth, Francesconi, and Frank (2002).

[25] A good review of applied methods in labour economics is given by Picchio (2006).

	Temporary	Temp to Perm	Temp to Perm Diff. Empl.	Temp to Perm Diff. Empl. Pos. Change
Dep Variable: Wage				
ATT	-0.142***	-0.101***	-0.198***	-0.214***
	(-7.38)	(-3.77)	(-5.57)	(-4.31)
Observations	29627	27045	26863	26863
Dep Variable: Comm. Time				
ATT	3.291***	2.156*	4.739**	14.47***
	(3.81)	(1.69)	(2.35)	(4.92)
Observations	29627	27045	26863	26863

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Propensity Score Matching Estimates

the two critical variables, wage and commuting time. The parameters are estimated using nearest neighbor matching across the list of variables already used in the previously presented regressions[26]. The four columns present the results depending on the variable chosen for the treatment: holding a temporary contract, having shifted from a temporary to a permanent contract, having performed this last change in employment status with a simultaneous change in employer and finally with the simultaneous change is employer and status is associated to a positive change in commuting time. The coefficients are in line with what already suggested by the OLS procedure. The penalty in terms of wage and time-to-work experienced by the temporary workers is clearly highlighted, but the prediction of a lack of immediate compensation as the worker experiences a change in her job status finds an empirical confirmation[27].

An extra step can be taken in order to address the issue of selection bias in the regression analysis. The reference in this case is of course to the two-step procedure suggested by Heckman (1979). Table 10 presents the results of the second stage, where the dependent variable is still given by the logarithm of the hourly wage, while in the first stage is conducted on the probability of holding a temporary contract at time $t-1$.

Two main results emerge from the presented estimates; first of all, the role of selection into

[26]The procedure employed in obtaining the estimates is based on Abadie, Herr, Imbens, and Drukker (2004); the matching is exact with respect to age and education.

[27]The parameter presented in the fourth column of table 9 and related to Commuting Time is presented only for completeness but cannot be considered informative. As the focus of the fourth column is to investigate the propensity score matching with respect to those workers that have experienced a positive change in commuting time within the two periods of observation, the estimated parameter is by construction positive, statistically significant and much larger in relative size with respect to the other coefficients presented in the same table.

	heck1	heck2	heck3	heck4
Log of Hourly Wage				
Commuting Time	0.0023***	0.0026***	0.0027***	0.0027***
	(3.08)	(3.09)	(3.12)	(3.10)
Interaction Temp - Comm. Time	-0.0006	-0.0012	-0.0013	-0.0013
	(-0.82)	(-1.13)	(-1.19)	(-1.17)
Different Employer	-0.0408	-0.0243	-0.0437	-0.0213
	(-1.20)	(-0.05)	(-1.02)	(-0.43)
From Temp to Perm.		-0.0108	-0.0300	-0.0154
		(-0.22)	(-0.63)	(-0.31)
Inter. Temp-Perm Diff. Employer		-0.0691		-0.0798
		(-1.09)		(-0.87)
Inter. Temp-Perm Diff. Employer			-0.0353	0.0152
With Positive Change in Comm. Time			(-0.54)	(0.17)
Inter. Temp-Perm Diff. Employer			0.0235	0.0741
With Negative Change in Comm. Time			(0.33)	(0.80)
Constant	0.850***	0.859***	0.867***	0.868***
	(4.78)	(4.82)	(4.84)	(4.84)
mills				
lambda	0.218***	0.217***	0.225***	0.224***
	(4.95)	(4.92)	(5.00)	(4.98)
rho	0.413	0.412	0.425	0.424
sigma	0.529	0.528	0.528	0.528
lambda	0.218	0.217	0.225	0.224
Observations	35165	35165	35135	35135

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

Other controls are: 7 race dummies, 10 sector dummies, 10 year dummies
Standard errors into brackets

Table 10: Heckman Procedure - Second Stage

temporary employment appears empirically relevant in determining the wage of the worker. In particular, the inverse Mills ratio is systematically statistically significant and the sign characterizing the coefficient ρ suggests that the unobservable characteristics linked to each of the two stages of the analysis are positively correlated. Furthermore, none of the explanatory variables meant to capture the changes in the labour status of the individual are significant anymore. It appears evident that as far as the observable characteristics only are taken into consideration, the predictions obtained through the simple theoretical analysis proposed in section 2 are at least partially confirmed, even if the occurrence of selection into temporary work is taken into account. The picture changes in case the role of unobservable characteristics are taken into account in the empirical analysis. In this framework, the explanatory power of the dummies representing the changes in working status tends to lose momentum; this pattern, appears to be common to all the relevant variables taken

into consideration in the study presented in this section, with the only exception of commuting time, which still shows positive and significant relations with the wage of the sampled individuals.

5 Conclusions

This paper addresses the issue of the presence and the extent of compensating differentials in terms of wage and working conditions between temporary and permanent employees. Most of the existing literature on temporary employment presents empirical evidence 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 workers are characterized by heterogeneous ability level, firms can offer either temporary or permanent contracts 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 Bertrand 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 characterize the individuals that happen to change employer but are still initially hired on a temporary base.

All these predictions are then empirically analyzed by testing a reduced form of the model. In this respect, the last two sections of the paper are devoted to a descriptive and an empirical study of data from the UK Labour Force Survey, covering an eleven-year period, 1994 to 2004. 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 simultaneously experiencing a change in employer and shifting from a temporary to a permanent

contract the results of the proposed regressions suggest a well defined pattern characterized by a reduction in the wage corresponding to a simultaneous increase in travel-to-work distance. The robustness of the coefficients is tested through different econometric procedures, which suggest that the role of unobservable characteristics in the selection into temporary employment can play an important role in the determination of the wage patterns of an individual.

As some of the theoretical predictions can not be fully confirmed by the proposed empirical analysis, this paper can still be seen as first step in a more complicated and general analysis of the differences between temporary and permanent workers. Several theoretical aspects still deserve to be fully investigated, with particular reference to a complete characterization of the career profile of the workers experiencing more than one consecutive spell in temporary employment. With respect to the empirical results, the issue of the effect of unobservable characteristics in the selection into temporary works remains open to further investigation and may constitute a substantial starting point for a new applied study of the features related to different job schemes.

Appendix 1

Proof of Condition 1

The condition in eq.14 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:

$$\Pi_{0,A}^{Comp} = pFH^{\beta} - (F-g)H \tag{31}$$

$$\Pi_{0,A}^{Coll} = pDH^{\beta} - \alpha c H \tag{32}$$

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:

$$\Pi_{0,A}^{*,Comp} = pF\left(\frac{F-g}{p\beta F}\right)^{\frac{\beta}{\beta-1}} - (F-g)\left(\frac{F-g}{p\beta F}\right)^{\frac{1}{\beta-1}} \tag{33}$$

$$\Pi_{0,A}^{*,Coll} = pD\left(\frac{\alpha c}{p\beta D}\right)^{\frac{\beta}{\beta-1}} - \alpha c\left(\frac{\alpha c}{p\beta D}\right)^{\frac{1}{\beta-1}} \tag{34}$$

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

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

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

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

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

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

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

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

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

■

Proof of Condition 2

Equation 23 stated:

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

which can be explicitly rewritten as:

$$\lambda_B \geq \frac{\begin{array}{c} p\ \Psi X^{\beta}_{0,B}-dX_{0,B}+ \\ -p\ (\Psi_B+\Lambda_B)\ (X_{0,B}+N_{0,A})^{\beta}-dX_{0,B}-\alpha(1-c)N_{0,A} \end{array}}{\begin{array}{c} p\ (\Psi_B+\Gamma_B)\ (X_{0,B}+N_{0,A})^{\beta}-d\,(X_{0,B}+N_{0,A})+ \\ -p\ (\Psi_B+\Lambda_B)\ (X_{0,B}+N_{0,A})^{\beta}-dX_{0,B}-\alpha(1-c)N_{0,A} \end{array}} \tag{35}$$

and simplified into:

$$\lambda_B \geq \frac{p[\Psi X_{0,B}^{\beta} - (\Psi + \Lambda)(X_{0,B} + N_{0,A})^{\beta}] + \alpha(1-c)N_{0,A}}{p(\Gamma - \Lambda)(X_{0,B} + N_{0,A})^{\beta} - \delta N_{0,A}} \tag{36}$$

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. 36 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:

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

which can be 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. 36 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 $\Pi^n_{1,B} > Z2 > Z_1$; 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 $\mathcal{D}> 0$ implies $p\ [(\Gamma - \Lambda)(X_{0,B} + N_{0,A})^{\beta}] > \delta N$. On the other hand, since $\mathcal{N}> 0$ 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, this result is not feasible, since $RHS < 1$ leads to:

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

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 11: 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.

Appendix 3

Variable	(1)	(2)	(3)	(4)
Temporary Contract	-0.0298	-0.0328	-0.0293	-0.0307
	(-0.88)	(-0.96)	(-0.86)	(-0.89)
Commuting Time	0.0018***	0.0018***	0.0018***	0.0018***
	(13.01)	(13.00)	(12.57)	(12.55)
Interaction Temp - Comm. Time	-0.0003	-0.0003	-0.0003	-0.0003
	(-0.34)	(-0.36)	(-0.36)	(-0.36)
Different Employer	-0.0005	0.0080	0.0035	0.0066
	(-0.06)	(0.89)	(0.39)	(0.73)
From Temp to Perm.	-0.0132	0.0446**	0.0280	0.0440**
	(-0.75)	(2.06)	(1.35)	(2.01)
From Temp to Temp	0.0171	0.0293	0.0209	0.0305
	(0.49)	(0.75)	(0.54)	(0.78)
Inter. Temp-Perm Diff. Employer		-0.148***		-0.140**
		(-4.13)		(-2.23)
Inter. Temp-Temp Diff. Employer		-0.0280		-0.0726
		(-0.54)		(-0.68)
Inter. Temp-Perm Diff. Employer			-0.157***	-0.0356
With Positive Change in Comm. Time			(-3.27)	(-0.49)
Inter. Temp-Perm Diff. Employer			-0.0988*	0.0231
With Negative Change in Comm. Time			(-1.88)	(0.31)
Inter. Temp-Temp Diff. Employer			-0.0216	0.0405
With Positive Change in Comm. Time			(-0.35)	(0.35)
Inter. Temp-Temp Diff. Employer			-0.0189	0.0432
With Negative Change in Comm. Time			(-0.24)	(0.35)
Age	0.0584***	0.0583***	0.0586***	0.0585***
	(31.86)	(31.81)	(31.81)	(31.77)
Age^2	-0.0007***	-0.0007***	-0.0007***	-0.0007***
	(-30.66)	(-30.62)	(-30.59)	(-30.56)
Education	0.0953***	0.0953***	0.0956***	0.0956***
	(49.68)	(49.71)	(49.69)	(49.72)
Experience	0.0107***	0.0108***	0.0108***	0.0109***
	(10.98)	(11.12)	(11.05)	(11.10)
$Experience^2$	-0.0001***	-0.0001***	-0.0001***	-0.0001***
	(-4.48)	(-4.59)	(-4.54)	(-4.58)
Married	0.0937***	0.0935***	0.0916***	0.0916***
	(14.70)	(14.68)	(14.35)	(14.35)
Managerial Duties	0.285***	0.285***	0.286***	0.286***
	(44.14)	(44.21)	(44.36)	(44.40)
Union Member	0.0420***	0.0419***	0.0407***	0.0408***
	(6.99)	(6.97)	(6.76)	(6.77)
Full-time Part-time	-0.0948***	-0.0967***	-0.100***	-0.101***
	(-5.91)	(-6.04)	(-6.24)	(-6.26)
Size of the Firm	0.0595***	0.0594***	0.0596***	0.0595***
	(21.42)	(21.40)	(21.33)	(21.33)
White	0.0184	0.0175	0.127**	0.126**
	(0.26)	(0.25)	(2.41)	(2.37)
Black Carab	-0.0207	-0.0222	0.0915	0.0902
	(-0.27)	(-0.29)	(1.50)	(1.48)
Black African	-0.113	-0.111	0	0
	(-1.28)	(-1.25)	.	.
Indian	-0.0635	-0.0653	0.0461	0.0441
	(-0.85)	(-0.87)	(0.80)	(0.76)
Pakis-Banglad	-0.101	-0.101	0.0052	0.0034
	(-1.25)	(-1.25)	(0.08)	(0.05)

Chinese	0	0	0.0927	0.0957
	.	.	(1.04)	(1.08)
Other	0.0352	0.0342	0.142**	0.141**
	(0.47)	(0.45)	(2.44)	(2.40)
Agriculture and Fishing	0	0	0	0
	.	.	.	.
Energy and Water	0.230***	0.231***	0.229***	0.230***
	(7.57)	(7.62)	(7.47)	(7.48)
Manufacturing	0.153***	0.154***	0.153***	0.154***
	(5.99)	(6.06)	(5.96)	(5.99)
Construction	0.134***	0.135***	0.132***	0.132***
	(5.02)	(5.08)	(4.90)	(4.92)
Distribution	-0.00584	-0.0045	-0.0050	-0.0043
	(-0.22)	(-0.17)	(-0.19)	(-0.16)
Hotels and Restaurants	-0.190***	-0.188***	-0.188***	-0.188***
	(-5.95)	(-5.91)	(-5.85)	(-5.85)
Transport and Communication	0.0693***	0.0707***	0.0698***	0.0701***
	(2.63)	(2.68)	(2.62)	(2.64)
Banking, Finance	0.211***	0.213***	0.211***	0.211***
	(8.04)	(8.10)	(7.94)	(7.97)
Public Admin	0.0848***	0.0861***	0.0852***	0.0857***
	(3.26)	(3.31)	(3.24)	(3.26)
Other Services	0.0006	0.0015	0.0042	0.0048
	(0.02)	(0.05)	(0.14)	(0.17)
North Region	0.0548***	0.0534***	-0.678***	-0.678***
	(2.65)	(2.58)	(-2.74)	(-2.74)
Yorkshire	0.0630***	0.0625***	-0.671***	-0.670***
	(3.22)	(3.20)	(-2.71)	(-2.71)
East Midlands	0.0885***	0.0878***	-0.646***	-0.645***
	(4.42)	(4.39)	(-2.61)	(-2.61)
Eest Anglia	0.134***	0.133***	-0.601**	-0.601**
	(6.33)	(6.28)	(-2.43)	(-2.43)
London	0.313***	0.312***	-0.422*	-0.421*
	(15.79)	(15.77)	(-1.71)	(-1.71)
Rest of South East	0.195***	0.194***	-0.538**	-0.538**
	(10.51)	(10.48)	(-2.18)	(-2.18)
South West	0.0951***	0.0947***	-0.640***	-0.639***
	(4.88)	(4.86)	(-2.59)	(-2.59)
West Midlands	0.106***	0.105***	-0.627**	-0.627**
	(5.53)	(5.49)	(-2.54)	(-2.54)
Manchester	0.101***	0.100***	-0.632**	-0.631**
	(4.92)	(4.88)	(-2.55)	(-2.55)
North West	0.0731***	0.0724***	-0.662***	-0.661***
	(3.52)	(3.48)	(-2.68)	(-2.68)
Wales	0.0511**	0.0505**	-0.682***	-0.681***
	(2.38)	(2.36)	(-2.76)	(-2.76)
Scotland	0.0731***	0.0724***	-0.660***	-0.659***
	(3.73)	(3.69)	(-2.67)	(-2.67)
North Irel	0	0	-0.732***	-0.731***
	.	.	(-2.95)	(-2.95)
Out UK	0.740***	0.738***	0	0
	(2.98)	(2.98)	.	.
Year 1994	-0.169***	-0.169***	-0.166***	-0.166***
	(-13.13)	(-13.15)	(-12.91)	(-12.91)
Year 1995	-0.0560***	-0.0560***	-0.0531***	-0.0530***
	(-4.10)	(-4.10)	(-3.89)	(-3.88)
Year 1996	-0.131***	-0.132***	-0.130***	-0.130***
	(-10.48)	(-10.53)	(-10.36)	(-10.37)
Year 1997	-0.126***	-0.126***	-0.124***	-0.124***
	(-9.70)	(-9.71)	(-9.58)	(-9.58)
Year 1998	-0.0822***	-0.0822***	-0.0806***	-0.0805***
	(-6.36)	(-6.36)	(-6.21)	(-6.21)
Year 1999	-0.0869***	-0.0871***	-0.0862***	-0.0861***

	(-6.65)	(-6.67)	(-6.58)	(-6.57)
Year 2000	-0.0282**	-0.0286**	-0.0286**	-0.0287**
	(-2.19)	(-2.22)	(-2.23)	(-2.23)
Year 2001	0.0062	0.0062	0.0071	0.0073
	(0.49)	(0.49)	(0.57)	(0.58)
Year 2002	0	0	0	0
	.	.	.	.
Year 2003	0.0257**	0.0258**	0.0277**	0.0278**
	(1.97)	(1.98)	(2.12)	(2.12)
Constant	0.0560	0.0578	0.678***	0.679***
	(0.63)	(0.65)	(2.63)	(2.63)
R^2	0.463	0.463	0.465	0.465
Adjusted R^2	0.461	0.462	0.464	0.464
Observations	26863	26863	26528	26528

Significance levels: $*$: 10% $**$: 5% $***$: 1%; t-statistics into brackets

Table 12: OLS Relation Wage Interaction Terms

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