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Temporary work agencies and equilibrium unemployment*

by

Michael Neugart[1]
Minda de Gunzburg
Center for European Studies
Harvard University
27 Kirkland Street
Cambridge, MA 02138 USA
Tel: (617) 495-4303;
Fax: (617) 495-8509
e-mail: neugart@fas.harvard.edu

Donald Storrie
Department of Economics
Centre for European Labor
Market Studies
University of Göteberg
e-mail: Donald.Storrie@
economics.gu.se

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A striking feature of OECD labor markets in the 1990s has been the very rapid increase of temporary agency work. We augment the equilibrium unemployment model as developed by Pissarides and Mortensen with temporary work agencies in order to focus on their role as matching intermediaries and to examine the aggregate impact on employment. Our model implies that the improvement in the matching efficiency of agencies led to the emergence and growth of temporary agency work. We also show that temporary agency work does not necessarily crowd out other jobs.

Keywords: temporary work agencies, matching model, equilibrium unemployment, crowding out
JEL-Classification: E24, J23, J41, J64

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[1]On leave from Wissenschaftszentrum Berlin für Sozialforschung (WZB) until July 2003.

Temporary work agencies and equilibrium unemployment*

Michael Neugart† and Donald Storrie‡

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A striking feature of OECD labor markets in the 1990s has been the very rapid increase of temporary agency work. We augment the equilibrium unemployment model as developed by Pissarides and Mortensen with temporary work agencies in order to focus on their role as matching intermediaries and to examine the aggregate impact on employment. Our model implies that the improvement in the matching efficiency of agencies led to the emergence and growth of temporary agency work. We also show that temporary agency work does not necessarily crowd-out other jobs.

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†Minda de Gunzburg Center for European Studies, Harvard University, 27 Kirkland Street, Cambridge, MA 02138 U.S.A., phone: 001-617-4954303, fax: 001-617-4958509, e-mail: neugart@fas.harvard.edu, on leave from the Wissenschaftszentrum Berlin für Sozialforschung (WZB) until July 2003

‡Centre for European Labour Market Studies, Department of Economics, University of Göteborg, e-mail: Donald.Storrie@economics.gu.se

1 Introduction

During the 1990s temporary agency work has increased rapidly in practically all OECD countries. In every Member State of the European Union (except Greece where it is illegal), temporary agency work has at least doubled during the 1990s, and in Scandinavia, Spain, Italy and Austria, it has increased at least five-fold. By the end of the decade it accounted for 1.3 percent of the stock of employment in the EU, Storrie (2002). The United States has also seen more than a doubling of agency employment in the 1990s, from 1.2 percent to 2.6 percent (Houseman et al. (2001)). Temporary agency work has been de-regulated in several European countries in 1990s and a proposed directive on agency work is currently before the European Parliament.[1]

Temporary agency work is the most recent expression of the proliferation of employment relationships in the last three decades. It can be defined as follows. The temporary agency worker is employed by the temporary work agency and, by means of a commercial contract, is hired out to perform work assignments at a client firm. This definition varies between countries only with respect to the employment status of the worker at the agency.

In this paper we extend an equilibrium unemployment model, as in Diamond (1981), Mortensen (1982), and Pissarides (1990) with temporary agency work in order to focus on its role as a matching intermediary and its aggregate impact on employment. To our knowledge the only formal model of agency work is Autor (2003) which relates the rise of agency work to the decline of employment-at-will in the United States. While this may be a reasonable hypothesis in the US, the rise of agency work in Europe can hardly be related to a tightening of employment protection in the last decade. Empirical work by Katz and Krueger (1999) based on regional data and representative case studies in Houseman et al. (2001) focus instead on the matching function of agencies.

Similar extensions of the equilibrium model of unemployment can be found in Holmlund and Lindén (1993), where macroeconomic effects of 're-

[1]The main aim of the directive is to establish the general principle of non-discrimination, in terms of basic working conditions, of agency workers compared to workers in the user firm doing the same or similar work. There are however several important exceptions: where a temporary worker has a permanent contract and is paid between assignments, where social partners can conclude collective agreements derogating from the principle by providing for alternative means to secure adequate protection and where an assignment or series of assignments with one user firm will not exceed 6 weeks.

lief jobs' are studied. Wasmer (1999) uses this approach to study the role of productivity growth on the emergence of fixed-term contracts. Fredriksson and Holmlund (2001), Boone et al. (2002), and Coe and Snower (1997) model the optimal design of unemployment benefit systems in such a flow setting. Pissarides (2001) studies the role of employment protection legislation in equilibrium unemployment. The political economy of active labor market policies is studied by Saint-Paul (1998), and crowding-out effects of low-educated workers on low skilled jobs by high-educated workers in Spain are modelled by Dolado et al. (2000) in such a framework.

We argue that deregulation of temporary agency work together with the widespread use of information and communication technologies helped to overcome a critical threshold level under which there were no positive revenues for temporary work agencies so that a market for agency activities could emerge. Further increases in matching efficiency due to improvements in reputation and, with the ever-closer relationships between agencies and client firms, the mitigation of some coordination failure, sustained the growth of agency work throughout the 1990s. Employing an equilibrium unemployment model of the labor market also allows us to study the aggregate impact of temporary work agencies. In a calibrated version of our model, we address issues such as whether temporary agency jobs crowd out other, 'regular' jobs. In this sense, we complement microstudies on transitions on the labor market that cannot identify net aggregate effects. See, for example, Almus et al. (1998).

The model is developed in section 3. Some analytical results are presented in section 4. In particular, it shows that intermediaries on the labor market will only exist if they are very efficient in placing workers to client firms. Section 5 presents some simulation results of the model. The last section concludes. However, before introducing the model it may be useful to present some basic empirical and institutional background to this novel and relatively un-researched employment relationship.

Table 1: Temporary agency work in 1999

	Rate of agency work in %
Netherlands	4.0
Luxembourg	3.5
France	2.7
USA	2.6
UK	2.1
Belgium	1.6
EU	1.4
Portugal	1.0
Spain	0.8
Sweden	0.8
Austria	0.7
Denmark	0.7
Germany	0.7
Finland	0.6
Ireland	0.6
Italy	0.2
Greece	0

Sources: For European countries see Storrie (2002). U.S. figures are from Houseman et al. (2001) and refer to 2000.

2 Temporary agency work: some basic empirical and institutional features

Table 1 presents the most recent available compilation of statistics on the level of temporary agency work with some degree of comparibility.[2] The Netherlands is the most agency work intensive country, followed by Luxembourg, France, the US, the UK and Belgium. The intensity is low in Austria, Germany, and the Scandinavian and Southern European countries.

Many of the characteristics of agency workers are similar to those in other temporary jobs, see for example, Booth et al. (2002), Dolado et al. (2002), and Holmlund and Storrie (2002). Thus, on average agency workers are younger, less well-educated and receive lower wages and less training than workers with more permanent contractual status, see Paoli and Merllié (2001) and Storrie (2002). However, unlike the gender and sector distribution of fixed-term contracts, agency work is generally most intense among men and in industry.[3] Temporary agency work is of very short duration, even shorter than fixed-term contracts, both in terms of the assignment at the client firm and the employment spell at the agency, see Storrie (2002). While some workers express a preference for agency work, they are a clear minority, see for example Cohany (1998). The rapid increase in the 1990s must be driven by the client firms' demand for agency work and the agencies' capability to supply it.

There are a number of reasons why the firm may hire labor on a temporary basis, such as for a specific task that is limited in duration, to replace an absent permanent employee, etc., see for example Schmid and Storrie (2001). Whatever the reason, severance costs may make frequent employment contracts for a short duration unprofitable for the firm. One of the most prominent trends in labor law in the last two decades in Europe has been the proliferation of the circumstances for which the employer may hire

[2]Data on temporary agency work is generally of very poor quality. In most countries questions on agency work are not asked in the labor force survey and even when they are research indicates serious reporting errors, see for example, Burchell et al. (1999). However, while one should be somewhat sceptical as to the accuracy of the level of temporary agency work, and comparisons between countries, the rapid increase of agency work in the 1990s is indisputable.

[3]Of course, there are some examples of higher wages and training levels in agency work than for otherwise similar directly employed persons. See Houseman et al. (2001) and Cam et al. (2002).

labor under conditions other than those under open-ended contracts. The employment protection literature explaining the rise and consequences of "flexible" employment contracts takes relatively lower severance costs as a theoretical point of departure. See Dolado et al. (2002) for a recent review of the interesting Spanish research.

We do not address the issue of why establishments in most OECD countries in the last two decades have, to an increasing degree, used various forms of temporary employment contracts, but take it as a stylized fact. However, it is relevant for this paper to demonstrate that agency work may be a more appropriate means of performing the same functions as temporary employment contracts.[4] The truly distinguishing feature of agency work in this context is that adjustment costs are directly borne by the agency. Of course, the client firm pays for this service, and this is a source of agency profits. However, the specialization of such functions in agencies with the potential for ensuing economies of scale, together with the potential for agencies to spread employment termination risks between various firms and sectors of the economy, may lead to lower costs through an outsourcing of these functions to the agency than for the client firms to perform them in-house. The outsourcing of some functions of the personnel department at the client firm is more obviously apparent when viewing the other, often-neglected, aspect of employment adjustment costs, i.e. recruitment. Matching is the key issue in our model and we return to why matching efficiency in agencies may be relatively high and has increased in the last decade in section 4.1.

There is some evidence that temporary work agencies are beginning to play a highly significant role as a matching intermediary. Katz and Krueger (1999) suggest that the rise of temporary agency work, with its potential to improve matching, may be a major factor in explaining the remarkable downward shift of the Phillips curve in the US during the 1990s. They find some empirical support for this claim by noting that the increase of temporary agency work coincided with an inward shift of the Beveridge curve. Furthermore, using cross-state regressions they find evidence that the rise of temporary work agencies in a state held down wage growth. However, they view their analysis as being "preliminary and highly speculative". Houseman et al. (2001) present some case study evidence which shows that the matching motive is an important factor behind the client firm's increasing recourse to

[4]Surveys of client firms find that the motivation for using agency workers are very similar to those for fixed-term contracts. See CIETT (2000) and Cam et al. (2002).

temporary agency work.

On the supply side, the increase in agency work in Europe is obviously related to the widespread deregulation of the sector during the 1990s, see OECD (1999) and Storrie (2002). The impact is indisputable in the countries where agency work has gone from being illegal to practically without regulation at all. This has been the case in Sweden and Finland and the changes in Italy and Spain have been almost as extensive.

There are three main means of regulation. First, the regulation of the sector, for example, as regards authorization and monitoring of the firms or the banning of agency work in particular industries. Second, to regulate the assignment at the client firm in a fashion similar to the restrictions placed on hiring on fixed-term contracts, for example, in terms of duration and "objective reasons". Third, the regulation of the contract at the agency where the essential matter is whether the agency worker is awarded the status of an employee or not. The US, UK, Ireland, Sweden, Finland and Denmark have practically no regulation of the sector or assignment. However, in Scandinavia, it is clear that the worker has an employment contract at the agency, while this is not always the case in the UK, Ireland and the USA. Most of the continental European countries, in particular France, Belgium, Italy, Spain and Portugal have a detailed regulation of both the sector and the assignment.

The trend appears to be moving away from the regulation of the assignment and sector towards some employment security for the worker at the agency. This is most noticeable in the Dutch legislation, of the late 1990s, which removed practically all regulation of the assignment and the sector but clarified that the agency worker did have an employment contract at the agency, which with time gives increased employment protection, see Pot et al. (2002). The radical deregulation in Scandinavia in the mid-1990s stipulated only employment contract status. Also in the UK, a spate of legislation at the the end of the decade extended various rights to "workers" which previously applied only to "employees" and encompassed many agency workers. It is thus this type of institutional set-up that we work with in the model in this paper, i.e. with employment status for agency workers and with some degree of income security.

Finally, we should note that such an institutional set-up, i.e. the deregulation of agency work as regards assignments and the sector, while awarding employment status to agency workers may provide a step towards the solution to one of the major conflicts in OECD labor markets in the last two

decades. It has always been assumed that the employers' demand for numerical flexibility and the workers preference for job security are irreconcilable. However, in principle, agency work can provide some employment security at the agency while providing flexible assignments at the client firm. Temporary agency work should thus be an important research topic in economics.

3 The model

3.1 Flow equilibria

We model four labor market states and corresponding flows (see figure 1). Workers can be unemployed U, employed on a regular job E, in the pool of workers of a temporary work agency A, or assigned to a job at a client firm T. Differentiating between states A and T captures the most outstanding characteristic of temporary agency work as a three party relationship. A worker is employed with a work agency in A, but assigned to a client in T. Thus matching occurs in bringing workers and temporary work agencies together as well as in assigning workers to client firms. Let the size of the labor force be $(e + a + t + u = 1)$, assuming that labor force growth is zero, where e, a, and t denote employment in states E, A, and T, respectively, and u is unemployment.

Job specific shocks occur at exogenous rates μ_i with $i = E, T, A$. If a shock hits a job in sector E the worker will become unemployed. He will also become unemployed, if a shock makes jobs at the temporary work agency (A) redundant. At a rate μ_T temporary jobs at the client firm (T) go sour. Then our worker will end up in the pool of workers of the temporary work agency.

Job offers for regular employment arrive at an unemployed person with a rate α_E and rate α_A for an agency job. We assume that workers accept the first job offer, regardless of whether it is a regular job or a job at an agency. A worker at an agency waiting for an assignment gets regular job offers at the rate $c_A \cdot \alpha_E$. An agency will find an assignment for a worker at a client firm at a rate α_T. While assigned to a client our worker gets a job offer for regular employment with rate $c_T \cdot \alpha_E$. We call the parameters c_A and c_T search effectiveness of workers in states A and T relative to unemployed workers.

Bringing job searchers S_i and vacancies V_i together so that a job is

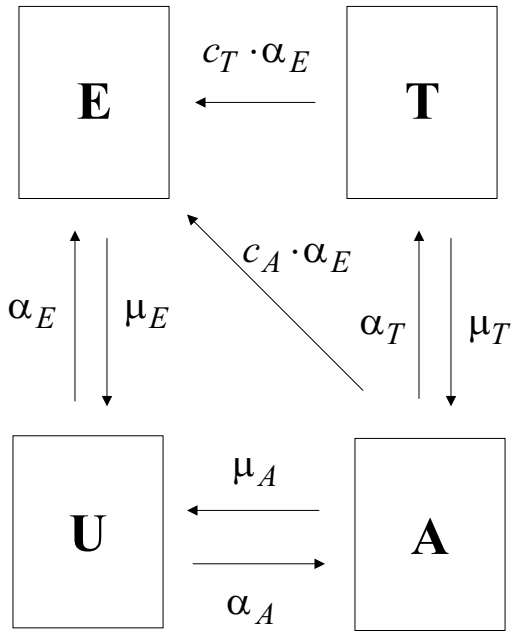

Figure 1: Labor market flows

formed incurs frictions. Matching workers to jobs is costly because of heterogeneity of job searchers and vacancies. Empirical research (see Petrongolo and Pissarides (2001)) suggests a constant returns matching technology and so we assume a Cobb-Douglas function in both sectors. Hence, we have $M_i = m_i \cdot V_i^{\nu} \cdot S_i^{1-\nu}$ with scale parameters m_i.

A firm that posts a vacancy in sector E faces job searchers from U, A and T. Taking into account different search effectiveness we have $S_E = u + c_A \cdot a + c_T \cdot t$. Temporary work agencies only search in the pool of unemployed workers, $S_A = u$. Furthermore, we have $S_T = a$, as temporary work agencies assign workers to client firms in T.

We define labor market tightness for firms in E, A and U as vacancies over job searchers, $\theta_i = \frac{V_i}{S_i}$, respectively. Any firm will fill a vacancy at the rate $q_i = \frac{M_i}{V_i} = M_i(1, \frac{1}{\theta_i})$.

The flow of new hires into the regular sector is given by $M_E = \alpha_E \cdot S_E$. Hence, the outflow from unemployment into regular jobs is the rate at which job offers occur times the number of unemployed searchers $\alpha_E \cdot u$. The flow from unemployment to temporary work agencies is given by $\alpha_A \cdot u$. The outflow from sector A into regular employment corresponds to effective searchers in A times the job offer arrival rate, $c_A \cdot a \cdot \alpha_E$. The flow of assignments is $\alpha_T \cdot a$. Hires into regular employment from temporary work are $c_T \cdot \alpha_E \cdot t$. Note that job offer arrival rates can also be written as $\alpha_i = \frac{M_i}{V_i} \cdot \frac{V_i}{S_i} = q_i \cdot \theta_i$ with $i = E, A, T$.

The vacancy filling rate declines with labor market tightness $q_i'(\theta_i) < 0$. The job offer arrival rates increases in labor market tightness $\alpha_i'(\theta_i) > 0$.

The flow equilibria are determined by equations (1) to (4):

$$\alpha_E \cdot u + c_A \cdot \alpha_E \cdot a + c_T \cdot \alpha_E \cdot t = \mu_E \cdot e \tag{1}$$

$$\mu_E \cdot e + \mu_A \cdot a = \alpha_E \cdot u + \alpha_A \cdot u \tag{2}$$

$$\alpha_A \cdot u + \mu_T \cdot t = \mu_A \cdot a + c_A \cdot \alpha_E \cdot a + \alpha_T \cdot a \tag{3}$$

$$\alpha_T \cdot a = c_T \cdot \alpha_E \cdot t + \mu_T \cdot t. \tag{4}$$

3.2 Labor demand

Let $J_{E,V}$ be the present discounted value of the expected profits of a vacant regular job and r the interest rate. The per time unit costs of a vacant job $r \cdot J_{E,V}$ must equal the expected return within that time unit t. The hiring costs per time unit are k_E. The rate at which a job is filled is q_E. The excess

value of a filled job is $(J_{E,F} - J_{E,V})$, where $J_{E,F}$ is the present discounted value of expected profits from a filled regular job. Hence, the value function for a vacant job in sector E can be written as

$$r \cdot J_{E,V} = -k_E + q_E \cdot (J_{E,F} - J_{E,V}). \tag{5}$$

The free entry condition implies that firms exploit all the profit opportunities by posting a vacancy and thus the value of a vacant job in equilibrium is zero. Under the assumption of free entry, equation (5) becomes $J_{E,F} = \frac{k_E}{q_E}$. As q_E is the expected duration of a vacancy, the latter states that in equilibrium the expected costs of a vacancy equal the expected discounted profits of a filled job.

A firm i earns y with a regular job, has wage costs w_i and faces the risk that the job becomes unproductive with probability μ_E. This diminishes returns by $J_{E,F,i} - J_{E,V}$. If the job becomes unproductive and the worker has to leave the firm, firing costs accrue. Empirical work shows that severance payments, a pure transfer from the firm to the worker, denoted by s in our model, make up by far the largest part of total firing costs. See Garibaldi and Violante (1999). Hence, the value function for a filled job is:

$$r \cdot J_{E,F,i} = y - w_i - \mu_E \cdot (J_{E,F,i} - J_{E,V}) - \mu_E \cdot s. \tag{6}$$

Let firms be small compared to the economy. Thus, the bargained wage at each firm i has no impact on the wage level in the economy, so that in equilibrium the wage at firm i is equal to the economy wide wage w. Then, regular job creation, which corresponds to a marginal condition for labor demand, follows from equations (5), (6), and $J_{E,V} = 0$ as

$$\frac{k_E}{q_E} = \frac{y - w - \mu_E \cdot s}{r + \mu_E}. \tag{7}$$

Labor demand for regular jobs in sector E is such that the expected costs of a vacancy, the left hand side of equation (7), equal expected discounted returns from a filled job. If there were no costs for posting a vacancy ($k_E = 0$) and no severance payments, the usual condition would hold with the marginal return equal to the wage. As $q'_E(\theta_E) < 0$ labor demand is downward sloping in the wage tightness space.

Firms may also open a vacancy for a temporary worker. We denote these jobs T. The costs of opening these vacancies per time unit are k_T. The firm

can fill the vacancy with a worker borrowed from a temporary work agency at the rate q_T. We assume that productivity on temporary jobs is the same as on regular jobs. See Houseman et al. (2001) for case study evidence on this assumption. The wage costs for the client firm shall be $\sigma \cdot w$. This means that client firms pay a mark-up $(\sigma - 1)$ on the wage w that is paid to workers on a regular job. Later we will introduce an equal profits condition that determines σ. For the moment note, that the value equations for temporary jobs become

$$r \cdot J_{T,V} = -k_T + q_T \cdot (J_{T,F} - J_{T,V}) \tag{8}$$

for the vacancy and

$$r \cdot J_{T,F} = y - \sigma \cdot w - \mu_T \cdot (J_{T,F} - J_{T,V}) - c_T \cdot \alpha_E \cdot (J_{T,F} - J_{T,V}) \tag{9}$$

for the filled job. With free entry to the market ($J_{T,V} = 0$) the marginal condition for labor demand for temporary workers is

$$\frac{k_T}{q_T} = \frac{y - \sigma \cdot w}{r + \mu_T + c_T \cdot \alpha_E}. \tag{10}$$

Finally, let us turn to labor demand of temporary work agencies. They hire workers from the pool of the unemployed. If a temporary work agency finds a worker the vacancy gets filled. We denote that state with F. However, the job remains unproductive until the temporary agency finds an assignment. This state is denoted with P. The value functions from which the temporary work agencies' demand for labor follows are thus:

$$r \cdot J_{A,V} = -k_A + q_A \cdot (J_{A,F} - J_{A,V}), \tag{11}$$

$$\begin{aligned} r \cdot J_{A,F} = &- f + \alpha_T \cdot (J_{A,P} - J_{A,F}) - \\ &\mu_A \cdot (J_{A,F} - J_{A,V}) - c_A \cdot \alpha_E \cdot (J_{A,F} - J_{A,V}), \end{aligned} \tag{12}$$

and

$$\begin{aligned} r \cdot J_{A,P} = &\sigma \cdot w - \delta \cdot w - \\ &\mu_T \cdot (J_{A,P} - J_{A,F}) - c_T \cdot \alpha_E \cdot (J_{A,P} - J_{A,V}). \end{aligned} \tag{13}$$

Again, the expected per time unit returns to a vacant job have to equal the per time unit opportunity cost $r \cdot J_{A,V}$. The expected returns are comprised of the additional value $J_{A,F} - J_{A,V}$ when a vacancy can be filled with probability q_A minus the costs of opening a vacancy denoted by k_A. The returns of having

an un-assigned worker consist of a retainer fee f that is paid to the worker, the value of a productive job over an idle job times the probability that the worker can be assigned, and losses that accrue if the unproductive job goes sour or if the worker finds a regular job. A filled and productive job brings in $\sigma \cdot w$ to the temporary work agency. That is the fee the client firm has to pay for borrowing the worker. The worker himself gets $\delta \cdot w$ from the temporary work agency. Returns are also diminished for the agency if the assignment at the client firm goes sour with probability μ_T. We assume that in this case the worker returns to the agency.[5] The worker is unproductive then, waiting for another assignment. The last term on the right hand side reflects the transition of a temporary worker assigned to a client firm to a regular job which occurs at the rate $c_T \cdot \alpha_E$. In this case, the job at the temporary work agency becomes vacant. The temporary work agency looses $J_{A,P} - J_{A,V}$.

The parameter δ which determines the income of an assigned agency worker as a fraction of the wage on a regular job and the retainer fee f is elaborated in more detail in the following section. Let us here state what follows from the value functions for labor demand from agencies. Free entry implies $J_{A,V} = 0$. Equations (11), (12), (13) and the free entry condition yield the marginal condition for labor demand of temporary work agencies as

$$\frac{k_A}{q_A} = \frac{\alpha_T \cdot (\sigma - \delta) \cdot w - (r + \mu_T + c_T \cdot \alpha_E) \cdot f}{(r + \mu_T + c_T \cdot \alpha_E)(r + \alpha_T + \mu_A + c_A \cdot \alpha_E) - \alpha_T \cdot \mu_T}. \tag{14}$$

Note that $J_{A,P} = 1/\alpha_T \cdot (J_{A,F} \cdot (r + \alpha_T + \mu_A + c_A \cdot \alpha_E) + f)$ from which follows that the net return of a productive job is always larger than the returns from a filled job ($J_{A,P} > J_{A,F}$) where the worker is yet to be assigned to a client firm.

We assume that temporary work agencies will charge fees to the client firm for lending out a worker such that expected profits from the assignment in T and regular jobs in E equalize.[6] Hence, temporary work agencies will choose a σ such that $(y - w - \mu_E \cdot s)/(r + \mu_e) = (y - \sigma \cdot w)/(r + \mu_T + c_T \cdot \alpha_E)$. Rewriting this condition gives σ as

[5] This is in line with the degree of job and income security outlined in section 2, as exemplified by open-ended contracts being the norm in Scandinavia and the job security awarded in the recent legislation in the Netherlands.

[6] Note, that this assumption is very much in the spirit of Dolado et al. (2000) who determine training costs for low skilled workers to be employed on less productive jobs in a matching model in such a way.

$$\sigma^* = \frac{1}{w} \cdot (y - \frac{r + \mu_T + c_T \cdot \alpha_E}{r + \mu_E} \cdot (y - w - \mu_E \cdot s)). \tag{15}$$

3.3 Value functions for workers

Let ψ_E, ψ_T, ψ_A, and ψ_U denote the present discounted value of the expected income stream of having a regular job E, of being assigned to a client firm in T, being in the pool of a temporary work agency (A), and being unemployed (U), respectively. Interpreting the present discounted values as assets, then in equilibrium every asset has to give a return per time unit equal to the capital market yield at the interest rate r. Thus, the return per time unit for a regularly employed individual i can be written as

$$r \cdot \psi_{E,i} = w_i - \mu_E \cdot (\psi_{E,i} - \psi_U) + \mu_E \cdot s.$$

When being regularly employed, the individual earns a wage w_i per time unit. At a rate μ_E he looses his job and becomes unemployed. This amounts to a value loss of $\psi_{E,i} - \psi_U$. However, the worker receives severance payments s.

The value function for the state of unemployment can be written as

$$r \cdot \psi_U = b + \alpha_E \cdot (\psi_E - \psi_U) + \alpha_A \cdot (\psi_A - \psi_U).$$

The left hand side can be interpreted as the reservation wage of an unemployed worker as it is the minimum income that has to be paid so that he ceases to search. The first term on the right hand side, b, is the per time unit income from unemployment. While unemployed the worker will move to employment in sector E with rate α_E and gain $\psi_E - \psi_U$. He may also get a job at a temporary work agency at a rate α_A which would raise income by $\psi_A - \psi_U$.

The value function for a worker at a temporary work agency is

$$r \cdot \psi_A = f + \alpha_T \cdot (\psi_T - \psi_A) + c_A \cdot \alpha_E \cdot (\psi_E - \psi_A) - \mu_A \cdot (\psi_A - \psi_U).$$

Workers in sector A receive a retainer fee f for being in the agency pool. With probability α_T they become assigned to a client and become productive. Workers in sector A find a job in sector E with probability $c_A \cdot \alpha_E$ which yields additional value of $\psi_E - \psi_A$. Unproductive jobs at temporary work

agencies, while workers wait to be assigned, are destroyed at rate μ_A which yields a loss of $\psi_A - \psi_U$.

While being assigned to a client firm the worker receives a fraction δ of the wage w that is paid for regular jobs, finds a regular job at a rate $c_T \cdot \alpha_E$, or looses his assignment with probability μ_T. Hence, the value function for an assigned worker is

$$r \cdot \psi_T = \delta \cdot w - \mu_T \cdot (\psi_T - \psi_A) + c_T \cdot \alpha_E \cdot (\psi_E - \psi_T).$$

Incentive compatibility requires that the present discounted expected value for a worker employed in sector E is larger than the value as a temporary worker and equal or greater than the value of being unemployed $\psi_E > \psi_T \geq \psi_A \geq \psi_U$.

A temporary work agency strives to keep the costs for workers as low as possible. If we assume, that all the unemployed workers are powerless vis à vis temporary work agencies, we may postulate that temporary work agencies offer retainer fees f and wages $\delta \cdot w$ which make their workers at the margin indifferent between working at a temporary work agency and staying unemployed ($\psi_T = \psi_A = \psi_U$). Admittedly, this is a strong assumption but it simplifies the analytical framework strikingly.[7] Furthermore, evidence suggests that temporary agency workers have a poor bargaining position, due to their often marginal position in the labor force, and low degree of unionization and representation, (Storrie (2002)) and thus have a weak bargaining position. If we employ the assumption of very powerful temporary work agencies that unilaterally can decide on the income of their employees, the value equations become:

$$r \cdot \psi_{E,i} = w_i - \mu_E \cdot (\psi_{E,i} - \psi_U) + \mu_E \cdot s \tag{16}$$

$$r \cdot \psi_U = b + \alpha_E \cdot (\psi_E - \psi_U) \tag{17}$$

$$r \cdot \psi_A = f^* + c_A \cdot \alpha_E \cdot (\psi_E - \psi_A) \tag{18}$$

$$r \cdot \psi_T = \delta^* \cdot w + c_T \cdot \alpha_E \cdot (\psi_E - \psi_T) \tag{19}$$

with

$$f^* = b + \alpha_E \cdot (1 - c_A) \frac{w + \mu_E \cdot s - b}{r + \mu_E + \alpha_E} \tag{20}$$

[7]Moreover, this assumption has been made in previous studies. For example, Dolado et al. (2000) assume in a matching model with skilled and unskilled workers and jobs, that wages in the unskilled sector are such that they equal the reservation wage of workers.

and

$$\delta^* = \frac{1}{w}(w + \mu_E \cdot s - (r + \mu_E + c_T \cdot \alpha_E)\frac{w + \mu_E \cdot s - b}{r + \mu_E + \alpha_E}). \tag{21}$$

If unassigned agency workers are as effective searchers as unemployed workers, agencies pay a retainer fee f^* that equals income from unemployment. If those workers were more effective in searching for a regular job than unemployed workers, agencies would offer a retainer fee lower than income from unemployment to make their employees as equally well off as unemployed workers, and vice versa. Note also, that if $c_T = 1$, assigned agency workers are as effective searchers as unemployed workers, and so equation (21) tells that $\delta^* = b/w$. This implies that assigned workers earn $\delta^* \cdot w = b$. Making use of the wage equation (which is developed in the next section, see equation (24)), it is possible to show that the income of assigned workers is less than income from unemployment ($\delta^* \cdot w < b$) if $c_T > 1$ and $\delta^* \cdot w > b$ if $0 < c_T < 1$. Thus, if an assigned worker profits from having a higher search effectiveness than an unemployed worker, the temporary work agency will reap the benefits from that by increasing the mark-down on wages paid in regular jobs. If the temporary agency worker's search effectiveness suffers from being assigned ($c_T < 1$), then the temporary work agency has to decrease the mark-down, so that income from an assignment becomes higher than income from unemployment. Otherwise, the worker would not take up a job at a temporary work agency.

Under the equilibrium assumption all firms pay a wage w. Then, the present discounted value of an employed worker becomes ψ_E instead of $\psi_{E,i}$. Solving the value functions of the workers for the difference in the present discounted values between being employed and unemployed yields

$$\psi_E - \psi_U = \frac{w + \mu_E \cdot s - b}{r + \alpha_E + \mu_E}. \tag{22}$$

Note that for a sufficiently low parameter value b, incentive compatibility is always fulfilled.

3.4 Wages

Wages on regular jobs are determined by Nash bargaining. Usually it is assumed that firms are small relative to the economy so that the bargained wage w_i between a worker and a firm has no impact on the equilibrium wage w. The threat point for the workers is the value of being unemployed ψ_U

and for the firm it is the value of a vacant job $J_{E,V}$. The wage from Nash bargaining is the solution of the weighted product that maximizes the net return for a worker and a firm of a filled job

$$\max_{w_i} \Omega_i = (\psi_{E,i} - \psi_U)^{\beta} \cdot (J_{E,F,i} - J_{E,V})^{1-\beta}.$$

With the free entry condition the value of a vacancy becomes zero ($J_{E,V} = 0$). Furthermore, the value of being unemployed is independent from w_i. Hence, the first order condition is

$$\beta \cdot J_{E,F,i} \cdot \frac{\partial \psi_{E,i}}{\partial w_i} = (\beta - 1)(\psi_{E,i} - \psi_U) \frac{\partial J_{E,F,i}}{\partial w_i}. \tag{23}$$

Under the equilibrium assumption we get the wage setting curve by inserting $\psi_E - \psi_U$ from (22) and J_E from (6) into equation (23) as

$$w = \frac{\beta}{1-\beta} \cdot \frac{k_E}{q_E} \cdot (r + \mu_E + \alpha_E) - \mu_E \cdot s + b. \tag{24}$$

The wage setting equation closes the model. It gives the bargained wage as a function of labor market tightness θ_E. As the job arrival rate $\alpha_E(\theta_E)$ is increasing in market tightness, and the vacancy filling rate for regular jobs ($q_E = q_E(\theta_E)$) is decreasing in market tightness, and $\beta/(1-\beta) > 0$ the wage setting curve is upward sloping.

The model solves recursively. The wage setting curve (24) and the labor demand curve (5) for regular jobs in sector E give the bargained wage w and labor market tightness θ_E. Then, one can solve for σ^* using equation (15). The marginal condition for the demand for temporary jobs (10) gives labor market tightness θ_T. Equations (20) and (21) determine the retainer fee f^* and the fraction δ^* of the wage on regular jobs that temporary workers receive, respectively. In the next step, one can use equation (14) to solve for labor market tightness in A. Finally, inserting θ_E, θ_A, and θ_U in the flow conditions, equations (1) to (4), gives the equilibrium rate of unemployment u, regular employment e, assignments t, and idle labor a at temporary work agencies.

4 Analytical results

4.1 The emergence of temporary work agencies

We already established that the wage setting schedule is upward sloping and labor demand for regular jobs is downward sloping in the real wage tightness space. Pissarides (1990) shows that there exists an equilibrium in a model with one type of job (E). We will explore under which conditions temporary work agencies will come into existence. Formally, whether there exists a positive labor market tightness θ_A. In the appendix a proof is presented stating, that one will observe temporary work agencies as intermediaries on the labor market if they are sufficiently good at assigning workers to client firms. Thus in our model the emergence and growth of temporary agency work is due to an upward shift in the matching efficiency parameter m_T. The question is why this may have occurred?

In many European countries one of the key factors is almost certainly the de-regulation of the sector, which was sketched in section 2. As de-regulation increases the opportunity for agencies to perform matching activities, it is certainly one of the obvious candidates to enable the emergence and growth of agency work in the 1990s in the OECD.

It was argued in section 2 that the characteristic feature of agency work was the outsourcing of the matching function to the intermediary. Matching on the labor market is one of the classic examples of exchange under asymmetric information, see Spence (1973), and is often phrased in terms of job searchers having more information of their capabilities and effort levels than the firm. In this situation an intermediary can reduce the uncertainty facing the firm as the agency will have the incentive to accurately report the quality of their workers to the client firm in order to build and maintain their reputation. The agency will be more concerned with reputation than a single job searcher as the agency has a greater number of possible future transactions. Furthermore, as the agency specializes in recruitment, i.e. search, screening and possibly training, this specialization will probably imply that an agency will recruit more workers than a typical client firm and thus may exploit economies of scale.[8] In the case of a temporary work agency, the uncertainty to the client firm is further diminished by the fact that, unlike hiring through a recruitment agency, the client firm does not need to adopt any employment

[8] Autor (2001a) finds that temporary work agencies provide training to screen workers.

risk and indeed a guarantee of quality may even be stipulated explicitly in the commercial contract between the agency and the client firm for the duration of the assignment.

The improvement of reputation has been a very prominent strategy of many agency companies in the last decade and several companies, such as Manpower and Randstad, have become recognizable brand names. This is almost certainly related to the two factors mentioned above, i.e. the information role played by agencies and the recent legal history of agency work. Prior to de-regulation, when agencies operated often in a legal grey zone, reputation was generally low and many were associated with shady practices. They have sought to build reputation with both potential employees and client firms by means of ethical codes of practice, advertising campaigns and the signing of collective agreements, see Storrie (2002). Furthermore, the agency sector has undergone considerable market consolidation during the 1990s. According to CIETT (2000), by 1998 the top five temporary work agencies accounted for over fifty per cent of turnover in eleven of the members states of the European Union. This process may have served to push out some of the smaller and less reputable agencies. Improved reputation has presumably improved the matching efficiency of temporary work agencies in that they are able to attract better job applicants and to gain acceptance of agency work with the personnel departments and the trade unions at the client firm.

Petrongolo and Pissarides (2001) note that technological advances can shift the matching parameter upwards. The rapid growth of agency work since the beginning of the 1990s coincided with the widespread introduction of information and communication technology (ICT). Internet job sites are able to contain appreciably more vacancy and job searcher information at much lower cost than, for example, newspapers. However, the availability of this technology by no means necessarily implies that there will be an increase in the direct contact between firms and job searchers without going through a matching intermediary. The fact that the technology significantly lowers the cost for the job seeker to apply for jobs may lead to employers being inundated with applications. Moreover, Autor (2001b) argues that there may be adverse selection and that intermediaries such as, temporary work agencies will be required to reap the benefits of the computerized matching technologies.[9] Thus the idea here is that ICT has the potential to increase

[9]Furthermore, the role of intermediaries for providing high quality information is a

matching efficiency. However, this potential can only be fully realized if exploited by intermediaries such as temporary work agencies.

Coordination failures, i.e the uncoordinated action of firms and workers, are according to Petrongolo and Pissarides (2001), potentially a major source of matching inefficiency. Just as the Business and Industrial Organisation literature has observed how supply and client firms coordinate their activities, there is evidence of increased coordination between agency and client firms. Indeed, Belkacem (1998), in a comparative study of France and Germany, compared the agency client firm relationship with other sub-contractors of the client firm. Macaire and Michon (2001) find that agency work is becoming more integrated into management systems of the client undertakings and is thus much more than a one-off measure to cope with unexpected situations. Thus, as temporary work agencies build up business relationships with their client firms and better understand their labor requirements, they may be more able to avoid coordination failure. This is a process that takes time and may be related to learning-by-doing. The learning process of agencies may also be related to sectors or regions as empirically illustrated for France in Lefevre et al. (2001).

Thus, the explanation for increased matching efficiency in temporary work agencies is that with de-regulation agencies were able to devote themselves to these activities, in some countries, for the first time and in others more easily. After de-regulation the agencies were able to build upon their reputation in order to attract workers and client firms. Reputation is also a vital factor in convincing the client firm that the agency will provide it with correct information on worker capabilities. As the agency becomes more like a supply firm, the closer relations between the agency and the client firm serve to reduce coordination failure. The learning-by-doing process also may apply to sectors and locations. There are thus a number of reasons why matching efficiency in agencies may have increased in the 1990s and of course we cannot distinguish between these various possibilities.

4.2 Comparative static results

Besides the emergence condition for temporary work agencies as intermediaries on the labor market, we can establish some comparative static results

much-researched issue in the E-commerce literature, see Malone et al. (1987) and Sarkar et al. (1995), which stresses economies of scale and scope and the reputation issue mentioned above.

Table 2: Comparative static results

	w	θ_E	θ_T	θ_A	e	a	t	u
m_A	0	0	0	+				
m_T	0	0	+					
m_E								
c_T	0	0	0					
k_A	0	0	0	−				
k_T	0	0	−					
k_E		−						
μ_T	0	0	+	−				
μ_E	−							
β	+	−	−					
b	+	−	−					
s	−	0	0	0	0	0	0	0

from our model (see table 2). Increasing the labor share in wage bargaining (β) turns the wage setting curve anti-clockwise (cf. (24)). As labor demand in the regular sector does not shift (see equation (7)), this yields a higher wage for regular jobs and a less tight market for firms in E. As θ_E decreases so does labor market tightness for firms in T. This follows from the fact that agencies will charge a σ that makes present expected profits for jobs in E and T equal. Under the zero profit condition this implies equal average hiring costs which drives the decrease of θ_T as θ_E falls.

Higher income from unemployment (b) shifts the wage setting curve upward. A change in b does not impact on labor demand. Therefore, wages in regular jobs increase and labor market tightness for firms in sector E declines. Furthermore, one observes a decrease in labor market tightness for firms opening a vacancy in T.

Larger severance payments (s) move the wage setting curve downwards. Labor demand also shifts downwards. Hence, wages are lower. Eliminating the wage from equations (24) and (7) shows that labor market tightness in E is not affected by changes in severance payments. This result is discussed in Burda (1992). As net returns are not affected by changes in severance payments, there is also no change in labor market tightness for firms in T. This follows from the reasoning sketched above, namely that average hiring

costs have to be equal between E and T. That tightness θ_A is unaffected can be seen from inserting f^*, σ^*, δ^* and w into the right hand side of equation (14) which leaves it unchanged if severance payments should alter. Finally, from the flow conditions, one can observe that the employment structure, e, a, t, and unemployment u are not affected by changes in severance payments.

Raising the costs for opening a vacancy in E turns the wage setting curve anti-clockwise. In addition labor demand becomes steeper. Therefore, the net impact on the wage level is ambiguous. Labor market tightness for firms in E decreases, inducing an increase in the vacancy filling rate. Thus, the impact on average hiring costs is also ambiguous.

Increasing the hiring cost (k_T) for firms hiring from agencies has no impact on wages and labor market tightness θ_E. Under the equal expected returns constraint, it follows from equation (10) that the vacancy filling rate q_T has to rise. This brings a drop in labor market tightness θ_T. The impact on θ_A is ambiguous.

If costs of hiring into the pool of temporary work agencies rise, this will only bring about a drop in labor market tightness θ_A. This follows from equation (14).

A higher job destruction rate for jobs in sector E shifts the wage setting curve down and turns it anti-clockwise. Labor demand also shifts down and becomes steeper. Hence, wages will be lower. The impact on labor market tightness for firms in sector E is ambiguous.

If jobs in T go sour at higher rate wages, w and θ_E are not affected. Inserting σ^* into the right hand side of equation (10) shows that average hiring costs for T are independent from the job destruction rate μ_T. Hence, labor market tightness θ_T will be unaffected. The right hand side of equation (14) becomes smaller which brings about a rise in the vacancy filling rate for A. Consequently labor market tightness θ_A has to fall.

If search effectiveness of assigned workers increases, one will not observe any impact on wages, and labor market tightness θ_E and θ_T.

There are no unambiguous results that could be reported for changes in the matching scale parameter for sector E. However, an increase of m_T raises labor market tightness in T, while it leaves wages and θ_E unaffected. A change in the scale parameter for matches of unemployed workers and vacancies posted by temporary work agencies, m_A, raises labor market tightness θ_A but does not change, w, θ_E, and θ_T.

5 Numerical examples

As a number of results are ambiguous, especially as regards the impact on the employment and unemployment rates, we conduct a numerical exercise. The values chosen are similar to those in previous numerical exercises with matching models (see table 3 for a summary of the baseline parameters). With those parameters the baseline model yields an employment rate of 90.7%, an unemployment rate of 6.6%, and a share of temporary agency work in the labor force of 2.7%.

Table 3: Baseline parameter values, quarterly calibration

Job productivity	$y = 1$
Real interest rate	r=0.0125
Productivity shock frequency for firms in E	$\mu_E = 0.05$
Productivity shock frequency for firms in A	$\mu_A = 0.3$
Productivity shock frequency for firms in T	$\mu_T = 0.05$
Per time unit hiring cost in E	$k_E = 1.2$
Per time unit hiring cost in A	$k_A = 5$
Per time unit hiring cost in T	$k_T = 1$
Workers' rent share	$\beta = 0.6$
Income from unemployment	$b = 0.5$
Matching elasticity	$\nu = 0.5$
Matching scale factor for E	$m_E = 1$
Matching scale factor for A	$m_A = 2.5$
Matching scale factor for T	$m_T = 2.5$
Relative search effectiveness from A	$c_A = 1$
Relative search effectiveness from T	$c_T = 1.1$
Severance pay	$s = 7$

Table 4 presents results of calculations that deal with the crowding-out aspect of temporary agency work. It could be argued that deregulation of the temporary agency work may increase agency employment at the cost of a reduction of regular employment. However, this is not necessarily the case. In our example the crowding-out of regular jobs crucially depends on the search effectiveness of workers while on an assignment. There are reasons to suppose that such search may be particularly effective. While

on assignment the agency employee may have better access to information on job openings at the work place than the unemployed. Also with the agency worker on location, the employer may more effectively search among the assigned employees. Moreover, the fact that the assigned worker has been screened and assigned by the agency may be a valuable signal to the employer. While one could argue that the assigned worker has less time for search, it would appear likely that the search efficiency enhancing factors should dominate.

We simulate two deregulation scenarios. In one the matching efficiency for assigning workers at client firms is increased. In the other, the costs of opening a vacancy for temporary work are reduced. We state percentage changes in employment and unemployment with respect to the baseline calibration for different values of search effectiveness. If the matching parameter m_T is increased to $c_T = 0.9$, we observe a drop in both unemployment (11.23%) and regular employment (0.59%) while temporary agency work increases. This follows from the fixed labor force assumption. In this case, policy that increases matching efficiency of agencies does indeed crowd out regular jobs. This result also holds for a search effectiveness of c_T which assumes that assigned workers are as effective searchers as unemployed workers. However, there is no crowding-out of regular jobs accompanying a policy that raises matching efficiency if relative search effectiveness is $c_T = 1.2$ or $c_T = 1.3$. Then, both regular employment and temporary agency work increase. A similar picture emerges if we reduce the costs of opening a vacancy. As long as relative search effectiveness of assigned workers is less than unity, regular jobs will be crowded out. If, as was argued above, that assigned workers are more effective searchers than unemployed workers, a policy that reduces temporary agencies' costs of opening vacancy increases both regular employment and employment at temporary work agencies. Thus, a labor market with temporary work agencies that reduce frictions in matching can contribute to more regular employment.

These findings may be interpreted as a policy complementarity which are increasingly been seen as critical in the evaluation of policy measures, Coe and Snower (1997). Our calculations, for example, suggests that deregulation of the temporary work agency sector will only not crowd out regular jobs if cutting costs for opening a vacancy or measures that improve matching efficiency at a temporary work agency are accompanied with a policy that ensures sufficiently high search effectiveness of assigned workers. There are practices of temporary work agencies that may effect the search effectiveness

Table 4: Numerical example: crowding-out

	$m_T = 3$		$k_A = 4.5$	
c_T	Δe	Δu	Δe	Δu
0.9	-0.59	-11.23	-0.55	-6.04
1	-0.23	-9.80	-0.23	-4.54
1.2	0.29	-7.58	0.22	-2.22
1.3	0.48	-6.70	0.38	-1.30

Change is in % with respect to the outcomes of the baseline model

of assigned workers. For example, in the UK the agency may require a "transfer-fee" if the assigned worker becomes employed at the client firm. In other countries, for example, Sweden such practices are explicitly prohibited in law.

6 Concluding remarks

Temporary agency work has grown very rapidly throughout the OECD in the 1990s, is a somewhat novel contractual form and has been extensively deregulated in many countries. Somewhat surprisingly, there has been practically no theoretical research on agency work and rather limited empirical work.

In this paper we attempt to theoretically approach the increasing use of temporary agency work by using a matching model. The equilibrium unemployment model captures the frictions in the labor market that temporary work agencies may serve to ease. The model seeks to explain why we have observed the emergence and increase of temporary agency work in most OECD countries. Another concern was whether the deregulation of temporary agency work necessarily crowds out regular jobs.

We show that temporary work agencies will come into existence as a labor market intermediary if a certain level of matching efficiency is attained in assigning workers to client firms. In the past decade many factors, such as deregulation, particularly in Europe, and technological improvements that allow posting of vacancies through the internet which can only be fully exploited by matching intermediaries, may have contributed to this sufficiently

high level of matching efficiency. Throughout the decade the increase in matching efficiency was sustained by improvements in the reputation of agencies and, with ever-closer relationships with the client firms, some mitigation of coordination failure. Thus, temporary agency work continued to grow during the 1990s.

We derived some comparative static results. However, some of the interesting issues could only be addressed by numerical examples. These numerical examples show that the growth of temporary agency work does not necessarily crowd out regular employment. Both regular employment and agency work, increase as long as the search effectiveness of assigned workers is sufficiently high relative to unemployed workers. We argue that there are several reasons to suppose that search while assigned to a firm is relatively effective, due to signaling effects and the low information costs of both employer and worker search. In this context it may thus be important that de-regulation of the sector as regards assignments should also address practices within agencies which place barriers on assigned workers moving on to regular jobs at the same employer. This result may be seen in the light of policy complementarities, in that single pieces of legislation may not be successful and that one rather has to launch a package of policies to assure positive results.

Appendix

Proposition 1 *There is always a positive labor market tightness θ_T. For sufficiently high matching efficiency m_T, labor market tightness θ_A will be positive.*

Proof 1 *Under the assumption of equal net returns for firms in E and T, the left hand side of equation (10) is always positive which implies a positive θ_T.*

¿From equation (14) follows that there is a positive θ_A if the net returns from having an unproductive job (a filled vacancy with an idle worker to be assigned) are positive for a temporary work agency. The denominator of (14) is always positive. Hence, one will observe a positive θ_A if

$$\alpha_T > f \cdot \frac{r + \mu_T + c_T \cdot \alpha_E}{(\sigma^* - \delta^*) \cdot w}. \tag{25}$$

The right hand side of this inequality is a function of labor market tightness in E only. Also observe, that the parameter m_T does not show up on the right hand side, but only in α_T. Under the assumption of equal present discounted expected profits we can take labor demand equations (7) and (10) and solve for the vacancy filling rate in T

$$q_T = \frac{k_T}{k_E} \cdot q_E. \tag{26}$$

The wage setting schedule and labor demand for E determine θ_E and therefore the right hand side of equation (26). Say that a set of parameters $\{\beta, k_E, \mu_E, m_E, s, b, k_T, r, y\}$ yields a vacancy filling rate $\bar{q}_T$ following equation (26). The properties of the vacancy filling rate q_T are such that a combination of $\{\bar{m}_T, \bar{\theta}_T\}$ will yield $\bar{q}_T$ as well as a combination $\{\tilde{m}_T, \tilde{\theta}_T\}$ with $\tilde{m}_T > \bar{m}_T$ and $\tilde{\theta}_T > \bar{\theta}_T$. As the job arrival rate α_T is increasing in m_T and θ_T, one can always find a sufficiently high matching scale parameter m_T so that condition (25) is satisfied.

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