Employment Protection and Temporary Work Agencies

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Abstract

Employers who use temporary agency staff in contrast to regular staff are not affected by employment protection regulations when terminating a job. Therefore, services provided by temporary work agencies may be seen as a substitute for regular employment. In this paper, we analyze the effects of employment protection on the size of the temporary work agency sector in a model of equilibrium unemployment. We find that higher firing costs may even reduce temporary work agency employment if agencies themselves are subject to employment protection, a consideration which distinguishes our results from those for fixed-term employment arrangements.

Keywords: employment protection, temporary work agencies, search and matching models, unemployment.

JEL code: J 30, J 64, J 65, J 68

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1 Introduction

During the past few decades, most European countries have experienced a rapid increase in the share of atypical (or non-standard) employment contracts. With regard to full-time employment, the two most important types have been fixed-term employment contracts and temporary work agency employment (see, for example, Booth et al. 2003, OECD 2004). For both types of work arrangements, reforms have been deliberately implemented in some countries to make it easier for firms to apply them, a development which is reflected, for example, in the OECD's indicator for employment protection (OECD 2004). These atypical work arrangements are seen as an instrument to enhance labor market flexibility. At the same time, in most countries, employment protection legislation for workers with regular open-ended contracts have remained largely unchanged. In evaluating these developments, commentators have pointed to the possible emergence of dual labor markets, characterized by stable and protected contracts for some workers, and rather instable and unprotected ones for the remaining workforce (see, for example, Boeri 1999). Firms are said to use atypical work contracts to circumvent stringent employment protection provisions for regularly employed workers.[1] In this respect, atypical work arrangements and regular employment contracts may be seen as interchangeable by firms if regular employment contracts are associated with dismissal costs for the firm while atypical work arrangements are not. The present paper analyzes, from a theoretical perspective, whether employment protection does indeed foster the evolution of temporary work agency employment and points out the circumstances under which even the opposite may hold true.

A growing strand of the scientific literature has investigated the interplay of atypical and regular employment contracts where employment protection legislation is in place. Most authors have focused on fixed-term contracts (see, for example, Blanchard and Landier 2002, Cahuc and Postel-Vinay 2002, and Wasmer 1999), whereas less research has been devoted

[1] This is the argument of, for example, some politicians and trade unionists in Germany. For instance, the union with the largest number of members in Germany, IG Metall, introduced a petition in the German Bundestag, arguing that "[e]specially, the biggest firms use (temporary employment) legislation for circumvention of co-determination rights of the works council as well as employment protection." (IG Metall, 2007).

to temporary agency employment. Neugart and Storrie (2006) focus on differences in the matching effectiveness between the regular and temporary agency work sectors. However, they also briefly discuss employment protection. Concentrating on severance payments, they find that such payments do not affect the emergence of temporary work agency employment. Autor (2003) investigates to ascertain for which tasks firms are likely to use temporary work agency employment in a setting where employment protection strengthens incentives for investment in firm-specific capital. Higher firing costs induce firms to outsource jobs characterized by a low requirement for firm-specific human capital. Nannicini (2006) discusses the optimal length of temporary work agency employment in a model with temporary peaks in demand. Nunziata and Staffolani (2007) integrate temporary work agencies in a theoretical framework assuming that they allow firms to save on hiring costs. They concentrate on the regulation of the temporary agency work sector. Empirical studies point to a positive correlation between employment protection and the extent of the temporary work agency sector for the US labor market; see Miles (2000) and Autor (2003). Furthermore, the OECD includes the regulation of temporary work agencies in its calculations for an overall measure of the stringency of employment protection legislation. This may also be seen as an indication for the belief in a substitutional relationship between regular and temporary agency work.

However, looking at a sample of 21 OECD countries relating strictness of employment protection legislation to the regulation of temporary work agency employment and the share of temporary work employment in 2004, we do not find any significant correlation (Figure 1). The corresponding data can be found in Appendix A.

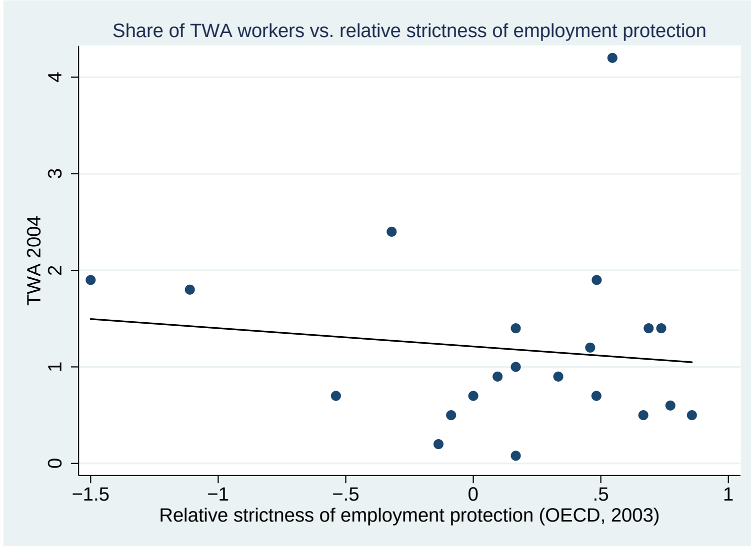

Figure 1: Temporary agency work versus relative strictness of employment protection (Source: CIETT, OECD)

Therefore, in the present paper, we concentrate on whether employment protection contributes to a substitution of temporary work agency employment and analyze this question in a theoretical model of equilibrium unemployment. An important distinction between fixed-term contracts and temporary work agency employment is the tripartite nature of the latter, whereas no intermediary is involved in the case of fixed-term contracts. In most countries, a worker signs a contract with a temporary work agency which assigns the worker to a client firm. This borrowing firm then has to pay a fee to the temporary work agency. The worker receives his salary from the temporary work agency. Whenever a borrowing firm dismisses a temporary worker, it does not have to bear any dismissal costs. After the layoff, the temporary work agency once again searches for a new possibility to place the worker with a new client firm.

Following Neugart and Storrie (2006), we model a labor market characterized by four different states. Every worker can either be employed regularly, be in the files of a temporary work agency but not yet assigned to a job, be conferred to a client firm or simply be unemployed. In order to have a reasonable framework to analyze employment protection, we augment the model with endogenous job destruction. Basically, we assume that employment protection affects only regular employment as one of the advantages of employing temporary workers for an employer is said to be the possibility to lay off a worker when he becomes redundant without any additional costs. We show that the opposite to the claim that a positive correlation exists between employment protection and the extent of temporary agency employment may hold true. An increasing level of employment protection can indeed lead to a decrease in temporary agency employment.

Our main interest is the change in regular as well as temporary agency employment in the case of a variation of firing taxes. Changes in dismissal costs have many effects on, for example, market tightness in the regular and temporary work sector, payments from the agencies to workers, and the agencies' profits.

As the total effect on the fractions of workers being employed in the regular and temporary sector is ambiguous from a theoretical point of view, we calibrate our model. Doing so, we distinguish between two scenarios. Within the first simulation, temporary work agencies themselves are not affected by an increase in firing taxes for regular contracts, but have to pay a fixed cost when laying off a worker. We find that an increase in dismissal costs of the regular sector leads to higher profits for the temporary work agencies. Hence, an increase in dismissal costs increases the share of the temporary agency work sector. The unemployment rate declines.

Within the second scenario, we assume that, whenever the temporary work agencies remove a worker, they face the same firing costs as regular firms do. Note, however, that the lending firm still does not face any dismissal cost. This is the institutional setting in Germany and many other countries. In this case, we observe a result contrary to the first scenario: the share of temporary agency work declines. This results from the fact that agencies' profits decrease as the positive effects from higher lending fees is more than offset by the negative effects stemming from the firing costs that the temporary work agency has to bear. The number of regular jobs also decreases because, in our simulation, temporary agency work serves as a stepping stone to the regular sector. Thus, the total number of unemployed individuals increases with dismissal costs. However, the results are sensitive with respect to the functional and parametric choices made.

In total, our model shows that the development of the temporary work agency sector may depend highly on how the temporary work agencies themselves are affected by dismissal costs. Whenever they face the same dismissal costs as regular firms do, firing taxes may not be an incentive for more temporary work.

The rest of the paper is organized as follows. Section 2 introduces the model. In section 3, we discuss the implications of employment protection. A numerical example is presented to assess the effects at work. The main findings are summarized in section 4. A mathematical appendix is added

2 The Model

2.1 Description

We depart from the model introduced by Neugart and Storrie (2006), in which labor markets are characterized by search frictions and each worker is allocated in one of four different states of the labor market. Workers may be employed with a regular contract (state E) or unemployed (state U) as in the standard matching model. In addition, workers may be in the files of a temporary work agency but not yet assigned to a client firm (state A) or assigned to a client firm (state T). Production takes place only while workers are located in state E or T. The number of workers in each state is depicted by the corresponding lower case letters. The working population is normalized to one (i.e. $a + e + u + t = 1$). There is a large supply of potential firms which can be divided into two types, productive ones and temporary work agencies. Productive firms can offer jobs in either state E or T. Temporary work agencies hire workers out of the pool of the unemployed and lend them to firms with jobs in state T. This setup captures the situation of countries such as France, Germany, the Netherlands, Sweden, and, to some extent, the UK in a stylized way (see Arrowsmith 2006, Cam et al. 2003, Neugart and Storrie 2006 for a further discussion). Whereas Neugart and Storrie (2006) restrict their attention to a setting where jobs are characterized by a constant productivity level, we combine their model with variable productivity and endogenous job destruction as introduced by Mortensen and Pissarides (1994). Figure 2 depicts the four

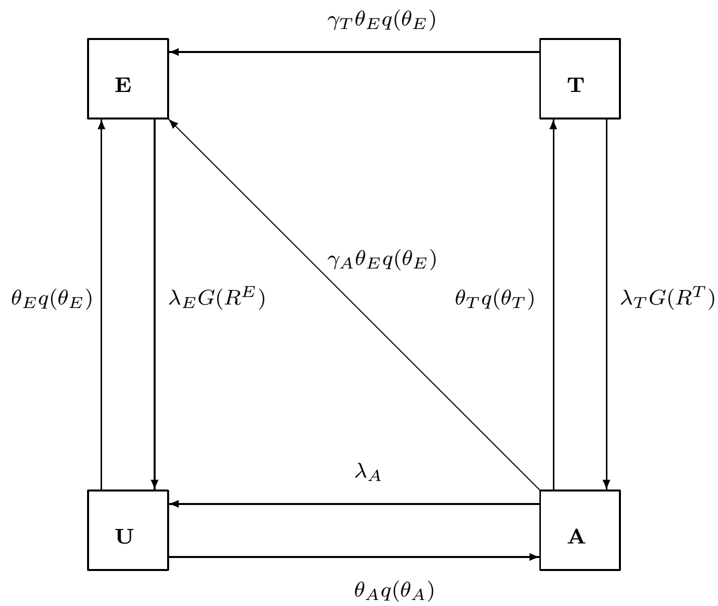

Figure 2: Labor Market Flows

states and movements of workers between states which will be described below.[2]

The model is in continuous time. The labor market is characterized by search frictions which impede the immediate filling of vacancies. Productive firms can set up vacancies in either state E or T, temporary work agencies create vacancies in state A. Vacancies are associated with costs c_j, $j = A, E, T$ per period. Unemployed workers seek employment and may get connected either to a regular job or a temporary work agency. Workers employed by a temporary work agency and either assigned to a client firm or not are still looking for regular employment as we assume that regular employment is associated with higher wages.[3] Search effectiveness of these workers which we capture by γ_T and γ_A may differ from that of unemployed ones where the latter is normalized to one. Finally, temporary work agencies with workers not yet assigned are looking for firms with vacancies in state T and vice versa.[4] The frictions in the labor market are summarized by a linear homogenous

[2]Figure 2 is basically the same as Figure 1 in Neugart and Storrie (2006).

[3]Recent evidence for such a wage gap can be found in Jahn (2008) for Germany, for example.

[4]As pointed out by Kvasnicka (2003), the first assignment of a worker almost always coincides with the moment the worker is hired by the temporary work agency, whereas activities such as screening take place prior to hiring. In this case, state A would also capture some workers attached to the agency but not yet hired.

matching function for each type of vacancies, $m_j(v_j, s_j)$, $j = A, E, T$, which give the number of newly filled positions per period as a function of the number of vacancies, v_j, and the number of effective job seekers for a corresponding position ($s_E = u + \gamma_A a + \gamma_T t$, $s_A = u$) or the number of agencies trying to assign their workers ($s_T = a$), respectively. With $\theta_j = v_j/s_j$ defined as market tightness in segment j, the rate at which a vacancy can be filled is given by $q_j(\theta_j) = m_j(v_j, s_j)/v_j$, with $q_j'(\theta_j) < 0$. The corresponding rates at which a job seeker finds employment or an agency is able to assign a worker to a lending firm are given by $\theta_j q_j(\theta_j)$ adjusted for search effectiveness where necessary, where $d(\theta_j q_j(\theta_j))/d\theta_j > 0$.[5]

After a vacancy in state E or T has been filled, production is taken up. In line with, for example, Pissarides (2000) we assume that newly created jobs are endowed with the currently best production technology associated with a productivity level normalized to one. Jobs are randomly hit by productivity shocks at rate λ_j, $j = E, T$, in which case a new idiosyncratic productivity level x is drawn from the interval $[0, 1]$ and assigned to the job. Productivity shocks are distributed according to the twice differentiable distribution function $G(x)$ with corresponding density function $g(x)$. For each of the sectors E and T a reservation productivity R^j can be determined, such that jobs will only be held active as long as current productivity surpasses this threshold value. Accordingly, regularly employed workers are dismissed at rate $\lambda_E G(R^E)$ in which case they move into the pool of unemployed workers. Firms in sector T release their workers at rate $\lambda_T G(R^T)$. When set free, workers move back into state A. Finally, workers in state A are hit by shocks at rate λ_A, in which case the relation with the temporary work agency is terminated and the worker moves back into unemployment.

Employment protection takes the form of a firing tax F, to be paid in the event of job terminations.[6] One major distinction between jobs in the regular sector E and the temporary

[5] The differentiation between matching functions allows us to capture varying degrees of effectiveness in matching for each segment. One advantage of temporary work agencies may be their professional expertise in assigning workers, arguing for a higher matching effectiveness in segment T.

[6] This approach is similar to the approach used, for example, by Mortensen and Pissarides (1999). We concentrate on the component of dismissal costs that are seen as "waste" ignoring notice periods or severance payments. Such transfers may be effectively undone by private agreements (Lazear 1990, Garibaldi and Violante 2005). This is not the case for the firing tax. Note further that, in our setup with individual wage bargaining in sector E, severance payments in the regular sector do not alter the the equilibrium values of

sector T is that firms in sector T do not have to pay the firing tax F when dismissing a worker. With respect to temporary work agencies, we will distinguish two scenarios: one in which the firing tax F is also due in the case of a worker being dismissed by an agency and one in which dismissal tax payments for agencies differ from that of regular firms.

Wages for regular workers are the outcome of a bargain between firms and workers in state E, where we apply the concept of a two-tier wage structure as is common in models of employment protection (see, for example, Mortensen and Pissarides 1999 or Pissarides 2000). Furthermore, firms with filled positions in state T have to pay a lending fee to the temporary work agency in return for borrowing the worker. Workers in state T or A are paid a wage by their agency. Wage bargaining and the calculation of the lending fee will be described in section 2.4.

The steady state values for the numbers of workers in each of the four states are derived by equalizing flows into and out of the four states for the equilibrium values of market tightness in each segment $(\theta_A, \theta_E, \theta_T)$ and reservation productivity levels (R^E, R^T).[7]

2.2 Productive Firms and Temporary Work Agencies

The present value of a job in state E with productivity x, $J_k^E(x)$, can be expressed by the Bellman equation

$$(r + \lambda_E)\, J_k^E(x) = x - w_k(x) + \lambda_E \left[\int_{R^E}^{1} J_i^E(x')dG(x') - G(R^E)F \right], \tag{1}$$

where the value of the job has to be differentiated according to whether the job has been newly created by hiring a former outsider, $k = o$, or already been hit by a productivity shock while active and therefore employing an insider, $k = i$. The necessity for this distinction follows from firing taxes and the two-tier wage structure employed. Current productivity equals x per period and the firm has to pay the wage $w_k(x)$ to the worker. The term in brackets mirrors the option value of the job in the event of a productivity shock which

market tightness and reservation productivity, which implies that the Lazear result holds (see Stähler 2007, chapter 6.5 for analytical details). Hence, severance payments do not influence the labor market structure in our setup.

[7] The mathematical details are to be found in Appendix B.

occurs at rate λ_E. As long as the newly drawn productivity level is above the reservation productivity, the job is held active. If the drawn productivity falls short of this threshold, the job is closed and the firm has to pay the firing tax F. r denotes the discount rate which is the same for all agents in the economy. The present value of vacancies in state E is determined by the arbitrage condition

$$rV^E = -c_E + q_E(\theta_E)\left[J_o^E(1) - V^E\right], \tag{2}$$

where c_E are search costs per period. Equation (2) takes account of the fact that newly created jobs will be endowed with the highest possible productivity level equal to one.

The value of a firm in state T, $J^T(x)$, is given by

$$\left(r + \lambda_T + \gamma_T \theta_E q_E(\theta_E)\right) J^T(x) = x - \omega(x) + \lambda_T \left[\int_{R^T}^{1} J_i^T(x')dG(x')\right], \tag{3}$$

where $\omega(x)$ are the labor costs for firms that hire a worker from a temporary work agency, i.e. $\omega(x)$ is the lending fee charged by the agency. At rate $\gamma_T \theta_E q_E(\theta_E)$, the hired worker will find regular employment and the relationship in state T is abandoned. The value of a vacancy in state T is given by

$$rV^T = -c_T + q_T(\theta_T)\left[J^T(1) - V^T\right], \tag{4}$$

where c_T are search costs per period.

Finally, we have to describe the value functions for the temporary work agency, which have to be distinguished according to whether the worker has already been assigned to a client firm. Agencies hire workers from the pool of unemployed and, hence, post vacancies there. Whenever a temporary work agency meets a worker, the vacancy will be filled and the corresponding value function for the job is indicated with the superscript A, F. Next, the agency wants to assign the worker to a vacancy in state T. After assignment, we indicate the respective value function by the superscript A, P. Thus, the Bellman equation for a vacancy in state A can be stated as

$$rV^A = -c_A + q_A(\theta_A)\left[J^{A,F} - V^A\right] \tag{5}$$

with search costs per period c_A. The present value of a filled vacancy in which the worker has not yet been assigned to a job in a client firm can be described by a wage $\widetilde{\omega}_A$ paid to the worker plus the option value of assigning the worker, an event occurring at rate $\theta_T q_T(\theta_T)$. Further, agencies may also be hit by a shock λ_A, in which case the employment relationship between the worker and the agency is dissolved. In this case, agencies face dismissal costs $\widetilde{F}$. At rate $\gamma_A \theta_E q_E(\theta_E)$ workers employed in a temporary work agency find regular employment. Thus, the corresponding Bellman equation reads

$$(r + \lambda_A + \theta_T q_T(\theta_T) + \gamma_A \theta_E q_E(\theta_E))\, J^{A,F} = -\widetilde{\omega}_A - \lambda_A \widetilde{F} + \theta_T q_T(\theta_T) J^{A,P}(1). \tag{6}$$

If the worker employed with the temporary work agency is assigned to a client firm, the temporary work agency gets the lending fee $\omega(x)$ and pays a wage $\widetilde{\omega}_T$ to the worker. Furthermore, there is possible job destruction at rate $\lambda_T G(R^T)$ and the possibility that the employed worker finds regular employment, which happens at rate $\gamma_T \theta_E q_E(\theta_E)$. Accordingly, the corresponding Bellman equation is given by

$$\left(r + \lambda_T G(R^T) + \gamma_T \theta_E q_E(\theta_E)\right) J^{A,P}(x) = \omega(x) - \tilde{\omega}_T + \lambda_T \left[\int_{R^T}^1 J^{A,P}(x') dG(x') + G(R^T) J^{A,F}\right]. \tag{7}$$

There is free market entry for vacancies. This implies that firms will create additional positions as long as V^j, $j = A, E, T$ is larger than zero. In equilibrium, $V^j = 0$ has to hold, implying

$$J_o^E(1) = \frac{c_E}{q_E(\theta_E)}\ , \ J^T(1) = \frac{c_T}{q_T(\theta_T)}\ , \ J^{A,F} = \frac{c_A}{q_A(\theta_A)}. \tag{8}$$

2.3 Workers

The present value of expected income for unemployed workers is determined by the following Bellman equation

$$(r + \theta_A q_A(\theta_A) + \theta_E q_E(\theta_E))U = b + \theta_A q_A(\theta_A) W^A + \theta_E q_E(\theta_E) W_o^E(1), \tag{9}$$

as they either find regular employment at rate $\theta_E q_E(\theta_E)$, or are hired by a temporary work agency at rate $\theta_A q_A(\theta_A)$. $W_o^E(1)$ denotes the present value of expected income of a newly hired worker in state E, whereas W^A is the corresponding value for a worker in state A. Finally, b denotes unemployment benefits. When employed in a regular job, state E, workers' expected income amounts to

$$(r + \lambda_E) W_k^E(x) = w_k(x) + \lambda_E \left[\int_{R^E}^{1} W_i^E(x') dG(x') + G(R^E)U \right]. \tag{10}$$

The right-hand side of equation (10) consists of the wage payment $w_k(x)$, $k = i, o$, and the option value in the event of a productivity shock. Whenever a shock yields a productivity level below reservation productivity, the worker becomes unemployed.

Workers employed at a temporary work agency and assigned to a client firm obtain the wage $\widetilde{\omega}_T$ from the temporary work agency. When workers in state T are set free, they return to the temporary work agency's pool of workers and obtain utility W^A. In addition, they find regular employment in state E at rate $\gamma_T \theta_E q_E(\theta_E)$. For workers employed at the temporary work agency and hired out to a client firm, the Bellman equation therefore reads[8]

$$(r + \gamma_T \theta_E q_E(\theta_E) + \lambda_T G(R^T))W^T = \tilde{\omega}_T + \gamma_T \theta_E q_E(\theta_E) W_o^E(1) + \lambda_T G(R^T) W^A. \tag{11}$$

Analogously, workers employed at a temporary work agency but not yet assigned, state A, are endowed with an expected income described by

$$\begin{aligned} (r + \theta_T q_T(\theta_T) + \gamma_A \theta_E q_E(\theta_E) + \lambda_A) W^A &= \widetilde{\omega}_A + \theta_T q_T(\theta_T) W^T \\ &\quad + \gamma_A \theta_E q_E(\theta_E) W_o^E(1) + \lambda_A U, \end{aligned} \tag{12}$$

where $\widetilde{\omega}_A$ is the wage paid by the agency.

Following Neugart and Storrie (2006), we assume that agencies are able to set wages $\widetilde{\omega}_A$ and $\widetilde{\omega}_T$ equal to the reservation wage of workers (see the discussion in Neugart and Storrie, 2006). This implies that a temporary work agency offers wages $\widetilde{\omega}_A^*$ and $\widetilde{\omega}_T^*$ which make its workers indifferent to either being hired by a temporary work agency or staying unemployed ($U = W^T = W^A$). Imposing this on equations (9), (11) and (12), we get

$$rU = b + \theta_E q_E(\theta_E) \left[W_o^E(1) - U \right], \tag{13}$$

[8]Note that we assume that, when assigned, agency workers are always paid $\widetilde{\omega}_T$ independent of current productivity. Therefore, the present value of expected income is independent of current productivity.

$$rW^T = \widetilde{\omega}_T^* + \gamma_T \theta_E q_E(\theta_E) \left[W_o^E(1) - U\right], \tag{14}$$

and

$$rW^A = \widetilde{\omega}_A^* + \gamma_A \theta_E q_E(\theta_E) \left[W_o^E(1) - U\right] \tag{15}$$

which tremendously simplifies our analysis.

2.4 Wage Payments and the Lending Fee

Given our assumption of workers' indifference to unemployment or employment at a temporary work agency, we calculate equilibrium values for wages $\widetilde{\omega}_A^*$ and $\widetilde{\omega}_T^*$ from equations (13) to (15) as

$$\widetilde{\omega}_A^* = b + (1 - \gamma_A)\theta_E q_E(\theta_E) \left[W_o^E(1) - U\right] \tag{16}$$

and

$$\widetilde{\omega}_T^* = b + (1 - \gamma_T)\theta_E q_E(\theta_E) \left[W_o^E(1) - U\right]. \tag{17}$$

Depending on whether workers employed at an agency find it more ($\gamma_A, \gamma_T < 1$) or less ($\gamma_A, \gamma_T > 1$) difficult to become regularly employed, agencies have to pay a mark-up or a discount on unemployment benefits b (see Neugart and Storrie, 2006).

Turning to wages in regular contracts, we follow the approach standard in literature assuming Nash bargaining and wages to be renegotiated each time a productivity shock occurs. Bargaining power of workers is given by β, $0 \leq \beta \leq 1$. As alluded to above, we apply the concept of a two-tier wage structure[9] with wages being determined by

$$w_o(1)^* = \arg\max \left(W_o^E(1) - U\right)^\beta J_o^E(1)^{1-\beta} \tag{18}$$

for newly created jobs and

$$w_i(x)^* = \arg\max \left(W_i^E(x) - U\right)^\beta \left(J_i^E(x) + F\right)^{1-\beta} \tag{19}$$

for existing jobs. The resulting wages are given by[10]

$$w_i(x)^* = \beta[x + rF + \theta_E c_E] + (1 - \beta)b \tag{20}$$

[9]The two-tier wage structure is commonly used when discussing employment protection. It guarantees that workers and firms share firing taxes according to their bargaining power. For more details, see Mortensen and Pissarides (1999, 2003).

[10]For mathematical details the reader is referred to, for example, Pissarides (2000).

and

$$w_o(1)^* = w_i(1) - \beta(r + \lambda_E)F. \tag{21}$$

With respect to the lending fee, $\omega(x)$, we follow Neugart and Storrie (2006) and assume that temporary work agencies set the lending fee such that firms become indifferent to employing a temporary agency worker or hiring the identical worker regularly at the time the contract is signed. However, the extension of the model allowing for variable productivity necessitates further assumptions on how lending fees are chosen. To avoid the possibility of (privately) inefficient separations, we additionally assume that the schedule of lending fees ensures that the corresponding reservation productivity R^T maximizes the joint surplus, $S^T(x)$, for the firm and the agency of a job in state T for every productivity level x.[11] The joint surplus is defined as

$$S^T(x) = J^T(x) + J^{A,P}(x) - J^{A,F}. \tag{22}$$

Thus, the schedule of lending fees is set such that, first,

$$J_o^E(1) = J^T(1) \tag{23}$$

and, second,

$$S^T(R^T) = 0 \tag{24}$$

hold true. The rationale of the equal profit condition (23) can be stated as follows. Assume that a firm with a vacancy in state T and a temporary work agency meet. Then, the firm with the vacancy can choose whether to offer the worker an employment contract directly or to conclude the contract with the temporary work agency. If signing a contract with the worker, who afterwards reneges on his contract with the agency, the firm and the worker would move to state E and wages would be bargained according to the Nash bargaining solution described before. Accordingly, the equal profit condition guarantees the highest profit the temporary work agency can achieve without risking the loss of its worker. Equation (24) assures that separations are efficient from the perspective of firms in state T and temporary work agencies, i.e. the reservation productivity R^T guarantees maximization of the partners' joint surplus.

[11] For sector E this assumption is implicitly made by using repeated Nash bargaining.

2.5 Equilibrium

To determine the equilibrium of the economy we have to establish the job destruction conditions for jobs in sector E and T as well as the job creation conditions for sectors A, E and T.

For firms with a job in sector E, profit maximization implies that jobs are held active as long as the present value of the job is larger than firing costs F. Reservation productivity R^E is therefore determined by $J_i^E(R^E) = -F$. Market tightness in segment E, θ_E, is determined by the condition for free market entry of vacancies described in equation (8). From equation (1) in combination with the two wage equations (20) and (21) the present value of a job in state E is given by

$$J_i^E(x) = (1-\beta)\frac{x - R_E}{r + \lambda_E} - F = J_o^E(x) - \beta F. \tag{25}$$

Combination of equations (25) and (1) yields the job destruction and job creation conditions in state E

$$R^E + \frac{\lambda_E}{r + \lambda_E}\int_{R^E}^{1}\left(x - R^E\right)dG(x) = b + \frac{\beta}{1-\beta}c_E\theta_E - rF \tag{26}$$

and

$$(1-\beta)\left[\frac{1-R^E}{r+\lambda_E} - F\right] = \frac{c_e}{q_E(\theta_E)}. \tag{27}$$

The equilibrium values for reservation productivity, R^E, and market tightness, θ_E, are obtained by simultaneously solving equations (26) and (27). As workers do not move from state E to state T or A, the equilibrium values for state E are independent from the outcome in the other states.[12] Given the equilibrium values for R^E and θ_E, we can calculate the gain in expected income of a newly hired worker, $W_o^E(1) - U$, and, therefore, the payments $\widetilde{\omega}_A^*$ and $\widetilde{\omega}_T^*$ according to equations (16) and (17).

Job creation and job destruction for firms with a job in state T are guided by free market entry of vacancies, equation (8), and $S^T(R^T) = 0$ as no firing taxes have to be paid in the event of job termination. As temporary work agencies are assumed to choose a schedule for the lending fee such that firms in T are indifferent to poaching the worker or signing the

[12] Consequently, the derivation of the two equations follows standard procedures; see, for example, Mortensen and Pissarides (1999) or Pissarides (2000).

contract with the agency, $J^T(1) = J_o^E(1)$, the job creation condition can be described by

$$\frac{c_T}{q_T(\theta_T)} = \frac{c_E}{q_E(\theta_E)} \tag{28}$$

where use has been made of equation (8). To determine the job destruction condition, we first describe the joint surplus $S^T(x)$, which, from equation (22), is given by

$$(r + \lambda_T + \gamma_T \theta_E q_E(\theta_E))S^T(x) = x - \widetilde{\omega}_T - (r + \gamma_T \theta_E q_E(\theta_E))J^{A,F} + \lambda_T \int_{R^T}^1 S^T(x')dG(x'). \tag{29}$$

Employing $S^T(R^T) = 0$, we get

$$S^T(x) = S^T(x) - S^T(R^T) = \frac{x - R^T}{r + \lambda_T + \gamma_T \theta_E q_E(\theta_E)}. \tag{30}$$

Again using $S^T(R^T) = 0$ and applying equation (30) to (29), we finally solve for the job destruction condition in sector T

$$(r+\lambda_T+\gamma_T\theta_E q_E(\theta_E))\left(R^T - \widetilde{\omega}_T - (r + \gamma_T \theta_E q_E(\theta_E))J^{A,F}\right) + \lambda_T \int_{R^T}^1 (x - R^T)dG(x) = 0 \tag{31}$$

which implies a positive relation between reservation productivity R^T and the present value $J^{A,F}$ (i.e. an agency's present value of income from having a worker in its files). An increasing value of $J^{A,F}$ indicates that the termination of a contract in order to reassign the worker to a different position becomes more profitable, implying an increase in the optimal reservation productivity R^T.

To be able to solve for reservation productivity R^T, we need a second relation linking the reservation productivity and the present value $J^{A,F}$ of an agency that has the worker in its files. This second equation is found by noticing that as $J^T(1) = J_o^E(1)$ holds true, the present value for the agency after assigning the worker can be represented by

$$J^{A,P}(1) = S^T(1) - J_o^E(1) + J^{A,F} = \frac{1 - R^T}{r + \lambda_T + \gamma_T \theta_E q_E(\theta_E)} + J^{A,F} - J_o^E(1). \tag{32}$$

The agency appropriates any joint surplus exceeding what has to be paid to the productive firm. Inserting equation (32) into the Bellman equation for temporary work agencies, equation (6), we get after rearranging terms

$$(r+\lambda_A+\gamma_A\theta_E q_E(\theta_E))J^{A,F} = -\widetilde{\omega}_A - \lambda_A \widetilde{F} + \theta_T q_T(\theta_T)\left[\frac{1 - R^T}{r + \lambda_T + \gamma_T \theta_E q_E(\theta_E)} - J_o^E(1)\right]. \tag{33}$$

Equation (33) specifies a negative relation between the agency's expected present value of income $J^{A,F}$ and reservation productivity R^T. The higher the reservation productivity, the shorter the expected job tenure. That reduces both the joint surplus and the agency's profit from assigning a worker. Consequently, the present value $J^{A,F}$ decreases with reservation productivity. Solving equations (31) and (33) simultaneously, we get the equilibrium values for R^T and $J^{A,F}$.

The final condition to be established is the job creation condition for state A. With $J^{A,F}$ resulting from equations (31) and (33), market tightness in segment A is determined by the condition for free market entry, equation (8).

3 Implications of Higher Firing Taxes and a Numerical Example

We are interested in the effect of firing taxes on the shares of workers in the different states of the economy. Equilibrium shares are determined by labor market flows which themselves depend on market tightness and reservation productivity levels for the different segments. In this section, we first outline which inferences can be made with respect to these variables. Second, in the next subsection we provide our calibration. Mathematical details for the first subsection are relegated to Appendix C.

3.1 Implications from Theory

Regarding regular employment (state E), an increase in the firing tax F results in a decrease in reservation productivity R^E as dismissals become more costly. At the same time, the increase in firing taxes reduces incentives for job creation as firms have to bear part of these costs according to their bargaining power. Therefore, market tightness θ_E decreases as well. Taken together, dismissals become less likely in the event of productivity shocks, which increases job tenure in sector E, but workers looking for regular employment are faced with lower hiring rates. These findings are well established in the literature on employment protection; see, for example, Mortensen and Pissarides (1999). The simultaneous changes in reservation productivity R^E and market tightness θ_E have an ambiguous effect on employment in state E.

With respect to sectors T and A, a decrease in market tightness θ_E directly affects wages $\widetilde{\omega}_A$, $\widetilde{\omega}_T$, and market tightness θ_T. A lower market tightness θ_E reduces the rate at which workers in the temporary work agency sector move to regular employment and therefore increases (decreases) wages $\widetilde{\omega}_A$ and $\widetilde{\omega}_T$ if search effectiveness of workers in state A or T is higher (lower) than one. This happens as the advantage (disadvantage) of being employed by a temporary work agency compared to being unemployed is diminished.

Further, given the equal profit condition assumption, there is a parallel movement of market tightness in segments E and T. An increase in firing taxes enhances bargaining power of agencies as the alternative of employing the worker directly has become less attractive for productive firms. Therefore, temporary work agencies can appropriate a higher share of the joint surplus, reducing incentives for setting up vacancies in T for productive firms.

The decision whether to set up a vacancy in segment A is guided by the present value of positions in state A, $J^{A,F}$, which determines market tightness θ_A. There are various channels through which an increase in firing taxes affects the present value $J^{A,F}$ for temporary work agencies in equilibrium. A direct effect of the decrease in market tightness in segment E is to make employment relationships in the temporary work agencies' sector more stable, because the probability that workers may leave for regular employment is reduced. This reduces the effective discount rate for temporary work agencies and therefore increases $J^{A,F}$ and θ_A. The decrease in the value of newly created jobs in sector E further increases $J^{A,F}$ and θ_A since temporary work agencies are able to seize a larger share of the joint surplus when assigning a worker to a firm in state T.

Additionally, the change in market tightness θ_E affects wages $\widetilde{\omega}_A$ and $\widetilde{\omega}_T$ as described above. The present value $J^{A,F}$ and therefore market tightness θ_A depend negatively on these payments. Consequently, there are additional positive (negative) effects on $J^{A,F}$ and θ_A if search effectiveness is lower (higher) for workers employed by a temporary work agency.

Contrary to the effects described so far, the decrease in market tightness θ_T following an increase in firing taxes, unambiguously reduces the present value $J^{A,F}$ and therefore market tightness θ_A because the rate at which the agency is able to assign its worker to a client firm decreases. Further, if temporary work agencies are subject to the same regulations as firms in sector E (but not the client firms in sector T), an increase in firing taxes reduces their profits directly.

To summarize, whether an increase in firing taxes will result in an increase or decrease in temporary work agency employment cannot be ascertained by theoretical considerations alone. The same holds for reservation productivity R^T because it is closely linked to the present value for temporary work agencies $J^{A,F}$ according to equations (31) and (33).

3.2 Numerical Example

3.2.1 Parameter values and functions used for calibration

For our simulation, we use a uniform distribution for productivity shocks, $G(x) = x$, and assume that the matching functions are Cobb-Douglas with equal weight on the two arguments,

$$m_j(v_j, s_j) = M_j\sqrt{v_j \cdot s_j}, \tag{34}$$

$j = A, E, T$, where M_j is a factor describing effectiveness of the matching process.[13]

Parameter	Symbol	Value
Rate of Productivity Shocks in E	λ_E	0.067
Rate of Productivity Shocks in T	λ_T	0.067
Rate of Separation Shocks in A	λ_A	0.50
Match Effectiveness in E	M_E	1.00
Match Effectiveness in T	M_T	3.00
Match Effectiveness in A	M_A	1.00
Search Costs per Period in E	c_E	1.20
Search Costs per Period in T	c_T	1.75
Search Costs per Period in A	c_A	5.00
Workers' Bargaining Power	β	0.60
Relative Search Effectiveness in T	γ_T	1.20
Relative Search Effectiveness in A	γ_A	1.00
Interest Rate	r	0.025
Unemployment Benefits	b	0.40

Table 1: Parameter Values for Calibration

[13] See Petrongolo and Pissarides (2001) for a survey on the empirics of the matching function.

The parameter values are taken from the numerical example in Neugart and Storrie (2006) and adapted to the modifications in our setup. The parametric specification is summarized in Table 1. One time period corresponds to about half a year. With respect to the firing tax $\widetilde{F}$, which an agency has to pay when dismissing a worker, we distinguish between two scenarios. In the first one, the firing tax for temporary work agencies is equal to $\widetilde{F} = 0.3$ and does not vary with firing costs for regular contracts. This implies that dismissal regulations for temporary work agencies differ from those of regular employment contracts. In the second scenario, the firing tax for temporary work agencies equals the one for regular contracts, $\widetilde{F} = F$, which seems to be a more appropriate setting for employment protection regulation, in particular, in Europe (see Eurofund, 2007). The other parameter values have been adapted to fit several criteria for a firing tax equal to $F = 1/2$, which seems to be a reasonable approximation for countries in western Europe.[14] These criteria are: an unemployment rate of about 8.5 per cent, reported by the ECB (2007) for 2006, expected job tenure of about 9 years for workers with a regular employment contract (see OECD, 2007) and a share of workers employed by temporary work agencies of about 1.5 per cent (see CIETT, 2007).

3.2.2 Results

Figure 3 depicts the present value of a temporary work agency with a worker not assigned to a client firm for firing taxes ranging from zero to two. The dotted line represents the scenario where firing taxes are fixed for temporary work agencies and do not vary with firing costs in sector E ($\widetilde{F} = 0.3$). The solid curve identifies the scenario which is characterized by firing taxes identical for firms in sector E and temporary work agencies ($\widetilde{F} = F$).

From the discussion above and the results represented in Figure 3 we conclude that the present value $J^{A,F}$ increases with firing taxes F if temporary work agencies are not affected by an increase in firing taxes. The positive effect on the present value $J^{A,F}$ of agencies being able to charge higher lending fees dominates the negative effects of a lower probability for

[14] The calculations for the firing tax is based on the estimate of the tax component of firing costs in Italy presented in Garibaldi and Violante (2005). They report ex-ante expected firing costs to amount to 18 months' wages where the tax component is about 20 per cent. With average wages of about 0.85 in our model, this results in a value of about 0.5 for the firing tax.

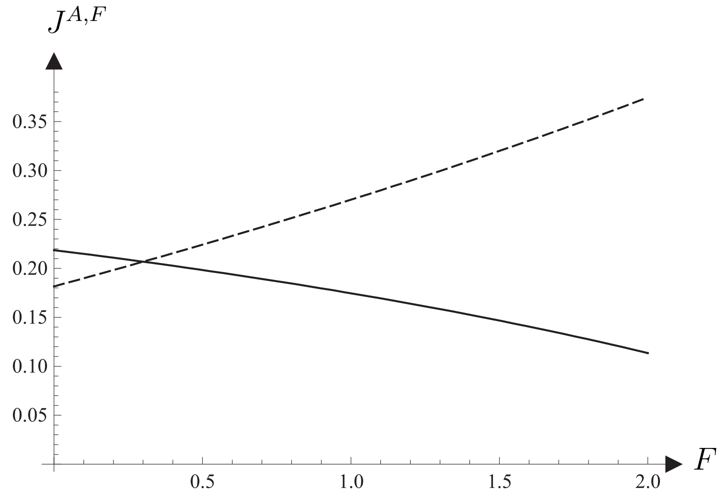

Figure 3: Present value of a temporary work agency with worker not assigned

assigning workers and, given $\gamma_T > 1$, a higher wage payment $\widetilde{\omega}_T$. However, in our example the opposite holds if the increase in firing taxes for regular jobs applies to temporary work agencies, too. In this case, the additional costs lead to a decrease in the present value $J^{A,F}$ and, in consequence, incentives for creating vacancies in state A are reduced. We would like to note that the latter has not necessarily held true for alternative specifications for the parameters. Nonetheless, our simulation provides insights in that whether temporary work agencies gain from employment protection for regular jobs may depend on the specific application of the regulations.

The implications for the shares of workers in states E, U and the temporary work sector (states A and T) are depicted in Figure 4.

For both scenarios our simulations predict only small changes in regular employment, whereas movements in the unemployment rate and the share of the temporary sector are more pronounced. Regular employment slightly decreases (increases) in the scenario where temporary work agencies are (not) affected by an increase in the firing tax.[15] In our example, the movements in regular employment are accompanied by parallel movements in the share

[15]Ljungqvist (2002) provides an elaborate discussion on the effects on employment for the conventional matching framework and different assumptions with respect to wage bargaining and the choice of functional and parametric specifications.

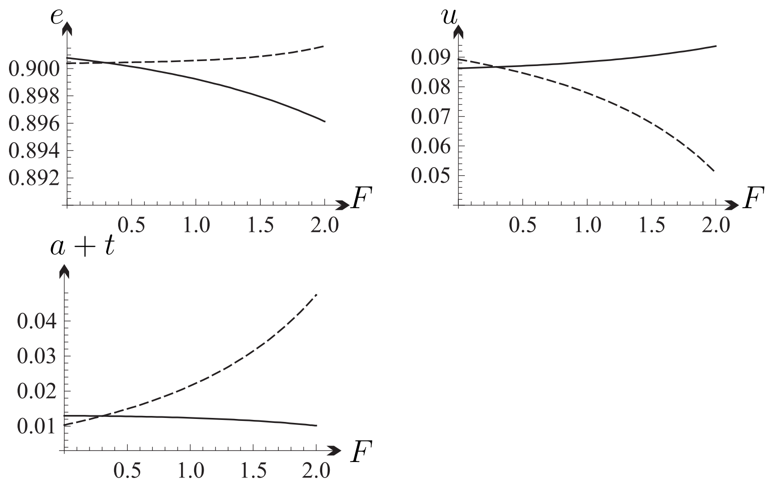

Figure 4: Shares of workers in states E, U, and A+T

of temporary workers. Accordingly, the unemployment rate moves in the opposite direction. Temporary work agency employment becomes more or less widespread in line with the profitability of setting up new jobs in this sector, mirrored by $J^{A,F}$. Therefore, the ratio of unassigned to assigned workers, a/t, depends mainly on market tightness θ_T. As market tightness in segment T decreases with firing taxes, this ratio will (slightly) increase with firing costs.

The link between regular and temporary work employment is likely to emanate from the temporary work sector. In light of the discussion in Neugart and Storrie (2006) and given our parameter values for the simulation, temporary agency work enhances matching effectiveness in the economy and serves to some extent as a stepping stone to regular employment.[16] In our simulation, the slight increase or decrease in regular employment therefore seems to originate from the rise or decline in the temporary work sector.

4 Conclusion

Atypical work arrangements may allow firms to circumvent employment protection for regular employment. This topic has gained much attention in the literature on fixed-term

[16]However, Kvasnicka (2008) casts doubt on such a stepping stone effect on the basis of German data.

employment contracts but less so in the literature on temporary work agency employment. While both types of atypical work arrangements allow for a saving on firing costs for productive firms, an important distinction between the two arrangements can be found in the tripartite relationship in the temporary work sector whereas no intermediary is necessary for purely fixed-term contracts. In our paper we analyzed whether stringent employment protection for regular contracts will favor agency employment in a model of equilibrium unemployment. Our findings point out that whether employment protection for regular contracts favors the emergence of a temporary work agency sector may critically depend on how agencies themselves are affected by requirements imposed by employment protection legislation.

Employment protection for regular jobs per se should indeed increase the demand for the services of temporary work agencies, which enables temporary agencies to raise lending fees and increase profits. Incentives for investment in the temporary agency sector are strengthened. However, in accordance with the tripartite work arrangements, temporary work agencies are affected by more stringent employment protection if they have concluded a regular contract with their workers, something called for by regulation in several European countries. This implies higher labor costs for temporary work agencies as well, reducing incentives for investment in this sector. The latter may dominate any positive effects, calling for a negative relation between the size of the temporary work agency sector and the stringency of employment protection. In conclusion, the existence of temporary work agencies may be more likely to be explained by other reasons such as short-term labor requirements (Pfarr et al., 2004) rather than as a substitute for regular employment to save on firing costs.

A Data

Country	(1) Share of temp. agency workers 2006	(2) Strictness of employment protection legislation (regular jobs)	(3) Strictness of employment protection legislation (temp. agency jobs)	(4) Relative strictness of employment protection legislation*
Austria	1.5	2.4	1.3	0.458
Belgium	2.1	1.8	3.8	-1.111
Czech Republic	0.7	3.3	0.5	0.848
Denmark	0.8	1.5	0.5	0.667
Finland	0.7	2.2	0.5	0.773
France	2.4	2.5	3.3	-0.32
Germany	1.3	2.7	1.8	0.333
Greece	0.1	2.4	2	0.167
Hungary	1.4	1.9	0.5	0.737
Ireland	1.5	1.6	0.5	0.688
Italy	0.7	1.8	1.8	0
Japan	1.9	2.4	2	0.167
Mexico	0.3	2.3	5.5	-1.391
Netherlands	2.5	3.1	1.6	0.484
Norway	1.0	2.3	2.5	-0.087
Poland	0.2	2.2	2.5	-0.136
Portugal	0.9	4.2	3.8	0.095
Slovakia	0.5	3.5	0.5	0.857
Spain	0.7	2.6	4	-0.538
Sweden	0.8	2.9	1.5	0.483
Switzerland	1.5	1.2	1	0.167
United Kingdom	4.5	1.1	0.5	0.545
United States	2	0.2	0.5	-1.500
Source	CIETT statistics for 2006	OECD 2004 Employment Outlook	OECD 2004 Employment Outlook	Own calculations

*: Relative strictness of employment protection legislation = ((2)-(3))/(2)

Table 2: Data on temporary agency work and strictness of employment protection legislation

B Shares of workers in the states A, E, U, T

To calculate the fractions of workers in the four states $j = A, E, U, T$, we have to consider worker flows as described in Figure 2. Inflows into unemployment result from dismissals in regular employment, $e\lambda_E G(R^E)$, and from dismissals by temporary work agencies, $a\lambda_A$. Outflows result from unemployed workers finding regular employment or being hired by a temporary work agency, $u\theta_E q(\theta_E)$ and $u\theta_A q(\theta_A)$. Thus,

$$\dot{u} = \underbrace{(1-u-t-a)}_{=e}\lambda_E G(R^E) + a\lambda_A - u\left(\theta_E q(\theta_E) + \theta_A q(\theta_A)\right).$$

Analogously, we derive the evolution of the number of workers in the files of an agency but currently not assigned to a firm

$$\dot{a} = u\theta_A q(\theta_A) - a\left[\lambda_A + \gamma_A \theta_E q(\theta_E) + \theta_T q(\theta_T)\right] + t\lambda_T G(R^T). \tag{B1}$$

The inflow into state A consists of dissolved assignments to firms in state T and newly hired unemployed workers. Outflows result from those workers who are assigned to a new client firm and from workers who succeed in finding regular employment. Furthermore, the employment relationship with the temporary agency may be dissolved for other reasons, which happens at rate λ_A. For the evolution of the number of workers in state T we get

$$\dot{t} = a\theta_T q(\theta_T) - t\left[\lambda_T G(R^T) + \gamma_T \theta_E q(\theta_E)\right] \tag{B2}$$

where, besides the flows between state A and T, it is recognized that a worker in state T may find regular employment. In steady-state the change in the number of workers in each state equals zero, $\dot{u} = \dot{a} = \dot{t} = 0$, which allows us to solve for the steady-state values u, a and t from the above equations. Regular employment is given by $e = 1-u-a-t$. Formally, the solution for a, t, u is given by

$$\begin{pmatrix} u \\ a \\ t \end{pmatrix} =$$

$$\begin{pmatrix} -(\theta_A q(\theta_A) + \theta_E q(\theta_E) \\ \quad +\lambda_E G(R^E)) & \lambda_A - \lambda_E G(R^E) & -\lambda_E G(R^E) \\ \theta_A q(\theta_A) & -(\lambda_A + \gamma_A \theta_E q(\theta_E) \\ & \quad +\theta_T q(\theta_T)) & \lambda_T G(R^T) \\ 0 & \theta_T q(\theta_T) & -(\lambda_T G(R^T) + \gamma_T \theta_E q(\theta_E)) \end{pmatrix}^{-1}$$

$$\times \begin{pmatrix} -\lambda_E G(R^E) \\ 0 \\ 0 \end{pmatrix} \tag{B3}$$

C Comparative Statics

State E and market tightness state T: in order to determine the changes in reservation productivity R^E and market tightness θ_E in response to an increase in the firing tax F, we totally differentiate equations (26) and (27) which, written in matrix form, yields

$$\begin{pmatrix} \frac{r+\lambda_E G(R^E)}{r+\lambda_E} & -\frac{\beta c_E}{1-\beta} \\ -\frac{1-\beta}{r+\lambda_E} & \frac{c_E q_E'(\theta_E)}{q_E(\theta_E)^2} \end{pmatrix} \begin{pmatrix} dR^E \\ d\theta_E \end{pmatrix} = \begin{pmatrix} -r \\ 1-\beta \end{pmatrix} dF. \tag{C1}$$

Applying Cramer's rule, we obtain

$$\frac{dR^E}{dF} = \frac{(r+\lambda_E)\left[\beta - r\frac{q_E'(\theta_E)}{q_E(\theta_E)^2}\right]}{(r+\lambda_E G(R^E))\frac{q_E'(\theta_E)}{q_E(\theta_E)^2} - \beta} < 0 \tag{C2}$$

and

$$\frac{d\theta_E}{dF} = \frac{(1-\beta)\lambda_E G(R^E)}{(r+\lambda_E G(R^E))\frac{q_E'(\theta_E)c_E}{q_E(\theta_E)^2} - \beta c_E} < 0. \tag{C3}$$

According to equation (28), we can conclude that the decrease in market tightness in segment E, θ_E, must be accompanied by a decrease in market tightness in segment T, θ_T.

Present value of a temporary work agency position, $J^{A,F}$**:** from total differentiation of equations (31) and (33) we obtain

$$\begin{aligned}&\frac{r+\lambda_T G(R^T)+\gamma_T\theta_E q_E(\theta_E)}{r+\lambda_T+\gamma_T\theta_E q_E(\theta_E)}dR^T-\left(r+\gamma_T\theta_E q_E(\theta_E)\right)dJ^{A,F}\\ &=\gamma_T\left(q_E(\theta_E)+\theta_E q_E'(\theta_E)\right)\left[J^{A,F}+\frac{\lambda_T\int_{R^T}^1(x-R^T)dG(x)}{(r+\lambda_T+\gamma_T\theta_E q_E(\theta_E))^2}\right]d\theta_E+d\widetilde{\omega}_T\end{aligned}\tag{C4}$$

and

$$\begin{aligned}&\frac{\theta_T q_T(\theta_T)}{r+\lambda_T+\gamma_T\theta_E q_E(\theta_E)}dR^T+\left(r+\lambda_A+\gamma_A\theta_E q_E(\theta_E)\right)dJ^{A,F}\\ &=-\left(q_E(\theta_E)+\theta_E q_E'(\theta_E)\right)\left[\gamma_A J^{A,F}+\frac{\theta_T q_T(\theta_T)\gamma_T(1-R^T)}{\left(r+\lambda_T+\gamma_T\theta_E q_E(\theta_E)\right)^2}\right]d\theta_E\\ &\quad+\left(q_T(\theta_T)+\theta_T q_T'(\theta_T)\right)\left[\underbrace{\frac{1-R^T}{r+\lambda_T+\gamma_T\theta_E q_E(\theta_E)}-J_o^E(1)}_{=S^T(1)-J^T(1)>0}\right]d\theta_T\\ &\quad-\theta_T q_T(\theta_T)dJ_o^E(1)-d\widetilde{\omega}_A-\lambda_A d\widetilde{F}.\end{aligned}\tag{C5}$$

The system of equations is depicted in a reduced form in equation (C6), as only the signs of the expressions are of interest.

$$\begin{pmatrix}+&-\\+&+\end{pmatrix}\begin{pmatrix}dR^T\\dJ^{A,F}\end{pmatrix}=\begin{pmatrix}+&0&0&+&0&0\\-&+&-&0&-&-\end{pmatrix}\begin{pmatrix}d\theta_E\\d\theta_T\\dJ_o^E(1)\\d\widetilde{\omega}_T\\d\widetilde{\omega}_A\\d\widetilde{F}\end{pmatrix}\tag{C6}$$

$+/-$ indicate positive and negative terms. Solving for $dJ^{A,F}/d(.)$, we find

$$\frac{\partial J^{A,F}}{\partial\theta_E},\frac{\partial J^{A,F}}{\partial J_o^E(1)},\frac{\partial J^{A,F}}{\partial\widetilde{\omega}_T},\frac{\partial J^{A,F}}{\partial\widetilde{\omega}_A},\frac{\partial J^{A,F}}{\partial\widetilde{F}}<0$$

and

$$\frac{\partial J^{A,F}}{\partial\theta_T}>0$$

on which the discussion in the main text is based.

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