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Screening on the job: should temporary jobs be subsidized?

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Abstract

The difficulty to allocate the right workers to the right jobs is an important source of market frictions. With the expansion of atypical jobs in the mid-1980's, the idea that screening and flexibility could be complementary motivations arose. The purpose of this paper is twofold : (i) First, we investigate the screening effect of fixed-term contracts on employment (ii) Then, we analyze different subsidized temporary job schemes and their impact on the social welfare. We extend the framework of Pries and Rogerson (2005) by allowing firms to hire workers on both temporary and permanent jobs. Screening takes the form of a learning process where both the employer and the employee infer the match quality during a temporary job. We show that when temporary jobs are used as a screening device, they increase the employment size. Hiring and wage subsidies reduce both the unemployment rate and unemployment duration but have a different impact on the transition rate between unemployment, temporary jobs and permanent jobs. The hiring subsidy can be welfare enhancing while a permanent and identical wage subsidy for all temporary employed workers is always welfare detrimental. However, allowing the wage subsidy to compensate low income temporary jobs have a positive impact on labour market performance and may increase the aggregate welfare.

Keywords: Fixed-duration contract, Subsidised temporary jobs, Active labor market policies, Screening, Unemployment, Matching model.

JEL Classification: H29; J23; J38; J41; J64

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1 Introduction

The difficulty to allocate the right workers to the right jobs is an important source of market frictions. Usually, the quality of a match is not completely known ex ante but must be experienced for a certain period to be fully revealed (Jovanovic (1979) andJovanovic (1984)). In this paper, we interpret temporary jobs as screening devices and analyze their impact on employment and social welfare.

So far, the literature has mainly focused on the role of temporary jobs in firms adjustment to idiosyncratic and aggregate shocks. Some consensus has formed among economists that fixed term contracts do not necessarily reduce unemployment, while leading to segmented labour markets with low transition into permanent employment (Bentolila and Dolado (1994), Blanchard and Landier (2002) and Cahuc and Postel-Vinay (2002)).

Recently, the idea that screening and flexibility could be complementary has also received particular attention (Nagypal (2001)). Under this positive assumption, temporary jobs could be used to reduce employers' uncertainty about the employability of job applicants and allow the unemployed to build up their work experience, prevent skill atrophy and signal their willingness to work. The existence of such contracts should therefore facilitate the matching process in the labour market and create effective stepping stones to permanent employment (Boockmann and Hagen (2008) and Portugal and Varejão (2009)).

Since screening on temporary jobs might have an economic value, there should exist an optimal share of those contracts in the employment pool. Any deviation from this reference quantity therefore makes a room for public policy. Employment subsidies have been widely used in many European countries as part of Active Labour Market Policy. Targeted at temporary jobs, they generate positions that otherwise would not be accepted by the unemployed (given the level of unemployment and welfare benefits) or would not be created by firms (given the minimum wages, presence of unions, or other restrictions increasing wage costs). However, the efficiency of such programs crucially depends on the design of the measure (Calmfors (1994)) and one of the main problems faced by governments is to avoid promoting "dead end" jobs, while maintaining sufficient incentives to get unemployed back to work.

The purpose of this paper is twofold. First, we investigate the screening effect of temporary jobs on transitions to regular employment. We extend the framework of Pries and Rogerson (2005) to allow firms to offer both temporary and permanent jobs to unemployed. Screening is a learning process where the employer and employee infer the match quality during a fixed-term contract. The probability that a temporary job becomes permanent is endogenously determined. Second, we analyze two different employment subsidy schemes aimed at reducing unemployment and market inefficiencies. Following Orszag and Snower (2003), we consider : (i) a permanent wage subsidy to unemployed and (ii) a temporary employment subsidy to employers for hiring them.

We show that when temporary jobs are used as a screening device, they increase the employment size. Indeed, the efficient share of temporary jobs among all jobs is positive. Beside, using labor market policy to reduce labor market inefficiencies can be welfare improving. Hiring and wage subsidies reduce both the unemployment rate and unemployment duration but have a different impact on the transition rate between unemployment, temporary jobs and permanent jobs. The hiring subsidy can be welfare enhancing while a permanent and identical wage subsidy for all temporary employed workers is always welfare detrimental. However, allowing the wage subsidy to compensate low income temporary jobs have a positive impact on labour market performance and may increase the aggregate welfare.

The reminder of this paper is organized as follows. The next section is devoted to the description of the model and the definition of the equilibrium. The subsidy schemes are defined in section 3. Section 4 describes simulation exercises. A welfare analysis is made in section 5. Section 6 finally concludes.

2 The model

The model we develop is a modified version of Pries (2004) and Pries and Rogerson (2005). It uses a simple learning process in the spirit of Jovanovic (1979). Firms can hire individual in both temporary and permanent contracts. We assume employers use temporary jobs as a way of screening workers before hiring them into permanent jobs.[1]. A worker on a temporary job can switch on a regular job if its productivity is revealed to be good. Separations occur at no cost exogenously. However, temporary jobs are also withdrawn from the market when the true quality of the match is revealed to be bad. Our model includes a non-Walrasian labor market with search and matching frictions as in Mortensen and Pissarides (1999). Wages are determined through a Nash bargaining process over the surplus.

2.1 Worker and entrepreneur preferences

There is a continuum of identical workers and entrepreneurs whose preferences are defined as follows :

$$\text{Workers} \qquad \sum_{t=1}^{\infty} \beta^t (C_t^W - aN_t)$$

$$\text{Entrepreneurs} \quad \sum_{t=1}^{\infty} \beta^t (C_t^E - k_v V_t - k_x X_t)$$

[1] Thereafter, "screening job", "unknown quality job" and "temporary job" are used without distinction

β is the discount factor and C_t^W and C_t^E are the workers and entrepreneurs' consumption respectively. a represents labor disutility and N_t is the working time, with $N_t = 1$ if the worker is employed and $N_t = 0$ otherwise. Concerning the entrepreneur, V_t vacancies are posted and X_t employment positions are created. To post a vacancy and to create an employment position a firm has to pay a cost k_v and a cost k_x respectively.

2.2 The matching process

Labor market flows are governed by a matching process. The number of matches M is given by a matching function $M = M(U, V)$, where U represents the number of unemployed workers. The matching function satisfies the usual assumptions, it is increasing, concave and homogeneous of degree 1. Let $\theta = V/U$ be the labor market tightness, a vacancy is filled with probability $q = M/V$ and an unemployed worker finds a job with probability $p = \theta q = M/U$. During the matching process, these probabilities are taken as given by workers and entrepreneurs. Note that the properties of the matching function imply that q and p satisfy $q'(\theta) < 0$ and $p'(\theta) = q(\theta) + \theta q'(\theta) > 0$.

2.3 Match quality information and timing of events

We follow Pries (2004) and Pries and Rogerson (2005)'s modeling but we add a new assumption. The true match quality can be unknown or directly revealed with probability γ when the worker and employer meet. If it is unknown the worker and the entrepreneur get information about the match quality through a screening process taking place in a temporary job. The observed match output of a temporary job is defined as follows :

$$y = \overline{y} + \varepsilon$$

$\overline{y}$ is the match true quality and ε is a white noise with mean zero. There exists two types of matches : good matches with $\overline{y} = y^g$ and bad matches with $\overline{y} = y^b < y^g$. When a match is formed, its quality does not change through time. However, the quality of the match may not be instantaneously revealed, a learning process occurs. It should be stressed that production is observed at the end of a period, after the wage contract being signed.

The timing of events is as follows. At the meeting date, a common signal π is received by the worker and the employer. It corresponds to the probability the match be a good one. This probability is drawn from a distribution $H(\pi)$. The worker and the employer ought to decide to continue their relationship. Continuing the relationship incurs a cost c paid by the entrepreneur while stopping it can be done at no cost. If it continues, at the beginning of the period, the true match quality may be revealed with probability γ. In such a case, the worker is hired on permanent job. The remaining fraction of matches for which the quality is unknown enters in a learning process. Output $y = \overline{y} + \varepsilon$ is observed at the end of each period as long as the relationship continues. The white noise ε is drawn from a uniform distribution whose support is $[-\omega, \omega]$, with $\omega > 0$. The observed value of output may reveal the match quality. Let assume that $y^g - \omega < y^b + \omega$, if the realized value of output lies between $y^g - \omega$ and $y^b + \omega$, the match quality cannot be inferred. Conversely, if $y \in [y^b - \omega, y^g - \omega[$ $(y \in]y^b + \omega, y^g + \omega])$, the match quality is bad (good). The probability α the match quality is observed can easily be determined, one has $\alpha = \frac{y^g - y^b}{2\omega}$.

2.4 Workers and employers behavior

Let $J_e^n(\pi)$ be the expected initial value of a newly matched entrepreneur *i.e.* before the quality of the match is possibly revealed. Let $J_e(\pi)$ be the value of an already matched entrepreneur. $J_e(\pi)$ applies for new matches and old matches. Finally, the value of an unfilled employment position is denoted by J_u. These values satisfy :

$$J_e^n(\pi) = \max\left\{J_u, \gamma\big[\pi J_e(1) + (1-\pi)J_u\big] + (1-\gamma)J_e(\pi) - (c - \tau_h)\right\} \tag{1}$$

$$\begin{aligned} J_e(\pi) &= \max\Big\{J_u, \pi y^g + (1-\pi)y^b - w(\pi) + \beta(1-\lambda)\big[\alpha(\pi J_e(1) + (1-\pi)J_u) \\ &+ (1-\alpha)J_e(\pi)\big]\Big\} \end{aligned} \tag{2}$$

$$J_u = -k_v + \beta\left[q\int J_e^n(\pi)dH(\pi) + (1-q)J_u\right] \tag{3}$$

Equation (1) says the value of a newly matched entrepreneur $J_e^n(\pi)$ is equal to the expected gain of the match less the net hiring cost $c - \tau_h$. This cost can be viewed as the time and the resources spend to screen applicants. τ_h is an hiring subsidy reducing the hiring cost. Equation (2) states the value of an already matched entrepreneur is equal to the present expected gain from a job plus the present value of the expected future gains. Equation (2) implies that wage contracts are signed before the output level is revealed. When the productivity is revealed to be good with probability $(1-\lambda)\alpha\pi$, the temporary job become a regular one: $J_e(1)$. The screening process stop but separations may occur exogenously. Finally, equation (3) says the value of a vacant job is equal to the present value of the expected gains less the vacancy posting cost k_v.

Consider now workers and let $V_e^n(\pi)$ denotes the expected initial value of a matched worker before the quality of the match is possibly revealed. $V_e(\pi)$ denotes the value of an already matched worker. As in the case of an entrepreneur, $V_e(\pi)$ applies for new and old matches (after the match quality may be or not revealed). Finally, V_u correspond to the value of an unemployed worker. These values writes:

$$V_e^n(\pi) = \max\left\{V_u, \gamma\left[\pi V_e(1) + (1-\pi)V_u\right] + (1-\gamma)V_e(\pi)\right\} \quad (4)$$

$$V_e(\pi) = \max\left\{V_u, w(\pi) + \tau_w(\pi) - a + \beta(1-\lambda)\left[\alpha(\pi V_e(1) + (1-\pi)V_u)\right.\right. \quad (5)$$

$$\left.\left. + (1-\alpha)V_e(\pi)\right] + \beta\lambda V_u\right\} \quad (6)$$

$$V_u = b + \beta\left[p\int V_e^n(\pi)dH(\pi) + (1-p)V_u\right] \quad (7)$$

According to (4), the value of a newly matched worker $V_e^n(\pi)$ is equal to the expected gain of the match. A worker engaged in a match whose probability of being a good one is π receives a wage subsidy $\tau_w(\pi)$. If the match quality is known, that is if $\pi = 1$, the wage subsidy is zero (see section 3 for a more detailed discussion about wage subsidy). Equation (5) states the value of an already matched worker is equal to the present income of the match (the current wage less the cost a plus the wage subsidy $\tau_w(\pi)$) plus the present value of the expected futur gains. Finally, equation (7) says the value of an unemployed worker is equal to the present value of its expected gains plus unemployment benefits b.

2.5 Equilibrium

Wages are determined according to a Nash bargaining process. Let ν be the bargaining power of workers and $S(\pi) = J_e(\pi) - J_u + V_e(\pi) - V_u$ the total surplus of a job characterized by the probability π. The bargaining process leads to the following total surplus sharing between workers and entrepreneurs :

$$V_e(\pi) - V_u = \nu S(\pi) \quad (8)$$

$$J_e(\pi) - J_u = (1-\nu)S(\pi) \quad (9)$$

The selection of matches at the time of hiring features two stages. The first one consists in, knowing the initial expected value of a match ($J_e^n(\pi)$), retaining only a proportion $1 - H(\underline{\pi})$ of less risky matches. Continuation decision is then taken if the signal π is greater or equal to a threshold $\underline{\pi}$. At the second stage, if the match quality is not initially revealed, the entrepreneur and worker have to decide, once again, to continue or not their relationship. Knowing the pre-selection $1 - H(\underline{\pi})$ and the expected value of a temporary jobs $J_e(\pi)$, the final proportion $(1 - H(\overline{\pi}))$ of matches that will be screened on temporary jobs is chosen. In other words the continuation decision is taken if π is greater or equal to a new threshold $\overline{\pi}$. Observe that if $c - \tau_h = 0$, the threshold $\underline{\pi}$ is equal to

0, we thus conjecture $\underline{\pi} < \overline{\pi}$. The equilibrium thresholds satisfy the following conditions:

$$J_e^n(\underline{\pi}) = J_u \tag{10}$$
$$J_e(\overline{\pi}) = J_u \tag{11}$$

The relevance of a two steps selection is twofold. First, the true quality of the match may be directly revealed if the employer pay a screening cost. Second, it allows employers to decide to continue the relation before and after the screening cost is paid. The uncertainty about the match quality and the expected gains from a temporary job are different after observing the proportion of new matches entering in a permanent job. During the second step the entrepreneur has a prior information, influencing its decision to carry on the relation. Then, the existence of screening costs is crucial to scrutinize both the signal extraction mechanism and the matches selection process.

The equations system determining the equilibrium can be reduced to a three equations system in three unknown: $\underline{\pi}$, $\overline{\pi}$ and $\theta = V/U$. Consider the definition of total surplus, equations (2), (3), (5) and (7) may be rewritten as follows :

$$\begin{aligned} S(\pi) &= \max\Big\{\pi y^g + (1-\pi)y^b + \tau_w(\pi) - a + \beta(1-\lambda)\big[\alpha\pi S(1) + (1-\alpha)S(\pi)\big] \\ &- (1-\beta)V_u - (1-\beta(1-\lambda))J_u, 0\Big\} \end{aligned} \tag{12}$$

Now using the free entry condition $J_u = k_x$ and (10) and (11) determining the thresholds $\overline{\pi}$ and $\underline{\pi}$, the equilibrium (whose derivation is given in appendix) can be summarized by the following system:

$$\gamma\underline{\pi}S(1) = c - \tau_h \tag{13}$$

$$\begin{aligned} (1-\beta)k_x + k_v &= \beta q\Big[\gamma S(1)\int_{\underline{\pi}}^1 \pi dH(\pi) - (c-\tau_h)(1-H(\underline{\pi})) \\ &+ (1-\gamma)(1-\nu)\int_{\overline{\pi}}^1 S(\pi)dH(\pi)\Big] \end{aligned} \tag{14}$$

$$\begin{aligned} (1-\beta(1-\lambda))k_x &= \overline{\pi}y^g + (1-\overline{\pi})y^b - a + \tau_w(\overline{\pi}) + \beta(1-\lambda)\alpha\overline{\pi}S(1) \\ &- \frac{\nu\theta}{(1-\nu)}\beta q(1-\gamma)(1-\nu)\int_{\overline{\pi}}^1 S(\pi)dH(\pi) \end{aligned} \tag{15}$$

with

$$S(1) = \frac{(y^g - y^b)(1-\overline{\pi}) - \tau_w(\overline{\pi})}{1-\beta(1-\lambda)(1-\alpha\overline{\pi})} \tag{16}$$

$$S(\pi) = \frac{[(y^g - y^b) + \beta(1-\lambda)\alpha S(1)](\pi - \overline{\pi}) + \tau_w(\pi) - \tau_w(\overline{\pi})}{1-\beta(1-\lambda)(1-\alpha)} \tag{17}$$

To complete the definition of the equilibrium, we have to determine labor market flows. Let define :

- E_g : the number of goods quality matches;
- E_n : the number of unknown quality matches;
- E_v : the number of vacant employment positions previously created.

Knowing that $\theta = V/U$, $\underline{\pi}$ and $\overline{\pi}$ are defined by equations (13) — (15), steady state labor market equilibrium flows characterized by E_g, E_n, E_v and V are obtained by solving the following system of equations :

$$\lambda E_g = (1-\lambda)\alpha E_n E[\pi|\pi \geq \overline{\pi}] + Vq(\theta)\gamma P[\pi \geq \underline{\pi}] \times E[\pi|\pi \geq \underline{\pi}] \tag{18}$$

$$E_n(\lambda + (1-\lambda)\alpha) = Vq(\theta)(1-\gamma)P[\pi \geq \underline{\pi}] \times P[\pi \geq \overline{\pi}|\pi \geq \underline{\pi}] \tag{19}$$

$$\begin{aligned} E_v = {} & (1-\lambda)\alpha E_n E[1-\pi|\pi \geq \overline{\pi}] + V - \gamma q(\theta) V P[\pi \geq \underline{\pi}] \times E[\pi|\pi \geq \underline{\pi}] \\ & -q(\theta)V(1-\gamma)P[\pi \geq \underline{\pi}] \times P[\pi \geq \overline{\pi}|\pi \geq \underline{\pi}] \end{aligned} \tag{20}$$

with $E[\pi|\pi \geq \underline{\pi}] = \frac{\int_{\underline{\pi}}^{1} \pi dH(\pi)}{\int_{\underline{\pi}}^{1} dH(\pi)}$, $P[\pi \geq \underline{\pi}] = 1 - H(\underline{\pi})$, $P[\pi \geq \overline{\pi}|\pi \geq \underline{\pi}] = \frac{1-H(\overline{\pi})}{1-H(\underline{\pi})}$, $E[\pi|\pi \geq \overline{\pi}] = \frac{\int_{\overline{\pi}}^{1} \pi dH(\pi)}{\int_{\overline{\pi}}^{1} dH(\pi)}$ and $P[\pi \geq \overline{\pi}] = 1 - H(\overline{\pi})$.

Equations (18)—(20) respectively describes steady state outflows and inflows from good quality matches, unknown quality matches and vacant employment position previously created.

2.6 Uniqueness of the equilibrium for small values of c

Some analytical results are difficult to obtain about the existence of the steady state equilibrium. However, an interesting result may be obtained for small values of the cost c and imposing $\tau_h = \tau_w(\pi) = 0$. Let's first suppose that $c = 0$. From equation (13), it immediately follows that $\underline{\pi} = 0$. If a worker and an entrepreneur meet, as there is no cost, it is worthwhile to wait for the match quality to be revealed or not, $\underline{\pi} = 0$. Furthermore, it can be hoped that $\underline{\pi}$ will increase and become positive as c increases. The following proposition provides some properties about the equilibrium for small values of the cost c.

Proposition 1 *If $c = 0$, then, $\underline{\pi} = 0$ and, if it exists, the solution in θ and $\overline{\pi}$ of the system formed by equations* (14) *and* (15) *is unique. Furthermore, the derivatives of θ, $\overline{\pi}$ and $\underline{\pi}$ with respect to c satisfy $\frac{\partial \overline{\pi}}{\partial c} < 0$, $\frac{\partial \theta}{\partial c} < 0$ and $\frac{\partial \underline{\pi}}{\partial c} > 0$.*

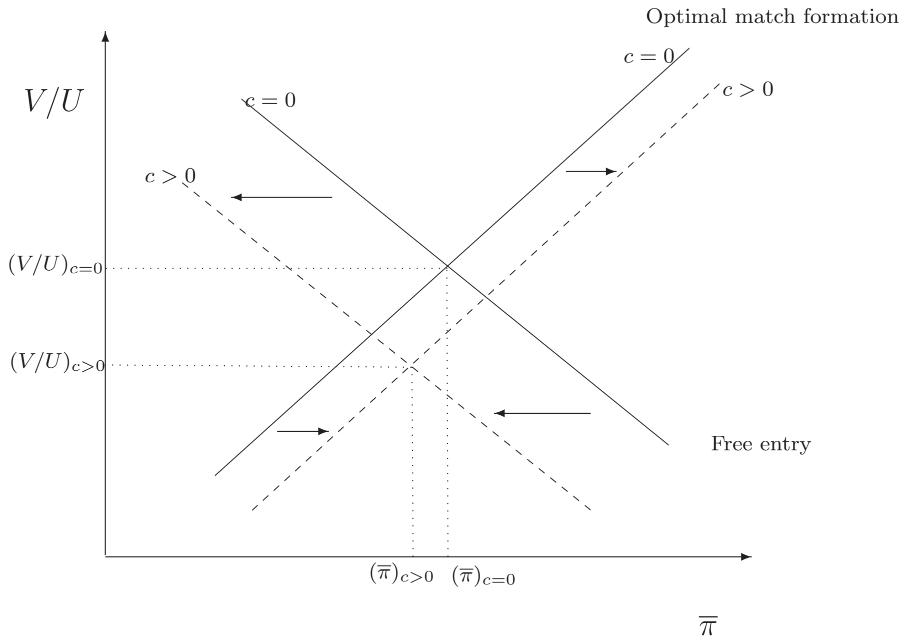


Figure 1: Equilibrium values of $\overline{\pi}$ and V/U.

Proof See appendix.

Proposition 1 states that for $c = 0$, the equilibrium is unique. Furthermore, proposition 1 shows how the equilibrium is perturbed if c increases. It follows that, by continuity, for small values of c, the equilibrium still exists and is unique. The effect of an increase in c on the equilibrium is represented in figure 1. This argument will enable us to provide an analytical result concerning labor market policies measures for small values of c.

3 Labor market policy

As previously mentioned wage and hiring subsidies are implemented in many OECD country (France, Switzerland, Canada, USA, UK, Sweden, Germany, etc.) as Active Labor Market Policies. Those allow to capture the main features of subsidized temporary employment program. The hiring subsidy is limited over time and delivered to employers. It has been designed to encourage them to hire individuals they would not have hired in the absence of subsidy. The wage subsidy is used to reduce employers labor cost and to increase their incentive to create employment positions. It can also be targeted on job seekers to encourage them to accept unsuitable job offers. The main idea is that it introduces compensatory effect and gives to low paid jobs a higher economic value. To be consistent with this feature we distinguish two wage subsidy schemes ($\tau_w^1(\pi)$ and $\tau_w^2(\pi)$). There expressions are defined as follows:

$$\tau_w^1(\pi) \begin{cases} = d & \text{if} \quad \pi < 1 \\ = 0 & \text{otherwise} \end{cases}$$
$$\tau_w^2(\pi) = \xi(1-\pi)^{\phi}$$

where $d > 0, \xi > 0$ and $\phi > 1$ represent the parameters of the subsidies schemes[2]. Both imply only temporary jobs are subsidized. The first one break at $\pi = 1$ while the second is a decreasing function of π. We then refer to $\tau_w^1(\pi)$ as a non-contingent wage subsidy and $\tau_w^2(\pi)$ as a contingent wage subsidy. Note that when $\phi \to 0$ $\tau_w^2(\pi) = \tau_w^1(\pi)$. $\tau_w^1(\pi)$ increases the value of a matched worker ($V_e(\pi)$) by an amount d whatever the observed match quality is. $\tau_w^2(\pi)$ satisfies $\tau_w^2(1) = 0, \tau_w^{2\,\prime}(\pi) < 0$ and $\tau_w^{2\,\prime\prime}(\pi) \geq 0$. The lower the present value of a temporary jobs the higher the wage subsidy. While this condition appears quite arbitrary, it allows to capture the compensatory effect and provides a suitable proxy for the wage subsidy commonly used. Finally, we assumed that these subsidies financed through a lump-sum tax T. The government budget constraint is given by:

$$T = bU + \tau_h qV(1 - H(\underline{\pi})) + E_n \int_{\bar{\pi}}^{1} \tau_w(\pi) \frac{dH(\pi)}{1 - H(\bar{\pi})}$$

4 Quantitative evaluation of the model

4.1 Data match for parameters selection

The benchmark economy is calibrated on the French economy using labor force surveys over the period 2003T2-2005T4. We compute monthly transition rates by assuming they are constant over one quarter. We assume that unknown quality jobs correspond to fixed-term contracts and good quality jobs correspond to permanent ones. We do not take into account seasonally contracts. Indeed, such contracts may serve as a buffer stock against demand fluctuations and are not used as screening devices. Only workers between 25 and 55 years old are considered in the sample. Ratios and parameters are chosen as follows and report with their empirical counterparts in table 1:

The reference period is the month. We set the discount factor to 0.9966, which gives an annual steady state interest rate close to 4%. The long run unemployment rate is set to 9.03% and the share of temporary jobs among all jobs is 9.32%. We target the transition rate from unemployment to temporary jobs $p\gamma E(\pi|\pi > \underline{\pi}) = 3.37\%$ and from unemployment to regular jobs $p(1-\gamma)P(\pi > \bar{\pi}|\pi > \underline{\pi}) = 2.2\%$. Then, 60.5% of new hiring are in temporary jobs. This ratio

[2] Their value will be chosen thereafter for the simulation.

is consistent with the one obtained by Givor and Wilner (2007) on French data (two third). The implied unemployment duration is 18 months. We set p to 0.3. Consequently, it takes 3.3 months for an unemployed worker to have a contact with a firm. The rate at which a firm fills a vacancy q is set to 0.45. Therefore, it takes 2 months and one week to fill a vacant job. At the steady state, the number of matches M must be equal to the number of separations. Knowing that $M = qV$ we can easily deduce the number of vacancies $V = M/q$ and the labor market tightness $\theta = V/U$. The annual job destruction rate is of about 10% (0.85% monthly) but the monthly workers flow rate in the data is 0.28%. We take an alternative value for $\lambda = 0.5\%$. The implied transition rate from temporary jobs to unemployment and from temporary jobs to regular jobs are 3.59% and 2.52% respectively, which is broadly consistent with their empirical counterpart (3.55% and 2.21% respectively). We impose $\nu = \eta = 0.5$. Then, the only externality comes from the screening process. The disutility of work must be lower than y_b to guarantee that bad matches are terminated. The distribution H(.) of probability π is a time-invariant Gaussian distribution with zero mean, variance σ_π and truncated below zero and above one. The remaining parameters α, γ, k_v, y_g, b, σ_π, $\underline{\pi}$ and $\overline{\pi}$ are set to match the different ratios mentioned above and to solve the system. The policy parameters $\tau_w(\pi)$ and τ_h are set to zero in the benchmark.

Variables	**Symbol**	**Data**	**Benchmark**
Unemployment rate	U	9.03	9.03
Share of unknown quality job	$E_n/(E_g + E_n)$	9.32	9.32
U $\rightarrow E_n$ transition rate	$p\gamma E(\pi \mid \pi > \underline{\pi})$	3.37	3.37
U $\rightarrow E_g$ transition rate	$p(1-\gamma)P(\pi > \overline{\pi} \mid \pi > \underline{\pi})$	2.20	2.20
$E_n \rightarrow E_g$ transition rate	$(1-\lambda)\alpha E(\pi \mid \pi > \overline{\pi})$	2.21	2.52
$E_n \rightarrow U$ transition rate	$\lambda + (1-\lambda)\alpha$	3.55	3.59
$E_g \rightarrow U$ transition rate	λ	0.28	0.5
Unemployment duration (month)	1/[U$\rightarrow E_n$+U$\rightarrow E_g$]	9.25	17.9
Share of new hiring in E_n	$\frac{U \rightarrow E_n}{U \rightarrow E_n + U \rightarrow E_g}$	60.5	60.5

Table 1: **Data match for parameters selection.**

Variables	Symbol	Value
Discount factor	β	0.9966
Probability $\bar{y}$ is reveal	α	0.031
Share of new match whose $\bar{y}$ is reveal	γ	0.21
Productivity of good quality matches	y^g	1.9
Productivity of bad quality matches	y^b	1
Standard deviation of H(.)	σ_π	0.52
Worker bargaining power	ν	0.5
Elasticity of the matching function	η	0.5
Labor disutility*	a	0.406
Replacement rate	ρ^R	0.34
Cost of creating employment positions*	k_x	0.104
Cost of posting vacancies*	k_v	0.081
Cost of screening*	c	0.113

Table 2: **Baseline parameters.** ** means that the parameter is expressed as a function of the monthly average wage*

4.2 Simulation

We simulate a reform consisting in subsidizing temporary jobs. The hiring subsidy and the wage subsidy are computed separately. Each one is equal to 5% of the benchmark monthly total output Y. It follows that $\tau_h = 0.05Y$, $d = 0.05Y$ and $\int_{\overline{\pi}}^{1} \tau_w(\pi) dH(\pi)/(1 - H(\overline{\pi})) = 0.05Y$. For the sake of simplicity, we assume that ϕ is equal to one. Results are reported in table 3[3].

[3]Wage subsidy 1 corresponds to $\tau_w^1(\pi)$ while wage subsidy 2 corresponds to $\tau_w^2(\pi)$.

	Benchmark economy	Hiring subsidy	Wage subsidy 1	Wage subsidy 2
$\underline{\pi}$	0.16	0.12	0.19	0.20
$\overline{\pi}$	0.68	0.69	0.65	0.55
$E(\pi\|\pi > \underline{\pi})$	0.47	0.44	0.49	0.72
$E(\pi\|\pi > \overline{\pi})$	0.81	0.82	0.79	0.50
$P(\pi > \overline{\pi}\|\pi > \underline{\pi})$	0.19	0.17	0.24	0.37
U	9.03	8.53	8.89	7.53
E_g	82.5	83.1	81.7	81.0
$E_n/(E_n + E_g)$	9.32	9.11	10.3	12.4
V	8.00	8.55	6.93	5.59
X	0.45	0.46	0.46	0.46
p	30.0	31.9	28.0	27.4
$U \to E_n$	3.37	3.51	3.75	5.47
$U \to E_g$	2.20	2.40	2.01	1.95
$E_n \to E_g$	2.52	2.53	2.45	2.25
$1/(U \to E_n + U \to E_g)$	17.9	16.9	17.4	13.5
$\int w(\pi)dH(\pi)$	1.90	1.89	1.83	1.77

Table 3: **Simulated labor market policies**

Consistent with Gerfin, Lechner, and Steiger (2005) and Orszag and Snower (2003)'s predictions (2005) the way subsidized temporary employment programs are implemented strongly affect their consequences on labor market outcomes. The effect of the subsidies depends on three key variables of the model: the tightness governing the contact rate and the two threshold $\underline{\pi}$ and $\overline{\pi}$ driving the proportion of match that will be screened on temporary jobs. Let us first discuss the impact of the hiring subsidy.

The hiring subsidy makes the screening process cheaper, reducing the cost of hiring a new worker. Consequently, entrepreneurs create more employment positions and post more vacancies as shown by the increase of X and V by 2.2% and 6.9% respectively. The impact of τ_h on the match selection is quite intuitive and highlights the link between the two thresholds. Consider the case in which c increases, as it is demonstrate graphically (see Figure 1) and analytically (see appendix). Continuing the relation commit firms to pay more irreversible expenditures. Two effects matter for matches selection[4]. First, firms are more reluctant to attempt to form an employment relation and only matches whose signal π is high enough are kept. This can be done by raising the threshold $\underline{\pi}$. Second, because firms know the proportion $1 - H(\underline{\pi})$ contains only matches whose signal is high enough, the expected gains from a job are greater. The optimal match formation curve move to the right while the Beveridge curve move to the left. As a consequence, the parties are less picky about the second selection and reduce $\overline{\pi}$. Then, the burden of the screening cost introduces an incentive for employers to continue the relation in order to pay off these irreversible expenditures.

[4]Recall that the selection of matches at the time of hiring features two stages.

This result is of course symmetric with respect to a decrease in c achieved by the hiring subsidy τ_h. When the screening cost is reduced firms cut back the lowest acceptable initial signal ($\underline{\pi}$). The fall in $\underline{\pi}$ increases the range of matches whose expected quality is lower, as shown by the fall in $E(\pi|\pi > \underline{\pi})$ of 6.4%. As a consequence, in the second step of the selection the cheaper the screening the pickier the selection. This is represented by the rise of $\overline{\pi}$ and the decrease of $P(\pi > \overline{\pi}|\pi > \underline{\pi})$ by around 1.5% and 11% respectively. Since p increases by around 6.3% the overall impact on the exit rate from unemployment is ambiguous (see definitions of the transition rates in table 1). Simulations show that the positive effect on the contact rate dominates the decrease in $E(\pi|\pi > \underline{\pi})$ and $P(\pi > \overline{\pi}|\pi > \underline{\pi})$. The transition rate from unemployment to good quality matches and to unknown quality matches become higher, reducing the average unemployment duration. The rise of $\overline{\pi}$ increases the conditional expectation $E(\pi|\pi > \overline{\pi})$ and drive the transition rate from E_n to E_g above its initial level. Finally, the pool of workers in good quality jobs is 0.77% higher while the size of unknown quality jobs declines by 1.68%. The unemployment size decreases by around 5.5%.

The impact of the two wage subsidies are qualitatively the same and pass through the same channels. When $\tau_w^1(\pi)$ or $\tau_w^2(\pi)$ are introduced, the relative value of a matched worker $V_e(\pi)$ becomes higher. The increase in the marginal value of such jobs allows temporary employed workers to take advantage of the surplus in the bargaining. Since firms expect an increase in the wage pressure and a decrease in their future profits they cut down the number of retained matches so as to keep only those whose signal is high enough. One more time, recall the existence of screening costs commit firms to irreversible expenditures. Then, firms are less choosy at the second stage of the selection and reduces $\overline{\pi}$ to pay off the cost c. The fall of the firms' expected profits reduces their incentive to post vacancies and the contact rate p. The effect on p overcomes the rise of $E(\pi|\pi > \underline{\pi})$, diminishing the chances of the unemployed to have a good quality job. However the increase of $P(\pi > \overline{\pi}|\pi > \underline{\pi})$ dominates the effect on p and boosts the transition rate from unemployment to unknown quality matches. Finally, the two wages subsidies reduces both the unemployment rates and the average unemployment duration.

The difference between the two wage subsidies arises from their dependance with π. In the wage negotiation, $\tau_w^2(\pi)$ reinforces the workers' position in matches whose signal is low, while $\tau_w^1(\pi)$ strengthens it identically. Consequently, $\tau_w^2(\pi)$ reduces the wages dispersion and limits the wage pressures compared to $\tau_w^1(\pi)$. But, the contingent wage subsidy also decreases the firms expected gains from a job since it makes weak signaling workers better off in the wage negotiation. The overall impact depends on the distribution of matches. A great number of matches featuring a weak signal π will have a larger impact on the expected gains from an employment position than the decrease in the wage pressure. This is the case in our model where $H(.)$ is a normal distribution with zero mean and truncated below zero and above one. It follows that the impact of $\tau_w^2(\pi)$ on the thresholds, the transition rates and the stock variables is stronger than $\tau_w^1(\pi)$.

4.3 Welfare and political economy

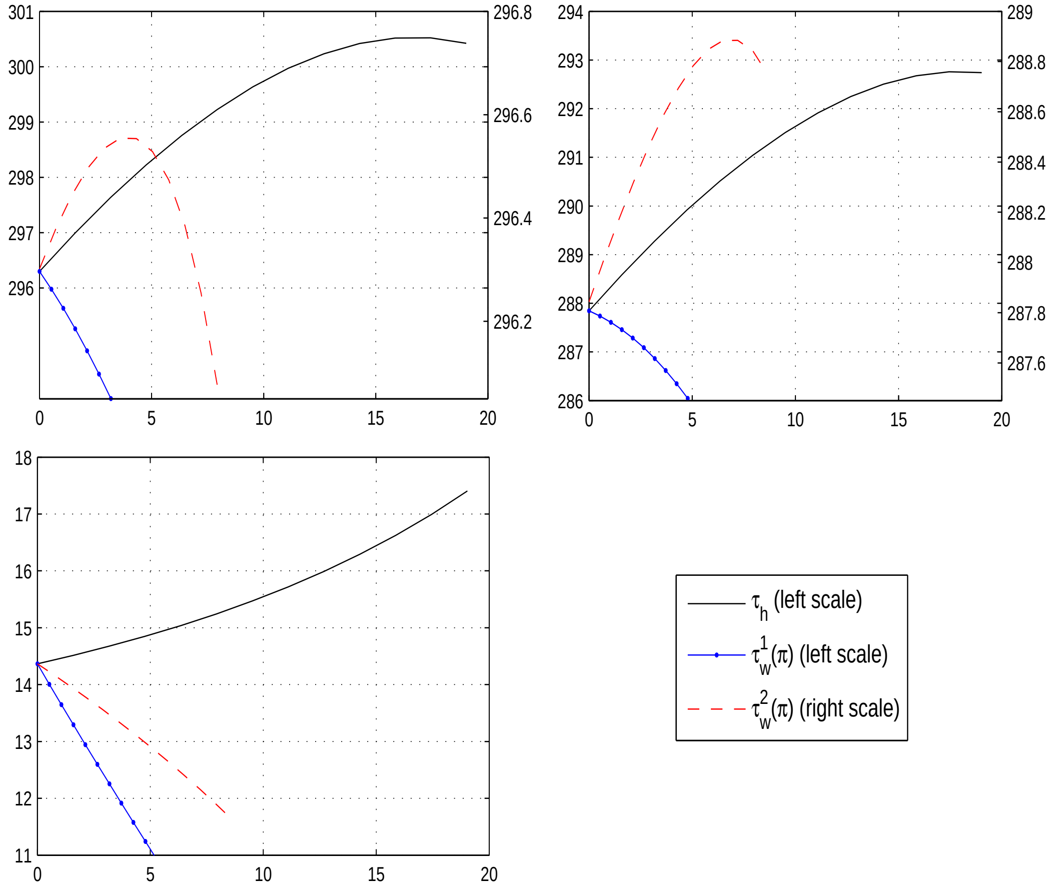
What is the efficient proportion of temporary and permanent jobs? Are subsidized temporary employment desirable? Are hiring subsidies preferred to wage subsidies? Should wage subsidies strengthen workers' position with weak observed signal? To answer these questions we investigate the consequences of the subsidy schemes from a welfare perspective. Because all agents are risk-neutral and they are no redistribution costs or idiosyncratic risks, the retained criterion is the aggregate welfare computed as the total output net of recruiting costs and the disutility of work. Let us first compare the decentralized equilibrium to a *laissez-faire* economy where no institution matters *i.e.* $b = \tau_h = \tau_w(\pi) = 0$. The Pareto allocation is derived in Appendix. Results are report in table 4.

	Benchmark economy	Laissez-faire economy
Employment	100.00	106.61
Good quality matches	100.00	102.40
Unknown quality matches	100.00	147.54
Share of unknown quality matches	100.00	146.40
Vacancies	100.00	158.53
Employment positions	100.00	106.61
Average wage	100.00	92.89
Aggregate welfare	100.00	103.94

Table 4: Optimal labor market policy

The benchmark calibration displays a welfare loss of about 4% relative to the first-best allocation. The efficient size of good and unknown quality matches are both greater. The Pareto allocation implies an higher share of temporary jobs among all jobs compare to the benchmark. The efficient number of vacancies and employment positions are 58.5% and 6.6% higher than in the benchmark economy respectively. Not surprisingly, the average wage appears lower since there are more workers on unknown quality jobs.

The above results highlights the existence of inefficiencies in the calibrated economy, leaving a room for policy instruments. Now we can investigate the extend in the reduction of welfare losses related to subsidies. We vary the level of the different subsidies and depict their consequences on agents and aggregate welfare. Results are reported in figure 2.



In line with previous results the hiring subsidy is always preferred to wage subsidies. The workers and entrepreneurs welfare are both increased when τ_h raises. The aggregate welfare reaches a maximum value at $\tau_h = 0.16\bar{w}$ and becomes 1.42% higher than in the benchmark case, reducing the welfare gap with respect to the efficient allocation by around one third. The wage subsidy $\tau_w^1(\pi)$ seems to be undesirable for workers as well for firms. Strengthening equally the position of all workers is always welfare detrimental. However, when allowing the wage subsidy to be a decreasing function of the observed signal ($i.e.$ $\tau_w^2(\pi)$), it enhances the aggregate and workers' welfare. Both reach a maximum value which are, however, lower than the ones induced by the hiring subsidy.

5 Conclusion

In this paper, we study the consequences on labor market outcomes and social welfare of temporary jobs as a screening device. Calibrated on French data, our on-the-job signal extraction model with search and matching frictions allows to reproduce the main stylized facts of the French labor market. We show that when temporary jobs are used as a screening device, the employment size can be increased. Indeed, the efficient share of temporary jobs among all jobs is positive. Besides, using labor market policy to reduce labor market inefficiencies can be welfare improving. Hiring and wage subsidies reduce both the unemployment rate and the unemployment duration but have a different impact on the transition rate between unemployment, temporary jobs and permanent jobs. The hiring subsidy can be welfare enhancing while a permanent and identical wage subsidy for all temporary employed workers is always welfare detrimental. However, allowing the wage subsidy to compensate low income temporary jobs have a stronger impact on labour market performance and may increase the aggregate welfare.

However, some assumptions limits the analysis and our model can be extend in many direction to deliver a deeper analysis. First, the cost of screening c and the probability that the true quality of the match is revealed at the time of hiring (γ) are both exogenous. It will be worth introducing an endogenous probability which depends on the firms' willingness to spend greater resources in screening. Second, the model admits a one period hiring subsidy or an indefinite duration wage subsidy while most of employment programs features open-ended subsidies. Third, the model implies that unemployed workers can not direct their search to temporary jobs or to permanent jobs. In this case it will be interesting to study the consequences of a dual labor market. Lastly, the implementation of labor market policies when temporary jobs are not fully is beyond the scope of this paper but remains an interesting issue for future research.

References

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

Blanchard, O., and A. Landier (2002): "The Perverse Effects of Partial Labour Market Reforms: Fixed Duration Contracts in France?," *The Economic Journal*, 112, F214–F244.

Boockmann, B., and T. Hagen (2008): "Fixed-term contracts as sorting mechanisms: Evidence from job durations in West Germany," *Labour Economics*, 15, 984–1005.

Cahuc, P., and F. Postel-Vinay (2002): "Temporary jobs, Employment Protection, and Labor Market Performance?," *Labour Economics*, 9, 61–91.

Calmfors, L. (1994): "What Can Sweden Learn from the European Unemployment Experiences?," *Swedish Economic Policy Review*, 1-2.

Gerfin, M., M. Lechner, and H. Steiger (2005): “Does Subsidised Temporary Employment Get the Unemployed Back to Work? An Econometric Analysis of Two Different Schemes,” *Labour Economics*, 12, 807–835.

Givor, P., and L. Wilner (2007): “Temporary Agency Employment as a Way out of Poverty?,” Mineo.

Jovanovic, B. (1979): “Job matching and the theory of turnover,” *Journal of Political Economy*, 87, 972–990.

——— (1984): “Matching, Turnover, and Unemployment,” *Journal of Political Economy*, 92, 108–1220.

Mortensen, D., and C. Pissarides (1999): “New developments in models of search in the labor market,” in *Handbook of Labor Economics*, vol. 3, chap. 2, pp. 2567–2627. Elsevier Science, New York.

Nagypal, E. (2001): “"Fixed-Term Contracts in Europe: A Reassessment in Light of the Importance of Match-Specific Learning,” IEHAS Discussion Papers 0110.

Orszag, J., and D. Snower (2003): “Designing employment subsidies,” *Labour Economics*, 10, 557–572.

Portugal, P., and J. Varejão (2009): “Why Do Firms Use Fixed-Term Contracts?,” IZA Discussion Papers 4380.

Pries, M. (2004): “Persistence of unemployment fluctuations: a model of recurring job loss,” *Review of Economic Studies*, 71, 193–215.

Pries, M., and R. Rogerson (2005): “Hiring policies, labor market institutions, and labor market flows,” *Journal of Political Economy*, 113, 811–839.

A Determination of the equilibrium

Consider equations (1) and (4) at the threshold $\underline{\pi}$. It is easily deduced that $\gamma\underline{\pi}(J_e(1) - J_u) = c - S_h$ and $V_e(1) = V_u$. It follows that the total surplus satisfies $S(1) = J_e(1) - J_u$ and the following condition about the threshold $\underline{\pi}$ is obtained :

$$\gamma\underline{\pi}S(1) \quad = \quad c \tag{21}$$

The threshold $\underline{\pi}$ is such that the expected gain of the match is just equal to the cost c. As their is an employment position creation cost, the free entry condition writes $J_u = k_x$. Using equations (5), (7) and (8), one gets :

$$(1-\beta)V_u \quad = \quad \beta p(1-\gamma)\nu \int_{\overline{\pi}}^{1} S(\pi)dH(\pi)$$

Similarly, using equations (2), (3) and (9), equation (14) is obtained :

$$\begin{aligned}(1-\beta)J_u \quad &= \quad -k_v + \beta q\gamma S(1)\int_{\underline{\pi}}^{1}\pi dH(\pi) \\ &+ \quad \beta q(1-\gamma)(1-\nu)\int_{\overline{\pi}}^{1} S(\pi)dH(\pi) - \beta q(c - S_h)(1 - H(\underline{\pi}))\end{aligned} \tag{22}$$

From the two above equations, one easily deduces that :

$$(1-\beta)V_u \quad = \quad \frac{\nu p}{(1-\nu)q}\left[(1-\beta)J_u + k_v - \beta q\gamma S(1)\int_{\underline{\pi}}^{1}\pi dH(\pi) + \beta qc(1 - H(\underline{\pi}))\right] \tag{23}$$

Using the above equation to eliminate V_u from (12) and using the free entry condition, one gets :

$$\begin{aligned}S(\pi) \quad &= \quad \max\Big\{\pi y^g + (1-\pi)y^b - a + \beta(1-\lambda)\big[\alpha\pi S(1) + (1-\alpha)S(\pi)\big] - (1-\beta(1-\lambda))k_x \\ &- \quad \frac{\nu p}{(1-\nu)q}\left[(1-\beta)k_x + k_v - \beta q\gamma S(1)\int_{\underline{\pi}}^{1}\pi dH(\pi) + \beta qc(1 - H(\underline{\pi}))\right], 0\Big\}\end{aligned} \tag{24}$$

Consider now equation (A) evaluate at $\overline{\pi}$, it satisfies $S(\overline{\pi}) = 0$. One gets :

$$\begin{aligned}0 \quad &= \quad \overline{\pi}y^g + (1-\overline{\pi})y^b - a + \beta(1-\lambda)\alpha\overline{\pi}S(1) - (1-\beta(1-\lambda))k_x \\ &- \quad \frac{\nu p}{(1-\nu)q}[(1-\beta)k_x + k_v - \beta q\gamma S(1)\int_{\underline{\pi}}^{1}\pi dH(\pi) + \beta qc(1 - H(\underline{\pi}))]\end{aligned} \tag{25}$$

Equation (22) and (25) give the third equation of the system *i.e.* equation (14). It is now easy to obtain a simplified expression of the total surplus $S(\pi)$ for values of $\pi \in [\overline{\pi}, 1[$ using $S(\pi) - S(\overline{\pi})$ given by and (25):

$$S(\pi) \quad = \quad \frac{[(y^g - y^b) + \beta(1-\lambda)\alpha S(1)](\pi - \overline{\pi}) + \tau_w(\pi) - \tau_w(\overline{\pi})}{1 - \beta(1-\lambda)(1-\alpha)} \tag{26}$$

Computing the total surplus value for $\pi = 1$ provides :

$$S(1) \quad = \quad \frac{(y^g - y^b)(1-\overline{\pi}) - \tau_w(\overline{\pi})}{1 - \beta(1-\lambda)(1-\alpha\overline{\pi})} \tag{27}$$

B Proof of proposition 1

To begin, let's define

$$\begin{aligned}\psi(\overline{\pi}) &\equiv \frac{y^g - y^b}{1-\beta(1-\lambda)(1-\alpha\overline{\pi})}\\ \zeta(\overline{\pi}) &\equiv \frac{\tau_w(\overline{\pi})}{1-\beta(1-\lambda)(1-\alpha\overline{\pi})}\\ \varphi(\overline{\overline{\pi}}) &\equiv \psi(\overline{\pi})(1-\overline{\pi})\end{aligned}$$

One easily checks that $\varphi(\overline{\pi}) > 0$, $\psi(\overline{\pi}) > 0$, $\psi'(\overline{\pi}) = -\frac{\alpha\beta(1-\lambda)(y^g-y^b)}{(1-\beta(1-\lambda)(1-\alpha\overline{\pi}))^2} < 0$, $\varphi'(\overline{\pi}) = -\overline{\pi}\psi(\overline{\pi}) + (1-\overline{\pi})\psi'(\overline{\pi}) < 0$ and $\overline{\pi}\psi'(\overline{\pi}) + \psi(\overline{\pi}) = \frac{(y^g-y^b)(1-\beta(1-\lambda))}{(1-\beta(1-\lambda)(1-\alpha\overline{\pi}))^2} > 0$.

Consider now equations (14) and (15). Having eliminated $\underline{\pi}$ thanks to equation (13), assuming $\tau_h = \tau_w(\pi) = 0$ and using the definition of $\psi(\overline{\pi})$, $\zeta(\overline{\pi})$ and $\varphi(\overline{\overline{\pi}})$ mentioned above we define $g(\overline{\pi}, \theta; c)$ and $f(\overline{\pi}, \theta; c)$ such that :

$$\begin{aligned}&g(\overline{\pi},\theta;c) \equiv y^b - a + (1-\beta(1-\lambda)(1-\alpha))\overline{\pi}\psi(\overline{\pi}) - (1-\beta(1-\lambda))k_x\\ &-\frac{\nu}{(1-\nu)}\theta\Bigg[(1-\beta)k_x + k_v - \beta q(\theta)\gamma\varphi(\overline{\pi})\int_{\frac{c}{\gamma\varphi(\overline{\pi})}}^1 \pi dH(\pi)\\ &+\beta q(\theta)c\left(1-H\left(\frac{c}{\varphi(\overline{\pi})}\right)\right)\Bigg] = 0 \qquad (28)\end{aligned}$$

$$\begin{aligned}&f(\overline{\pi},\theta;c) \equiv -k_v - (1-\beta)k_x + \beta q(\theta)\gamma\varphi(\overline{\pi})\int_{\frac{c}{\gamma\varphi(\overline{\pi})}}^1 \pi dH(\pi)\\ &+\beta q(\theta)(1-\gamma)(1-\nu)\psi(\overline{\pi})\int_{\overline{\pi}}^1(\pi-\overline{\pi})dH(\pi) - \beta q(\theta)c\left(1-H\left(\frac{c}{\gamma\varphi(\overline{\pi})}\right)\right) = 0 \qquad (29)\end{aligned}$$

Computing the derivatives of f and g with respect to $\overline{\pi}$, θ and c and evaluating them at $c = 0$ provides :

$$\begin{aligned}g_1(\overline{\pi},\theta;0) &= (1-\beta(1-\lambda)(1-\alpha))(\psi(\overline{\pi}) + \overline{\pi}\psi'(\overline{\pi})) + \frac{\nu}{1-\nu}q(\theta)\gamma\varphi'(\overline{\pi})\int_0^1 \pi dH(\pi) > 0\\ g_2(\overline{\pi},\theta;0) &= -\frac{\nu}{1-\nu}\left[(1-\beta)k_x + k_v - \beta q(\theta)\gamma\varphi(\overline{\pi})\int_0^1 \pi dH(\pi)\right] + \frac{\nu}{1-\nu}\beta\theta q'(\theta)\gamma\varphi(\overline{\pi})\int_0^1 \pi dH(\pi)\\ &= -\beta(1-\gamma)\nu q(\theta)\psi(\overline{\pi})\int_0^1(\pi-\overline{\pi})dH(\pi) + \frac{\nu}{1-\nu}\beta\theta q'(\theta)\gamma\varphi(\overline{\pi})\int_0^1 \pi dH(\pi) < 0\\ g_3(\overline{\pi},\theta;0) &= -\frac{\nu}{1-\nu}\theta\beta q(\theta) < 0\end{aligned}$$

$$\begin{aligned}f_1(\overline{\pi},\theta;0) &= \beta\gamma q(\theta)\varphi'(\overline{\pi})\int_0^1 \pi dH(\pi)\\ &+ \beta q(\theta)(1-\gamma)(1-\nu)\psi'(\overline{\pi})\int_{\overline{\pi}}^1(\pi-\overline{\pi})dH(\pi)\\ &- \beta q(\theta)(1-\gamma)(1-\nu)\psi(\overline{\pi})(1-H(\overline{\pi})) < 0\\ f_2(\overline{\pi},\theta;0) &= \frac{q'(\theta)}{q(\theta)}((1-\beta)k_x + k_v) < 0\\ f_3(\overline{\pi},\theta;0) &= -\beta q(\theta) < 0\end{aligned}$$

The signs of the above derivatives immediately follow from the signs of the derivatives of φ, ψ and q. That is $\psi'(\overline{\pi}) < 0$, $\overline{\pi}\psi'(\overline{\pi}) + \psi(\overline{\pi}) > 0$, $\varphi'(\overline{\pi}) < 0$ and $q'(\theta) < 0$.

Uniqueness Suppose $c = 0$, we easily deduce the slope of the optimal match formation equation (equation (28)) and the slope of the free entry condition (equation (29)) are respectively positive and négative ($-g_1(\overline{\pi}, \theta; 0)/g_2(\overline{\pi}, \theta; 0) > 0$ and $-f_1(\overline{\pi}, \theta; 0)/f_2(\overline{\pi}, \theta; 0) < 0$). It follows the solution of the system formed equations (28) and (29), if it exists, is unique (see figure 1).

Sign of the derivatives with respect to c The derivatives of θ and $\overline{\pi}$ with respect to c for $c = 0$ write :

$$\begin{aligned}
\frac{\partial \theta}{\partial c} &= \frac{-f_1(\overline{\pi}, \theta; 0) g_3(\overline{\pi}, \theta; 0) + g_1(\overline{\pi}, \theta; 0) f_3(\overline{\pi}, \theta; 0)}{f_1(\overline{\pi}, \theta; 0) g_2(\overline{\pi}, \theta; 0) - g_1(\overline{\pi}, \theta; 0) f_2(\overline{\pi}, \theta; 0)} < 0 \\
\frac{\partial \overline{\pi}}{\partial c} &= \frac{-f_3(\overline{\pi}, \theta; 0) g_2(\overline{\pi}, \theta; 0) + g_3(\overline{\pi}, \theta; 0) f_2(\overline{\pi}, \theta; 0)}{f_1(\overline{\pi}, \theta; 0) g_2(\overline{\pi}, \theta; 0) - g_1(\overline{\pi}, \theta; 0) f_2(\overline{\pi}, \theta; 0)} \\
&= -\frac{\beta^2 (1-\gamma) \nu q(\theta) \psi(\overline{\pi}) \int_{\overline{\pi}}^{1} (\pi - \overline{\pi}) dH(\pi) (q(\theta) + \theta q'(\theta))}{f_1(\overline{\pi}, \theta; 0) g_2(\overline{\pi}, \theta; 0) - g_1(\overline{\pi}, \theta; 0) f_2(\overline{\pi}, \theta; 0)} < 0
\end{aligned}$$

Finally, from equation (13), it is easy to deduce that if $c = 0$, $\frac{\partial \underline{\pi}}{\partial c} = \frac{1}{\varphi(\overline{\pi})} > 0$.

C Determination of the Pareto allocation

It can be shown the steady state Pareto allocation can be summarized by the following system of three equations in θ, $\overline{\pi}$ and $\underline{\pi}$[5]. Let's also recall the matching function being by assumption a Cobb-Douglas one, one has : $\frac{\partial M(U,V)}{\partial U} = \eta \theta q(\theta)$ and $\frac{\partial M(U,V)}{\partial V} = (1-\eta) q(\theta)$.

$$\begin{aligned}
&0 = y^b - a + (1 - \beta(1-\lambda)(1-\alpha)) \overline{\pi} \psi(\overline{\pi}) - k_x (1 - \beta(1-\lambda)) - \frac{\eta}{1-\eta} \theta (k_v + (1-\beta) k_x) \\
&k_v + (1-\beta) k_x = \beta \Bigg[\varphi(\overline{\pi})(1-\eta) q(\theta) \gamma \int_{\underline{\pi}}^{1} \pi dH(\pi) + (1-\eta)(1-\gamma) q(\theta) \psi(\underline{\pi}) \int_{\underline{\pi}}^{1} (\pi - \underline{\pi}) dH(\pi) \\
&-c(1-\eta) q(\theta)(1 - H(\underline{\pi})) \Bigg] \\
&\gamma \underline{\pi} \varphi(\underline{\pi}) = c
\end{aligned}$$

D Aggregate Welfare

Workers and entrepreneurs aggregate welfare writes:

$$\begin{aligned}
\mathcal{W}^W &= \sum_{t=0}^{\infty} \beta^t (C_t^W - a N_t) \\
\mathcal{W}^E &= \sum_{t=0}^{\infty} \beta^t (C_t^E - k_v V_t - k_x X_t)
\end{aligned}$$

[5] The details of the maximization program and the derivation of equilibrium conditions are not presented in this paper because they are too long. However they are available upon request.

where

$$
\begin{aligned}
C_t^W &= E_{g,t}w_t(1) + E_t^n \int_{\overline{\pi}_t}^1 w_t(\pi)\frac{dH(\pi)}{1-H(\overline{\pi})} + bU_t - T_t \\
C_t^E &= E_{g,t}y^g + E_t^n \int_{\overline{\pi}_t}^1 (y^g\pi + y^b(1-\pi))\frac{dH(\pi)}{1-H(\overline{\pi})} - cq_tV_t(1-H(\overline{\pi}_t)) \\
&\quad -E_{g,t}w_t(1) - \int_{\overline{\pi}_t}^1 e_t^n(\pi)w_t(\pi)dH(\pi)
\end{aligned}
$$

Aggregate welfare corresponds to the sum of entrepreneurs and workers' welfare.