

Search Capital ^{*}

Carlos Carrillo-Tudela [†]

Eric Smith [‡]

University of Essex,

University of Essex

CESifo and IZA

January 2013

Abstract

We construct a simple equilibrium search model in which workers accumulate information about previously met employment contacts. We term the latter search capital. Here search capital (partially) insures workers against adverse shocks. The model provides a theory of job-to-job transitions that are associated with voluntary or involuntary mobility and with wage rises or wage cuts. It also show why low wage and younger workers are associated with a higher probability of becoming unemployed.

Keywords: Search Capital, Turnover, Wage cuts.

JEL: J62, J63, J64.

^{*}We would like to thank Pieter Gautier, Ludo Visschers and Manolis Galenianos for useful discussions. The usual disclaimer applies.

[†]Correspondence: Department of Economics, University of Essex, Wivenhoe Park, Colchester, CO4 3SQ, UK. Telephone: +441206873414. Fax: +441206872724. Email: cocarr@essex.ac.uk

[‡]Correspondence: Department of Economics, University of Essex, Wivenhoe Park, Colchester, CO4 3SQ, UK. Telephone: +441206872724. Fax: +441206872724. Email: esmith@essex.ac.uk

1 Introduction

In the last decades job search theory has become an important tool to understand the workings of modern labour markets. In particular, models that consider on-the-job search have provided a very useful framework to analyse the process driving workers' job and wage mobility as well as the nature of wage dispersion among equally productive workers (see Burdett and Mortensen, 1998, Postel-Vinay and Robin, 2002). In most of these models labour market imperfections take the form of informational frictions about the location of jobs. Over time workers make their way up the earnings distribution as they find better paid employment through constant search. When displaced or changing jobs, however, workers lose their search capital; that is, a worker "forgets" any information about the location or availability of previous held jobs. This feature is unappealing as it is in the worker's interest to accumulate such information and use it to escape unemployment or find a better job. Indeed, recent work done in the networks literature points out the importance employment contacts have in helping reduce informational frictions and the re-allocation of workers (see Calvó-Armengol and Jackson, 2003, among others).

The objective of this paper is to formalise these ideas in a simple equilibrium job search model, where search capital is a valuable asset that (partially) insures workers against adverse shocks. In our model on-the-job search not only allows workers to increase their wages, but to accumulate information about the location of jobs. The latter has a positive value as displaced workers may recall previously met employment contacts. This simple mechanism leads to two main predictions. (i) Job-to-job transitions can be associated with voluntary or involuntary mobility and with wage rises or wage cuts; (ii) low wage and younger workers are associated with a higher probability of becoming unemployed.

2 The Model

2.1 Economic Environment

Our model is based on the framework developed by Postel-Vinay and Robin (2002) and Carrillo-Tudela, Menzies and Smith (2009). Time is continuous and goes on forever. There is a unit mass of workers and firms with a common discount rate $r > 0$. Workers maximize the expected sum of lifetime consumption. Firms operate using a constant return to scale technology and maximize the expected sum of their profits.

A worker is characterised by his employment status and amount of search capital. During unemployment, this worker consumes $z > 0$ units of output. While employed at wage w , the worker produces $x > z$ and consumes w . The worker's search capital, n , represents his number of employment contacts, excluding the current employer or any firm that the worker might have just met. To keep the analysis as simple as possible let

$n = 0, 1$. Further, a worker loses his contact at a Poisson rate of $\phi \geq 0$. The latter can be interpreted as the rate at which search capital depreciates.

Unemployed workers meet a firm at rate $\lambda \geq 0$. Employed workers meet a firm at rate $s\lambda$, where $s \geq 0$ denotes the worker's search intensity. Upon a meeting a complete information auction takes place for the worker's services among the just met firm and, if available, from the worker's other contact or employer. Independent of the acceptance decision, a worker with no previous contacts adds the newly met firm to his contact list. If the worker transit from unemployment to employment, however, the newly met firm becomes his employer and it does not count as a contact.

At rate $\delta \geq 0$, an employed worker is exogenously displaced from the current job. When this happens, the current employer receives a payoff of zero and the worker receives a take-it-or-leave-it offer from the firm that is still in contact with him (if any). If the worker accepts the offer, the worker moves from one employer to the other without an intervening spell of unemployment. If the worker rejects the offer (or if the worker did not have a contact), the worker becomes unemployed.

2.2 Definition of Equilibrium

Let $\sigma_f = (w_1, w_2)$ denote the strategy of a firm, where the first element denotes the wage the firm offers to a worker in an auction with one bidder and the second element the wage the firm offers to a worker in an auction with two bidders. Let U_n denote the lifetime utility of a worker who is unemployed and has n contacts. Let $E_n(w)$ denote the lifetime utility of a worker who is employed at the wage w and has n contacts. Let M_{n+1} denote the value to the firm of participating in an auction with $n + 1$ bidders. Let C^u denote the value to the firm of being in contact with an unemployed worker who has no other contact. Similarly, let C^e denote the value to the firm of being in contact with an employed worker who has no other contact. Finally, let $J_n(w)$ denote the value to a firm from employing a worker who has n contacts at wage w .

The expected value of an unemployed worker satisfies

$$rU_n = z + \lambda[\max\{E_n(w_{n+1}), U_1\} - U_n] + n\phi[U_0 - U_1].$$

Noting that an employed worker stops searching after having one contact (the capital gains from doing so are zero), the expected value of employment at wage w satisfies

$$rE_0(w) = w + s\lambda[\max\{E_1(w_2), E_0(w)\} - E_0(w)] + \delta[U_0 - E_0(w)],$$

$$rE_1(w) = w + \delta[\max\{E_0(w_1), U_1\} - E_1(w)] + \phi[E_0(w) - E_1(w)].$$

Since $E_n(w)$ is strictly increasing in w , the worker's acceptance strategy in an auction with $n + 1$ bidders has the reservation property. Let $\sigma_w = (R_1, R_2, R_2^e(w))$ denote the

strategy of a worker, where R_n denotes the reservation wage in an auction with n bidders and $R_2^e(w)$ denotes the reservation wage of an employed worker in an auction with two bidders given current wage w .

The firm's expected value from meeting a worker with no other contacts

$$M_1 = \max_w \{I[w \geq R_1](J_0(w) - C^u)\} + C^u,$$

where I is an indicator function that takes the value of one if $w \geq R_1$ and zero otherwise. The firm's expected value from meeting a worker who is unemployed with one contact or is employed at wage w' with no contacts is

$$M_2 = \max_w \left\{ I[w > w_2](J_1(w) - C^e) + I[w = w_2] \left(\frac{J_1(w) - C^e}{2} \right) \right\} + C^e,$$

where the firm offers the wage w to the worker and the other contact (or current employer) offers him the wage w_2 and we have conjectured that $w_2 \geq R_2$ and $w_2 \geq R_2^e(w')$.

Definition: A Symmetric Equilibrium is a worker's strategy $\sigma_w = (R_1, R_2, R_2^e(w))$ and a firm's strategy $\sigma_f = (w_1, w_2)$ such that:

(i) For $n = 0, 1$, $E_n(w) \geq U_1$ if and only if $w \geq R_{n+1}$, and $E_1(w) \geq E_0(w')$ if and only if $w \geq R_2^e(w')$;

(ii) For $n = 0, 1$, w_n solves the firm's maximization problem describe by M_n .

2.3 Characterisation of Equilibrium

The wage offered in a one bidder auction is $w_1 = R_1$ and the wage offered in a two bidder auction w_2 solves $J_1(w_2) = C^e$. Hence, the firm's strategies $\sigma_f = (w_1, w_2)$ imply $M_1 = J_0(w_1)$ and $M_2 = J_1(w_2) = C^e$, where $J_n(w_{n+1})$, C^e and C^u are given by

$$rJ_n(w_{n+1}) = x - w_{n+1} - s\lambda(n-1)J_{n+1}(w_{n+2}) - \delta J_n(w_{n+1})$$

$$rC^e = \delta(M_1 - C^e) - \phi C^e$$

$$rC^u = \lambda(M_2 - C^u) - \phi C^u.$$

The following result describes the indifferent condition faced by firms in an auction with two bidders.

Lemma 1: Given $w_2 \geq \max\{R_2, R_2^e(w_1)\}$,

$$w_2 = \frac{(r + \phi)(r + \delta + s\lambda)}{(r + \phi)(r + \delta + s\lambda) + \delta(r + \delta)}x + \frac{\delta(r + \delta)}{(r + \phi)(r + \delta + s\lambda) + \delta(r + \delta)}w_1.$$

Note that the weight on w_1 is positive because the value of not hiring the worker (and waiting for a job displacement and a subsequent wage of w_1) is decreasing in w_1 . On the other hand, an unemployed worker with no contacts gets offered a wage $w_1 = R_1$ such

that he is indifferent from accepting the job; i.e $E_0(w_1) = U_1$.

Lemma 2: *Given $w_2 \geq \max\{R_2, R_2^e(w_1)\}$,*

$$w_1 = \varphi w_2 + (1 - \varphi)z,$$

where

$$\varphi = \frac{\lambda[(r + \lambda + \delta) - s(r + \lambda + \phi)](r + s\lambda + \delta + \phi)}{(r + \delta)(r + \lambda + \phi)(r + \delta + \phi + \lambda + s\lambda) + \lambda^2(\phi + s(r + \lambda))} < 1.$$

The weight on w_2 is positive when $s \leq (r + \lambda + \delta)/(r + \lambda + \phi)$. First, φ is decreasing with search intensity as unemployed workers are prepared to accept a lower wage today as an investment for future wage growth (see Postel-Vinay and Robin, 2002). At the same time, φ is increasing with the value of search capital. Given that an unemployed worker has the option of continue searching and increasing his wage when meeting another contact, a firm must compensate the worker for giving up this option. The relative importance of these channels then pins down the sign of φ .

Proposition 1: *The wages offered in equilibrium satisfy:*

$$w_1 = \alpha x + (1 - \alpha)z \quad \text{and} \quad w_2 = \beta x + (1 - \beta)z,$$

where

$$\alpha = \frac{\varphi(r + \phi)(r + \delta + s\lambda)}{(r + \phi)(r + \delta + s\lambda) + (1 - \varphi)\delta(r + \delta)}, \quad \beta = \frac{(r + \phi)(r + \delta + s\lambda)}{(r + \phi)(r + \delta + s\lambda) + (1 - \varphi)\delta(r + \delta)}$$

and $w_2 > w_1$.

To complete the characterisation of equilibrium we need to derive workers' reservation wages $\sigma_w = \{R_1, R_2, R_2^e(w_1)\}$. The above arguments show that $w_1 = R_1$. The reservation wages of workers in a two bidder auction are derived by solving $E_1(R_2) = U_1$ and $E_1(R_2^e) = E_0(w_1)$. It is straightforward to verify that $w_2 \geq \max\{R_2, R_2^e(w_1)\}$ is indeed satisfied.¹ Further, $J_0(w_1) > C^u > 0$ implies firms strictly prefer to hire an unemployed worker at the first meeting rather than keeping the worker as a contact. In a competitive auction, $J_1(w_2) = C^e > 0$ implies firms are indifferent between hiring the worker and keeping the worker as an employed contact and hence there is no profitable deviation. These arguments establish existence. Uniqueness can be established by showing that there is no equilibrium where firms offer a wage $w_{n+1} < R_{n+1}$.

Theorem 1: *The reservation strategies $\sigma_w = (R_1, R_2, R_2^e(w_1))$ and the offer strategies $\sigma_f = (w_1, w_2)$ describe the unique symmetric equilibrium with on-the-job search.*

¹To verify this claim first note that $R_2 = R_2^e(w_1)$. This follows as R_2 solves $E_1(R_2) = U_1$, while $R_2^e(w_1)$ solves $E_1(R_2^e) = E_0(w_1) = U_1$. Next note that the solutions of w_2 and w_1 described in Proposition 1 imply that $E_1(w_2) > E_0(w_1) = U_1 = E_1(R_2)$. Since E_1 is increasing in w , we get that $w_2 > R_2$.

3 Implications

This simple model is consistent with two observed properties of wage and employment dynamics that traditional search model have a difficult time in explaining. In particular, the model generates voluntary job-to-job transitions that are associated with wage rises and involuntary job-to-job transitions that are associated with wage cuts, both prominent features of modern labour markets (see Jolivet, Postel-Vinay and Robin, 2006). If an employed worker meets another firm, he chooses an employer with equal probability and keeps the other firm as an additional contact (a voluntary job-to-job transition with a wage rise). If subsequently his job is destroyed, the worker takes employment with his contact (if still available) at a lower wage, experiencing an involuntary job-to-job transition with a wage cut.

The nature of wage cuts is very different from that explored in other papers (see Postel-Vinay and Robin, 2002), in which workers accept voluntary wage cuts when changing to a job in a more productive firm that offers higher wage growth prospects. Adding firm heterogeneity also generates this type of job-to-job transition. Connolly and Gottshack (2008), however, present evidence showing that an important proportion of job transitions that involve a wage cut do not lead to faster wage growth in subsequent employment as implied by Postel-Vinay and Robin (2002). Furthermore, the importance of involuntary transitions is stressed by Nagypal (2005) who report that although job-to-job movements are approximately twice as large as employment-to-unemployment changes in the US, only a small fraction (less than 5%) of employed workers are actively searching. Jolivet, Postel-Vinay and Robin (2006) also find that involuntary mobility (reallocation shocks and layoffs) are more frequent than voluntary mobility. It is then important to have a theory of job mobility that is consistent with this evidence.

Given that the amount of search capital is correlated with a worker's wage the model also implies that low wage workers have a higher probability of experiencing unemployment than high wage workers. Since worker's search capital is correlated with time spent in employment, younger workers also have a higher probability of becoming unemployed. These two implications are again consistent with empirical evidence. In particular, Stewart (2007) finds strong evidence showing that low wage jobs significantly increase the worker's probability of experiencing unemployment. This evidence is normally attributed to "unstable" jobs that exhibit a high separation rate. We argue that the accumulation of contacts over time and the possibility of recall seems a plausible competing explanation.

4 Conclusion

This paper puts forward the concept of search capital and shows it is useful to workers to avoid unemployment when faced by a job destruction shock. We argue that search capital provides an explanation for the coexistence of job-to-job transitions that involved

a wage rise and a wage cut and are associated with voluntary and involuntary mobility. Further, we argue that it can also provide an explanation for why low wage and younger workers face a higher unemployment risk than older, more experience, workers, without relying on difference in productivities or job characteristics.

References

- [1] Burdett, K. and Mortensen D., 1998, Wage differentials, employer size, and unemployment, *International Economic Review*. 39, 257-273.
- [2] Calvó-Armengol, A. and Jackson M.O., 2004, The Effects of Social Networks on Employment and Inequality, *American Economic Review*. 94, 27-46.
- [3] Carrillo-Tudela, C., Menzio G. and Smith E., 2009, Job Search with Bidder Memories, *International Economic Review*. forthcoming.
- [4] Connolly, H. and Gottschalk P., 2008, Wage Cuts as an Investment in Future Wage Growth: Some Evidence , *Labour: Review of Labour Economics and Industrial Relations*. 22, 1-22.
- [5] Jolivet, G., Postel-Vinay, F. and Robin J-M., 2006, The Empirical Content of the Job Search Model: Labor Mobility and Wage Distributions in Europe and the US, *European Economic Review*. 50, 877-907.
- [6] Nagypal, E., 2005, On The Extent of Job-to-Job Transitions, mimeo. Northwestern University.
- [7] Postel-Vinay, F. and Robin J-M., 2002, The Distribution of Earnings in a Equilibrium Search Model with State-Dependent Offers and Counteroffers , *International Economic Review*. 43, 989-1016.
- [8] Stewart, M., 2007, The Inter-related Dynamics of Unemployment and Low-Wage Employment, *Journal of Applied Econometrics*. 22, 511-531.