

Persuasion in Competitive Search Equilibrium

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Barcelona, Aug 28th 2023

Introduction

- In several markets, the buyer and sellers may have limited information about the value of trade.
 - In the labour market, both the employer and the employee may have limited information about how good the match is:
 - In terms of how well the worker will enjoy the job tasks she is supposed to perform as well as the work environment – which we refer to as the “amenity level” of the match.
 - And in terms of how productive the worker will be when performing these specific tasks: the productivity of the match.
 - In housing markets, both the buyer and the seller may have limited information about how the house in question satisfies the buyer’s specific needs.
- In such cases, the agents may have incentives to reveal information to potential trading partners.

Setting

- We consider a labour market with search frictions (also relevant for a housing market).
- Both workers and firms are *capacity constrained*, and can trade with at most one agent from the other side of the market.
- Workers and firms are symmetrically but imperfectly informed about a pay-off relevant variable.
- Mostly analyze the case where the agents are imperfectly informed about the amenity level the worker obtains by working for the firm.
 - The firm “persuades” the worker to accept the job.
- We also briefly discuss the case in which the agents have limited information about the productivity of the match.

Results

- If firms *ex ante* can advertise and commit to wages but not how much information it will reveal, firms will not reveal any (or very little) information.
- If firms *ex ante* can commit to both wages and how much information they will reveal, maximum information will be revealed and wages set according to the Hosios condition.
- If there is a sufficiently high minimum wage:
 1. Firms reduce the information provided to the worker in order to extract rents from them
 2. Share the match surplus according to a Modified Hosios Rule which allocates more surplus to the worker.
 3. This sharing rule is constrained efficient in a well-defined sense.

Literature

- Kamenica and Gentzkow (2011) and Gentzkow and Kamenica (2016) study persuasion without and with competition.
- Board and Lu (2018) analyse a model in which buyers search sequentially and firms decide how much information to release to the consumers.
- Dogan and Hu (2022) analyse optimal information provision in a model of sequential search.
- Au and Whitmeyer (2023) analyse a model of persuasion in which firms compete to attract customers.
- None of the papers have prices or capacity constrained sellers, which is key in competitive search equilibrium as it is defined in Moen (1997) and Acemoglu and Shimer (1999), see Wright, Kircher, Julien, and Guerrieri (2021) for a survey.

Model

- One-shot model.
- All workers-firm matches have the same productivity y .
- Each firm advertises one vacancy with a contract attached to it.
- Each worker sends one application.
- A firm may get zero, one, or any number of applicants.
- Firms who get applicants contact one of them.
- If a contract is signed, it cannot be renegotiated.
- Unmatched workers receive unemployment benefit/continuation value b , unmatched firms get 0.

- Probability that a worker is contacted by a firm is equal to $p(\theta)$, where θ is the tightness in the relevant sub-market (ratio of vacancies to searching workers).
- Probability that the firm attracts at least one applicant is $q(\theta) = p(\theta)/\theta$.
- Assume that $\eta = \left| \frac{\partial q(\theta)}{\partial \theta} \frac{\theta}{q(\theta)} \right|$ is increasing in θ and goes to 0 (1) as θ goes to 0 (∞).

Amenities

- The “amenity level” in a given job is a random variable z , $z \in \{z_l, z_h\}$, $z_l < z_h$.
- The common prior is that $z = z_h$ with probability μ and $z = z_l$ with probability $1 - \mu$
- We assume that $y + z_h > b > y + z_l$

Information revelation

- The firm may reveal information about the amenity level through a signalling mechanism:
 - If the signal (recommendation) is low, $z = z_l$ with probability 1, and the match is terminated.
 - If the signal (recommendation) is high, $z = z_h$ with probability $m \geq \mu$.
 - The mechanism is Bayes plausible: The probability κ of a high signal is $\kappa = \mu/m$, $\kappa \in [\mu, 1]$.
- The *precision level* of the signal, m , is a choice variable for the firm.
- The firms always set m sufficiently high so that the worker accepts the job if the signal is high.

Ex post pay-offs

- The expected utility for a worker of being matched

$$\begin{aligned}u(w, m) &= \kappa(w + mz_h + (1 - m)z_l) + (1 - \kappa)b \\ &= \mu\left(z_h - z_l - \frac{b - z_l - w}{m}\right) + b\end{aligned}$$

u is increasing in m .

- The expected profit for the firm of being matched:

$$\pi = \kappa(y - w) = \frac{\mu}{m}(y - w)$$

π is decreasing in m .

- Match surplus:

$$S = \pi + u - b = \mu\left(z_h - z_l - \frac{b - z_l - y}{m}\right)$$

S is increasing in m

- For workers

$$U = p(\theta)u(w, m) + (1 - p(\theta))b$$

- For firms

$$\Pi = q(\theta)\pi$$

- In equilibrium, all firms that attract applicants give the workers the same *ex ante* pay-off U .
- A firm that offers a more attractive contract attracts a longer queue of workers.

Detour: firms set m after the match is formed

- *Ex post* it is in the firm's interest to set m as low as possible.
- If $w + \mu z_h + (1 - \mu)z_l \geq b$, the firm sets $m = \mu$ (uninformative signal).
 - The unique equilibrium is such that $m = \mu$, $\kappa = 1$ (workers are always hired).
- If $w + \mu z_h + (1 - \mu)z_l < b$, the firm sets $m = \mu$, the firm sets m such that $w + mz_h + (1 - m)z_l = b$.
 - The worker is indifferent between accepting the job and not, and receives no surplus.

Equilibrium: firms advertise both w and m

Competitive search equilibrium is a contract (m^*, w^*) , a market tightness θ^* , and an npv utility U^* such that

1. (m^*, w^*) , maximizes $\Pi = q(\theta) \frac{\mu}{m}(y - w)$ subject to the following constraints:
 - 1.1 $p(\theta)u(w, m) + (1 - p(\theta))b = U^*$.
 - 1.2 $m \in [\mu, 1]$
 - 1.3 $w \geq w^{\min}$
2. Zero profit, that is

$$\Pi = \frac{\mu}{m}q(\theta^*)(y - w^*) = k \quad (1)$$

where k is the entry cost.

Lagrangian and FOC

- Lagrangian

$$L = q(\theta) \frac{\mu}{m} (y - w) + \lambda \left(\rho(\theta) \mu \left(z_h - z_l - \frac{b - z_l - w}{m} \right) + b - U^* \right) - \rho(m - 1) - \omega(w^{\min} - w)$$

with $\rho(m - 1) = 0$ and $\omega(w^{\min} - w) = 0$.

- FOC wrt θ , w and m :

$$\eta(y - w) = \lambda \theta (1 - \eta) (m(z_h - z_l) - (b - z_l - w)) \quad (2)$$

$$q(\theta) = \lambda \rho(\theta) - \omega m / \mu \quad (3)$$

$$y - w = \lambda \theta (b - z_l - w) - \rho \frac{m^2}{q(\theta) \mu} \quad (4)$$

as in CSE.

Result 1: Full information disclosure in the unconstrained equilibrium

Proposition

Suppose firms are unconstrained when setting wages ($w^{\min} = b$). Then the profit-maximizing contract prescribes that $m = 1$. Hence firms disclose all available information to the workers. Equilibrium is given by the equations

$$U = b + p(\theta)\eta S$$

$$S = \mu(y + z_h - b)$$

$$k = q(\theta)(1 - \eta)S$$

Results when $w \geq w^{\min}$ binds

Proposition

There is a unique value \bar{w} such that firms provide less than full information whenever $w^{\min} \geq \bar{w}$.

Let γ be the the elasticity of S with respect to m , $\gamma = \frac{S'(m)m}{S} > 0$, and $\beta^{\text{eff}} \equiv \eta(1 + \gamma)$.

Lemma

In the constrained equilibrium, the worker's utility is given by a modified Hosios condition

$$U = b + p(\theta)\beta^{\text{eff}} S \quad (5)$$

where $\beta^{\text{eff}} \equiv \eta(1 + \gamma) > \beta$.

Constrained efficiency

Consider a benevolent planner who cares about the sum of the agents' *ex ante* expected incomes, and who can overturn the firms' decisions concerning m but no other decisions in the economy. We say that the equilibrium allocation is constrained efficient if the planner implements the same m as in the market solution.

Proposition

The market solution is constrained efficient.

- An increase in y has no effect or increases m (depending on $\eta'(\theta)$).
 - The firm absorbs shocks to y .
- An increase in b increases m (increases unemployment even more).

Alternative model: unknown worker productivity

- Firms advertise wages, attract workers, and interview them in random order at cost c (the first interview is for free).
- A worker that is interviewed tries to persuade the firm to hire her.
 - Only one applicant: the worker maximizes the probability of being considered acceptable.
 - More than one applicant: the workers maximize the probability of being the preferred candidate
- Issues:
 - How will the firm structure the interviews.
 - How will wages be set?

Concluding remarks

- Analyse how Bayesian persuasion may impact labour market outcomes.
- Agents have symmetric but imperfect information about how well the work environment suits a particular worker.
- Analyse when firms disclose all available information, and the welfare consequences when they do not.
- Way forward:
 - Extend the current model to a dynamic setting.
 - Study other aspects of learning (learning about match productivity).

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