Match Me if You Can:
Wage Secrecy and Matching in a Search Model

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Abstract

This paper investigates the strategic behaviors of firms and workers in an equilibrium job-search model with on-the-job search. We introduce the possibility of the adoption by both workers and firms of a "wage secrecy norm" that influences the information structure in the market. By doing so, we endogenize strategic decisions that firms must make about whether or not to match their employees' outside offers. Our model presents settings under which workers' information sets shape the outcome of the market in respect to wages, wage profiles, and search intensity. We describe the conditions that make firms and workers better off by adopting a normative standard of wage secrecy, in which workers do not discuss their wages and firms impose secrecy policies.

We show that the degree of competitiveness in the market for labor may establish one of three possible equilibria in steady state: when employers' competitiveness is low, firms apply a full information policy and match relatively few outside offers; when competitiveness is medium, firms apply a secrecy policy (and workers comply with it) and discriminate among workers in whether or not to match outside offers; finally, when the competitiveness is high, firms may increase workers' wages to the non-searching level and match all outside offers.

Keywords: labor-market frictions; search intensity; wage secrecy; social norm

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Introduction

Our study probes the strategic behaviors of firms and workers in a general-equilibrium job-search model with on-the-job search where firms set wages. When a worker receives an outside job offer, h/her employer may retain h/her by matching it. But since workers control the intensity of their search, the offer-matching policy creates a moral-hazard problem: the more probable it is that the firm will match the offer, the more searches will perform, inflicting a cost on the firm. Previous studies addressed this problem by allowing firms either to provide workers with upward-sloping-tenure wage contracts (Burdett and Coles, 2003) or to commit to a specific matching policy (Postel-Vinay and Robin, 2004).

This study makes two main contributions to this line of literature. First, it integrates the two strategic tools of the firm (wage contracts and matching of outside offers) in one model and allows us to explore the complementary and substitutional effects of those tools by endogenizing the firms' strategic matching decisions (along with more conventional wage setting). Second, it introduces the possibility of the adoption of a "wage secrecy norm" by both workers and firms. The model provides a setting within which the workers' information set shapes the outcome of the market in respect to wages, wage profiles, and search intensity. Under some provided conditions, firms and workers are better off adopting a normative standard of wage secrecy, in which the former conceal their matching behaviors and the latter do not discuss their wages. Secrecy mitigates the negative effect of the moral-hazard problem of matching by allowing firms to match only a selected segment of workers; by the same token, it diminishes workers' ability to accurately estimate the return to search and, thereby, limits search intensity.

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The economic impetus behind this study originates in the importance of the flow of workers from one workplace to another. This flow, a major source of labor supply – in some markets, up to 50% of new jobs are filled by employed workers[1] – is the result of both active and passive on-the-job search (OJS). We use the notion of active and passive

[1] Longhi (2007) reports that according to the British LFS (Labour Force Survey), in 2005 almost 10% of the active population in the UK were actively looking for a job; 45 % of them were unemployed while 50% already held jobs.

search to cover the wide variety of searching behaviors that workers invoke: some routinely expend time and effort in searching new jobs and soliciting outside offers; others do as little as allowing potential employers to glimpse at their personal profiles on social network Web sites. Either way, a growing number of workers, especially the young (Pissarides and Wadsworth, 1994), participate in a non-loyal employment relationship in which rent-seeking searches and wage bargaining between incumbent firms and poaching firms are common. Naturally, incumbent firms, especially in a competitive labor-market environment, try to confront this problem lest it harm profits severely. They may do this by giving workers a greater incentive not to search (by offering wage and/or non-monetary compensation) and/or by inducing workers not to quit (by matching the outside offers that they receive).[2]

The goal of the paper is to propose a more general theory for firms' and workers' behavior in such an environment. The study is based on a search and matching model that provides a very useful canonical framework for the analysis of labor-market frictions, specifically various conflictual circumstances between employees and employers. Although on-the-job search have appeared in various models since the late 1970s (Jovanovic, 1979; Jovanovic, 1984; Mortensen, 1988), it was Pissarides (1994) who first developed a model including on-the-job search, a matching function, and non-cooperative wage behavior.

This study joins a line of inquiry in the literature that combines equilibrium search models (see Mortensen 2003 for a survey) with contract theory (see Bolton and Dewatripont, 2005, for a review). The initial premise in this literature is that workers' search intensity is strongly related to their wage. Mortensen and Pissarides (1999) showed, within a fixed-wage posting framework, that higher paid employees search less actively. (This helps to explain why higher paying firms have lower rates of labor turnover.) An immediate evolution occurred in Stevens (2004) and Burdett and Coles (2003), who allowed firms to offer upward-sloping-wage tenure contracts. The latter study presented a model in which workers and firms are homogeneous, firms make take-it or leave-it offers, and workers search while employed. Within such an environment,

[2] Note that from this point forward, the term matching in refers to the act of matching outside offers by the current employer

they showed that all firms offer wage-tenure contracts that imply a smooth increase in any employee's wage with tenure.

A parallel and empirically driven branch of this field of research focuses on the importance of on-the-job search and matching in explaining and estimating wage dispersion among workers of equal ability (Postal-Vinay and Robin, 2002a and 2002b). More recently, Postal-Vinay and Robin (2004) study the effect of a commitment not to match on workers' search decisions: when search costs are set to zero, a plausible pattern is the emergence of a dual labor market, with "bad" jobs at low-productivity, non-matching firms and "good" jobs at high-productivity, matching firms.

As mentioned, one of the main issues in the literature on matching is the moral-hazard problem. Matching is profitable for firms: when a worker receives an outside offer, the firm may retain h/her and maintain h/her output (and the associated profits) by matching the offer. Without matching, the worker quits and the hiring firm loses h/her production. From the worker's point of view, however, matching increases the return to search. Therefore, the stronger the probability of matching, the more searches employees may conduct. More active searching damages the firm because again it must either match (losing some of the labor surplus) or not match (losing the entire labor surplus). The outcome of this moral hazard may be suboptimal matching that may lead workers to over- or under-search.

This study proposes a solution to the moral-hazard problem by introducing a wage-secrecy norm. When secrecy is exercised, workers are uncertain about the actual extent of matching inside their own firm. Since matching is closely related to the return for search, this uncertainty may eventually mitigate workers' searching activity. As an example, consider a very simplified case in which workers who differ in productivity level know only the average level of matching. This vagueness allows firm to match only such offers as are tendered to the most profitable workers. The overall level of search activity is kept low because workers cannot know who will be matched and who will not.

Similarly, we construct a model in which firms' specific shocks determine the individual worker's productivity. Although this productivity is unknown to the worker, we assume that workers can identify colleagues who resemble themselves. At full information, a worker can observe wage changes among these similar workers and induce the firm's matching policy accurately. When secrecy is introduced, however, workers experience difficulties in estimating the expected matching policy. Under secrecy, before a worker decides to search, s/he has only one available source of information: the number of similar workers who left the workplace.[3] This signal, however, is not perfect because workers cannot differentiate between the noisy process of job destruction and quitting occasioned by an unmatched outside offer. Clearly, if the number of quitting workers is relatively high, matching is expected to be low and vice versa.

The structure of information with secrecy has two main results. First, the average high-productivity agent underestimates her matching probability and, therefore, does not search intensively. (As a parallel, the average low-productivity worker overestimates her matching probability but is not prompted to search on this account.) Second, under secrecy, contrary to the openness scenarios, a certain proportion of workers search anyway: the individuals who obtain a better signal about the realization of matching at their workplace. Due to their advantage, these workers can use the firm's biased matching behavior to their own benefit – and to search. The results suggest that some proportion of rent-seeking on-the-job searching may be attributed to secrecy.

In the model, secrecy is generated following a decision made by the firm. However, since the entire body of information is available to workers (collectively but not personally), we consider an additional constraint to secrecy: workers' consent. Absent such consent, workers may easily defeat the firm's secrecy policy by simply revealing to one another all necessary information. We assume that if secrecy is not in the workers' best interest (at least *ex ante*), firms cannot persistently keep information secret (unless some compensatory transfers are available).[4] However, this study focuses mainly on secrecy in respect to wage changes, which, we believe, are even more common and less controversial.

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[3] Around 50% of job quitting among young employees traces to direct switching to a new workplace (Parsons, 1991).

[4] From a more realistic perspective, as wage secrecy is practically illegal in some countries (Edwards, 2005), it is very hard to assume that a firm under regular market conditions can force its employees to accept a complete wage secrecy regime without their consent. In real life, secrecy depends on collaboration with the entire headcount; hence, even when the incentives are relatively week we would expect workers to eventually violate the norm when it harms them.

The common wage-secrecy norm prohibits any disclosure of individuals' remuneration data and is self-enforced in formal and informal ways. At the informal level, several behavioral sanctions sustain the norm. For example, since people deem pay information very intimate,[5] they considered it rude and inappropriate to be asked about their wages. On the other side of the scale, people who deliberately reveal their (high) wages are considered arrogant and obnoxious. At the formal level, wage-secrecy policies are widespread among employers; Lawler (2003) found that only 3.5% of the largest US firms have an "open pay-information system." The strength of the secrecy norm, however, varies across cultures, groups, and circumstances.[6]

Previously, Danziger, and Katz (1997) also suggested that the role of wage secrecy is to reduce effective labor mobility. In their model, wage secrecy prevents free flow of information about the nature of outside options. It allows firms to increase an employee's wage without changing the firm's cost scheme dramatically because other workers are oblivious to any wage change made or outside offers found. Thus, the firm retains its most valuable workers even when they can get a better job offer. Consequently, wage secrecy makes risk shifting feasible but avoids the extreme inefficiencies caused by the rigidity of binding job contracts. This explanation is valid for highly competitive markets, but in these cases it appears that wage secrecy is just a specific part of a broader "trade secrets" secrecy. Furthermore, it does not fully address internal firm issues.

The last part of this study is devoted to solving the general equilibrium problem. We present the free entry condition and illustrate the potential dynamic toward steady state. Our general equilibrium results suggest that the degree of competitiveness in the market for labor sets one of three steady-state equilibria: when employer competitiveness is low, firms apply a full information policy and match relatively few outside offers; when competitiveness is medium, firms apply a policy of secrecy (and workers obey it) and discriminate among workers in respect to matching outside offers; finally, when the competitiveness is high, firms may increase workers' wages and match all outside offers.

[5] On the basis of a survey, Fox and Leshem (2004) found that people prefer to discuss expenses more than they do income and that talking about income and wealth is considered highly intimate.

[6] To the best of my knowledge, there are no available data on differences in secrecy levels among countries.

The rest of this paper is organized as follows: Section 2 presents the model; Section 3 profiles the characteristics of equilibrium in a partial equilibrium environment; Section 4 extends the results to a general equilibrium setting and provides a series of computed examples; and Section 5 concludes and discusses the main results.

2 The Model

Consider a labor market in a steady state within an infinite-horizon overlapping generation framework. A unit mass of atomistic workers faces a unit mass of competitive firms that produce one good. Workers live in two periods only and can be either employed or unemployed. Their utility function is simply their wage. Workers and firms are assumed to be risk-neutral with no discount rate[7].

Firms produce an output at a constant return to scale technology. Productivity is heterogeneous: when a new worker is assigned to a workplace, an individual productivity shock determines her productivity level. Productivity may be high or low with equal probability. Inside the workplace, workers are sorted into production units that are differentiated by productivity. In high-productivity units, each worker produces A (A>1) in any period; in low-productivity units, each worker produces 1 in any period.[8] Workers' productivity does not change over time at the same workplace but does change when workers switch to a new employer, with no covariance to the previous productivity.

Whenever they hire a new worker, firms pay a lump-sum adjustment cost of T. The difference between high and low productivity is assumed to be large enough that A–1>T, meaning that it is profitable to move a "low-productivity worker" into a high-productivity position if possible.

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[7] These two assumptions do not affect the nature of our results and we use them for simplicity. Moreover, risk aversion among workers generally increases the positive effects of secrecy.

8 Possible Intuitions: this may reflect two different levels of capital. With high capital per worker, each worker's marginal productivity is high and vice versa. Another intuition: some project are urgent and very profitable for the firm others are not, by allocating workers the firm sets their productivity. Third intuition, there are differences in the "personal chemistry" between workers and their managers. Some workers are doing well and others do not. The quality of relationship is orthogonal to workers' ability and it is boss specific.

Job destruction is generated by an exogenous stochastic process. $\theta_{i,t}$ denotes the job-destruction probability at firm i in period t.[9] The job destruction parameter $\theta_{i,t}$ is drawn from a uniform distribution: $\theta_{i,t} \sim U[0, D]$ where $0 < D < 1$. Job destruction occurs only in the second period of production. Workers who lose their jobs may immediately reenter the labor market like all other unemployed workers (but lose their tenure and, therefore, lose the chance to receive outside offers).

2.1 Searching and Hiring

Workers and firms are paired in a costly undirected search process. Firms meet workers via two channels: workers who actively seek work (unemployed workers and on-the-job searchers) approach firms and firms can actively search for workers and poach employed workers from other firms. Poaching involves a cost of h (the cost of attempting to poach one employed worker irrespective of the outcome of the attempt). Workers experience the situation the other way around: on the job, workers encounter an outside firm at probability λ ($0<\lambda<1$) and may increase their match intensity by searching actively. In this case, they pay a cost of c and raise the probability of matching to 1.

The reservation wage of workers is b. We assume that employers may not pay any wage below this due to minimum wage laws.[10,11] The minimum wage is upper-bounded by 1-T, meaning that hiring workers for low-productivity positions is still profitable for firms. We also assume $b < 1 - \frac{T}{2} - c$ (which does not always overlap with the previous condition, because c might be smaller than $\frac{T}{2}$), which ensures that searching may be an option for low-productivity workers (when $b \geq 1 - \frac{T}{2} - c$ searching is never optimal for low-productivity workers, our model becomes degenerate

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9 Notation note: as the model is fully symmetric and as we discuss steady state equilibrium, the specific notation for firm (i) and time (t) in all parameters and variables will be omitted below unless when they are needed for clarification.

10 Were they not forced to pay the minimum wage, firms might claim workers' entire surplus by offering them a very low wage at the first job contract – much as Postel-Vinay and Robin (2004) found, where matching firms can attract workers although they pay them less than their previous employers did. We would like to preclude this type of behavior by firms.

11 Burdett and Mortensen (1998) present an equilibrium framework that allows for on-the-job (OTJ) search in addition to unemployed search and in which the minimum wage shifts the equilibrium wage offer distribution up and results in higher wages for workers without negative efficiency effects.

Workers who are unemployed (either because they are at the beginning of their life in the first period or due to job destruction in the second period) are paired with a firm at probability 1. Workers can meet only one outside firm per period.

2.2 Matching and Outside Offers

When an employed worker is contacted by another firm (pursuant to active or passive searching by the employee), the incumbent employer may either try to retain h/her or not. The decision on matching outside offers is made at the beginning of each period and is unit-specific. It is also the outcome of the information structure in the market (which is predetermined by the firm). Finally, matching is affected by the firm's decision on wage contracts. Let $m^{k,j}(w^k)$ denote the matching decision for a wage of w^k ($k\in\{l,h\}$) with information structure j ($j\in\{\text{full information, secrecy}\}$). For brevity, we will usually use the shorter notation of m^l ,m^h ($0\leq m^k\leq 1$) to express the firm's matching policy toward low- and high-productivity workers, respectively. Note that $m^k=1$ means that the firm matches any offer and $m^k=0$ means that the firm never matches. We allow firms to apply a mixed strategy, i.e., to choose to match offers only sometimes ($0<m^k<1$).

2.3 Wage Contracts

Firms wage-discriminate. When it meets a worker, a firm offers a hiring wage, w, which depends on the specific worker's employment status, productivity level, and bargaining power (actually the value of her work for the incumbent firm). Wage contracts are long-term contracts that can be changed only by mutual agreement. This means that firms can only increase the current wages of employed workers.

When a worker switches jobs, the only source of a wage increase is matching. Hence, whenever a firm decides not to match, an outside firm may attract the employee by offering her an epsilon wage increase. In this case, the worker experiences no wage or utility change by switching workplaces.

Whenever matching occurs, both firms enter a Bertrand competition over the worker. The result of such a competition resembles a "second price auction." The winning firm pays epsilon above the value of the worker to the losing firm. Table 1 illustrates the possible results of such a competition.

Table 1: Results of Matching an Outside Offer

Incumbent \ Poacher	High-productivity job Value for poacher: A–T	Low-productivity job Value for poacher: 1–T
Low-productivity Job; Value for incumbent: 1	w=1 the worker moves	w=1–T the worker stays
High-productivity Job; Value for incumbent: A	w=A–T the worker stays	w=1–T the worker stays

2.4 Information Structure

Workers know the parameters and structure of the model but do not know their productivity type (h/l) and, therefore, do not know the relevant matching policy of the firm (i.e., the policy that will be applied to them if they search). As workers are grouped into units, they do know who the other members of the unit are.[12] They always observe any co-worker how leave the workplace inside their own unit (without knowing what the reason for quitting was).

We consider two states of information: openness and secrecy.

2.4.1 Openness

Under openness, workers are aware of any change in any co-worker's wage. Since this is the only source of wage increases, workers can fully discover their firm's offer-matching policy and their own productivity level. We assume that the number of workers in each unit is large enough that wage openness always ends up in full productivity discovery. Actually, as the following sections of this paper show, a worker needs to see only one co-worker's wage change in order to obtain all necessary information. Note that since the firm is the driving force of changes in the information structure, it will most likely publish information about workers' productivity levels, its own matching policy, and wage changes. This information, however, is not reliable (actually, firms always have an

[12] The model may hold even if workers only have some informative signal about their productivity level. To simplify the calculations, we stretch this assumption into full knowledge.

incentive to deceive and underestimate productivity and matching probability) unless workers can verify it.

2.4.2 Secrecy

Under secrecy, workers do not reveal their wages to each other, observe wage changes, share information, and disclose the fact of their job-searching, if any. Firms, in turn, do not supply any information to their workers. The only source of information is the observation of workers who quit; each worker may observe workers who stop showing up. Now, workers quit for two reasons: job destruction and unmatched outside offers, solicited and unsolicited. Based on the known parameters, workers can estimate the matching policy and, as a result, their own productivity. Note that the ability of workers to accurately estimate their type is affected by the distribution of job destruction. As D increases, the signal quality weakens.

It is assumed that the information sets are independent; thus, each worker estimates unit productivity on her own. Technically, we assumed that every worker knows N (different, older-generation) workers in h/her unit and can observe when they leave the workplace. Such a structure is needed in order to limit the historical effect of the stochastic process. The various sampling sets make sure that the firm cannot respond to a specific destruction shock that would complicate our analysis.[13]

2.5 Scheduling

Since this is an overlapping-generation model, two overlapping generations work together at any point of time. The time sequence is as follows:

First period: 1. All new unemployed workers meet a firm. 2. Firms reveal the productivity of the specific job. 3. Firm tenders a “take-it or leave-it offer”; workers reply. 4. Production. 5. Workers discover the older generation’s wage information. 6. A quitting observation takes place (in view of the information structure).

Second period: 1. Workers estimate the probability of belonging to Type H. 2. Firms revalue their contracts and may increase wages. 3. Workers choose their search intensity

[13] In reality, workers join the firm continually; therefore, each worker’s information set is different. This leads us to a similar outcome in regard to the actual information-gathering process.

(1/0) based on their wage, their estimated type, and the expected matching behavior of the firm. 4. Exogenous job destruction takes place (fired workers reenter the labor force similarly to the first period). 5. Workers search for or receive unsolicited offers (at probability λ). 6. Poaching firms tender outside offers; incumbent firms match them or not (where applicable). 7. Bertrand competition takes place among competing firms (where applicable). 8. Workers move / stay with or without wage change/ 9. Production.

3. Partial Market Equilibrium

We first analyze the system within a partial equilibrium framework by taking λ as exogenous and discarding the free-entry and market-clearance conditions. We characterize the outcome of the system in respect to search decisions, on the one hand, and matching policy and wage offers, on the other hand. Our analysis proceeds from the full-information case to the secrecy case and concludes with a discussion of optimal information-policy considerations.

3.1 Definition of Equilibrium

A steady-state equilibrium is the trio of wages, matching policies, and search intensities under a specific information set (secrecy or full information), in which the set of wages $(w_{t=1}^{l}, w_{t=1}^{h}, w_{t=2}^{l}, w_{t=2}^{h})$ and the matching policy (m^{l}, m^{h}) maximizes the firm's expected profit subject to optimal search intensities (s^{l}, s^{h}) that the employees choose. The search intensity, in turn (expressed in 1/0 terms), maximizes workers' utility given their wages and the expected matching policy.

3.2 Full Openness

Under a full-information regime (i.e., openness), workers know exactly what their type is. As a result, firms separate their maximization function in respect to each productivity level. They also acquire the ability to discriminate among workers.

Proposition 1:

- *Under openness, wages and matching policies are separable.*
- *Equilibrium exists under each of the three following strategies:*

i. *Minimal wage, partial matching, no search* $\{w_{t=2}^{k} = b, m^{k} = M^{k}(b)\}$

ii. High wage, full matching, no search $\{w_{t=2}^k = \bar{w}^k, m^k = 1\}$

iii. Minimal wage, full matching, search $\{w_{t=2}^k = b, m^k = 1\}$

where: $\mathrm{M}^{\mathrm{k}}(\mathrm{b}, \mathrm{c}, \mathrm{T}, \lambda)$ is the maximum matching frequency beneath which workers at productivity level k (h or l) will not search.

and: $\bar{\mathrm{w}}^{\mathrm{k}}(\mathrm{b}, \mathrm{c}, \mathrm{T}, \lambda)$ is the wage beyond which workers will not search even when the firm fully matches.

Proposition 2:

The main characteristics of the partial-matching equilibrium are:

- *Low productivity workers are always matched more than high productivity workers.*
- *Up to a given difference in productivities,* $(A < \bar{A} = 3 - b)$*, workers with high-productivity jobs are more likely to quit.*[14]
- *Without search, workers in high- and low-productivity jobs have the same expected wage.*[15]

The next subsection constructs the results of full-information equilibria and provides intuitions for the proofs of the foregoing propositions. Since the equilibrium problem is a "Stackelberg equilibrium" problem, we solve it by using backward induction: we start with the worker's reaction function and then analyze the decisions of firms. To make matters clear, we devote a separate subsection to each productivity level.

3.2.1 High-Productivity Workers' Decision

We start by analyzing the decision that high-productivity workers will make. At the beginning of the second period, workers compare their expected utilities with or without search (given their productivity level). Note that when matching takes place, a high-productivity worker will expect to be offered a wage of A–T at 0.5 probability and of 1–T at 0.5 probability depending on the level of productivity at the poaching firm.

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[14] Proof in Appendix 5.

[15] Proof in Appendix 5.

The expected utility without search is the expected gain from wage without an outside offer plus the expected wage after receiving an offer (with or without matching):

$$E\left[\left(u_{t=2}^{h} \middle| NS, w_{t=2}^{h}, m^{h}\right)\right] = E\left[(1-\theta_i)\left[(1-\lambda)w_{t=2}^{h} + \lambda\left[m^{h}\left(\frac{A-T}{2}+\frac{1-T}{2}\right) + (1-m^{h})w_{t=2}^{h}\right]\right] + \theta_i\, b\right] \quad (1)$$

Likewise, the expected utility with search is the expected wage, with or without matching, less the search cost:

$$E\left[\left(u_{t=2}^{h} \middle| S, w_{t=2}^{h}, m^{h}\right)\right] = E\left[\left(1-\theta_{i,t}\right)\left[m^{h}\left(\frac{A-T}{2}+\frac{1-T}{2}\right) + (1-m^{h})w_{t=2}^{h} - c\right] + \theta_i\, b\right] \quad (2)$$

Note that the cost, c, is paid only if the worker does not lose her job to job destruction.

We let M^{h} denote the benchmark matching level that makes workers indifferent to searching and not searching. Comparing the foregoing equations (NS≥S), we get:

$$M^{h} = Min\left[\frac{c}{(1-\lambda)\left(\frac{A+1}{2}-T-w_{t=2}^{h}\right)}, 1\right] \quad (3)$$

Workers will search whenever $m^{h} > M^{h}$ and will not search whenever m^{h} is lower (and, by assumption, also equal). When M^{h}=1 workers will never search regardless of the actual m^{h}. And when M^{h}=0, searching is always optimal (For any positive c, however, M^{h} is never zero).

Obviously, a firm can always set $m^{h}=M^{h}(w_{t=2}^{h})$ and, thereby, eliminate all searching. Another possible alternative, however, is to set the value of $w_{t=2}^{h}$ so that M^{h} will be 1. We use $\overline{w}^{h}$ to denote the wage level that quashes all searching irrespective of the matching policy (M^{h}=1). Simple algebra yields: $\overline{w}^{h} = \left(\frac{A+1}{2} - T\right) - \frac{c}{(1-\lambda)}$. Clearly, for any $w_{t=2}^{h} \geq \overline{w}_{t=2}^{h}$ workers will prefer not to search (regardless of the probability of matching). Since there is a minimum wage, however, no firm can pay a wage below b. Therefore, when $\left(\frac{A+1}{2} - T\right) - \frac{c}{(1-\lambda)} < b$ the firm will pay b and workers will never search even if the firm matches all outside offers. Hence:

$$\overline{w}_{t=2}^{h} = Max\left[\left(\frac{A+1}{2} - T\right) - \frac{c}{(1-\lambda)}, b\right] \quad (4)$$

Note that when $\overline{w}_{t=2}^{h}$>1–T, outside offers of low-productivity jobs (which generate a maximum offer of 1–T) are not high enough to promote any wage change for the worker.[16]

3.2.2 The Firm's Problem (high Productivity)

Firms set wages and matching policies in order to maximize their expected profit. Given the constant return-to-scale technology and the identicality of all workers except in the productivity of their jobs, we can equivalently maximize the expected profit per worker hired in Period 1. The first step in the analysis to show that it is almost never optimal for a firm to allow searching. Our structure implies that when workers search and firms fail to match, the firm's expected profit per worker is zero because all workers quit. When workers search and firms match all outside offers, the firm's expected profit is the average of the profit when the poacher offers a high-productivity job and the profit when he offers a low productivity job:

$$E\left[\left(\pi_{t=2}^{h}\middle|S, m=1\right)\right] = E\left[(1-\theta_i)\frac{1}{2}(T+(A-1+T))\right] = \left(1-\frac{D}{2}\right)\left(T+\frac{A-1}{2}\right) \quad (5)$$

Naturally, when workers search, the value of $w_{t=2}^{h}$ does not affect firms' expected profit (assuming that it is lower than 1–T).

We now compare the foregoing result with the expected profit when $w_{t=2}^{h} = \overline{w}_{t=2}^{h}$ and no one searches, with the limitation of $\overline{w}_{t=2}^{h} \leq 1-T$: [17]

$$E\left[\left(\pi_{t=2}^{h}\middle|NS, \overline{w}_{t=2}^{h} \leq 1-T\right)\right] = E\left[(1-\theta_i)\left[(1-\lambda)(A-\overline{w}^{h}) + \frac{\lambda}{2}(A-1+2T)\right]\right] \quad (6)$$

Plugging $\overline{w}_{t=2}^{h}$ into the equation above and doing some algebra, we get:

$$E\left[\left(\pi_{t=2}^{h}\middle|NS, \overline{w}_{t=2}^{h} \leq 1-T\right)\right] = \left(1-\frac{D}{2}\right)\left[\left(T+\frac{A-1}{2}\right)+c\right] \quad (7)$$

Comparing (5) and (7) we can see that for c>0, we get: $E\left[\left(\pi_{t=2}^{h}\middle|NS, \overline{w}_{t=2}^{h} \leq 1-T\right)\right] > E\left[\left(\pi_{t=2}^{h}\middle|S\right)\right]$. Note that when $\left(\frac{A+1}{2}-T\right)-\frac{c}{(1-\lambda)} < b$ the foregoing result does not hold. Whenever we have such a b, however, it is never optimal for the worker to search (M=0) and therefore a search equilibrium may not exist.

[16] Consequently, the firm's profit function also changes, of course.

[17] This condition is important because otherwise the wage is higher than the maximum wage offered by the outside offer of a low-productivity job. This means that the firm transfers a rent to the worker and, therefore, has a smaller profit.

When $\overline{w}_{t=2}^{h} > 1 - T$, it implies that $A > 1 + \frac{2C}{1-\lambda}$ and the profit function becomes:

$$E\left[\left(\pi_{t=2}^{h} \middle| NS, \overline{w}_{t=2}^{h} > 1 - T\right)\right] = E[(1-\theta_i)\left[(1-\lambda)(A - \overline{w}^{h}) + \frac{\lambda}{2}(A - \overline{w}^{h} + T)\right] \quad (8)$$

Again, placing $\overline{w}_{t=2}^{h}$ into the above equation and after some algebra we get:

$$E\left[\left(\pi_{t=2}^{h} \middle| NS, \overline{w}_{t=2}^{h} > 1 - T\right)\right] = \left(1 - \frac{D}{2}\right)\left[\left(1 - \frac{\lambda}{2}\right)\left(\frac{c}{1-\lambda} + \frac{A-1}{2}\right) + T\right] \quad (9)$$

Comparing the above two profit values, we can see that allowing search is more profitable than offering a high wage only if $A > 1 + \frac{(2-\lambda)2c}{\lambda(1-\lambda)}$. Clearly, if λ is high enough or low enough, this condition is never satisfied. However, a segment of λ in which allowing search is more profitable than offering high wages may exist (if A is high enough). As for partial matching, under some conditions we can find λ such that it is better to allow search and fully match than to offer low wages with only partial matching.[18] In sum, allowing workers to search is a feasible equilibrium whenever $\overline{w}_{t=2}^{h} > 1 - T$, meaning that the firm pays a higher initial wage than the post-bargaining wage for outside low-productivity offers. In this case, allowing workers to search decreases the firm's payroll expenditure. Since our study tends to focus on matching policies, full matching with or without searching (when the worker's wages are paid) is relatively similar (especially in a general equilibrium framework). Therefore, we are inclined to include the search equilibrium with the other full-matching equilibrium.

When the firm does not allow searching, its behavior is limited to the set of $\{\{w_{t=2}^{h}, M^{h}(w_{t=2}^{h})\}$ where $w_{t=2}^{h} \in [b, \overline{w}_{t=2}^{h}]$ and $M^{h}(w_{t=2}^{h})$ is the no-search matching value that we developed in the previous section. Actually, the only two possible wage levels are the corner solutions: b and $\overline{w}_{t=2}^{h}$. This happens because the firm's profit function in this segment is either monotonic or has a single minimum point inside the segment.[19]

Next, to discover the firm's equilibrium behavior, we need to compare the expected profit under the two possible strategies, $(b, M^{h}(b))$ and $(\overline{w}^{h}, 1)$. Clearly, if $\overline{w}^{h} \leq b$ the firm must pay b and match all outside offers. The more interesting cases involves $\overline{w}^{h} > b$.

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[18] The intuition is that when λ is high enough, matching influences the profit function more than the starting wage does because more and more workers will receive an outside offer. The actual condition is omitted because it is messy and non-informative .

[19] For a detailed proof, see Appendix 1.

Given $w_{t=2}^{h} = b$ the compatible no-search matching policy is $M^{h}(b) = Min\left[\frac{c}{(1-\lambda)\left(\frac{A+1}{2}-T-b\right)}, 1\right]$. When $\overline{w}^{h} > b$ it also implies that the minimum is not binding[20] and we may plug $M^{h}(b) = \frac{c}{(1-\lambda)\left(\frac{A+1}{2}-T-b\right)}$ directly into the expected per-worker profit:

$$E\left[\left(\pi_{t=2}^{h} \middle| NS, b, M^{h}(b)\right)\right] = E[(1-\theta_i)[(1-\lambda)(A-b) + \frac{\lambda c(\frac{A-1}{2}+T)}{(1-\lambda)\left(\frac{A+1}{2}-T-b\right)}] \qquad (10)$$

As we showed above (equations 7 and 9), the expected profit function at high wage is dependent on the value of $\overline{w}_{t=2}^{h}$ in respect to $1-T$. Hence, the condition for preferring the low-wage policy is:

- For $\overline{w}_{t=2}^{h} \leq 1-T$:

$$(1-\lambda)(A-b) + \frac{\lambda c(\frac{A-1}{2}+T)}{(1-\lambda)\left(\frac{A+1}{2}-T-b\right)} > \left(T + \frac{A-1}{2}\right) + c \qquad (11)$$

- For $\overline{w}_{t=2}^{h} > 1-T$:

$$(1-\lambda)(A-b) + \frac{\lambda c(\frac{A-1}{2}+T)}{(1-\lambda)\left(\frac{A+1}{2}-T-b\right)} > \left(1-\frac{\lambda}{2}\right)\left(\frac{c}{1-\lambda} + \frac{A-1}{2}\right) + T \qquad (12)$$

Unfortunately, there are no strict and simple conditions for preferring one strategy over the other. However, we may sketch the following general characteristics of the optimal no-search policy:

I. There is always a segment of $\lambda \in [0, \lambda_1(A)]$ at which a partial matching policy is optimal. The size of λ_1 is dependent on the size of A, which determines the relevant profit function under full matching between the two possible values of λ_1.

II. For $1 \geq \lambda \geq \bar{\lambda}^{h} \equiv 1 - \frac{c}{\frac{A+1}{2}-T-b}$, all potential matching policies merge and expected profits as well as matching behaviors and wages are equal.

III. There may not be a segment of λ which full matching is strictly optimal.

---

[20] Proof: when $b < \overline{w}^{h} = \frac{A+1}{2} - T - \frac{c}{(1-\lambda)}$ it implies $\frac{c}{(1-\lambda)\left(\frac{A+1}{2}-T-b\right)} < \frac{c}{(1-\lambda)\left(\frac{A+1}{2}-T-(\frac{A+1}{2}-T-\frac{c}{(1-\lambda)})\right)} = 1$.

IV. If a value of λ for which full matching is optimal exists, for any higher λ, full matching weakly dominates partial matching.[21]

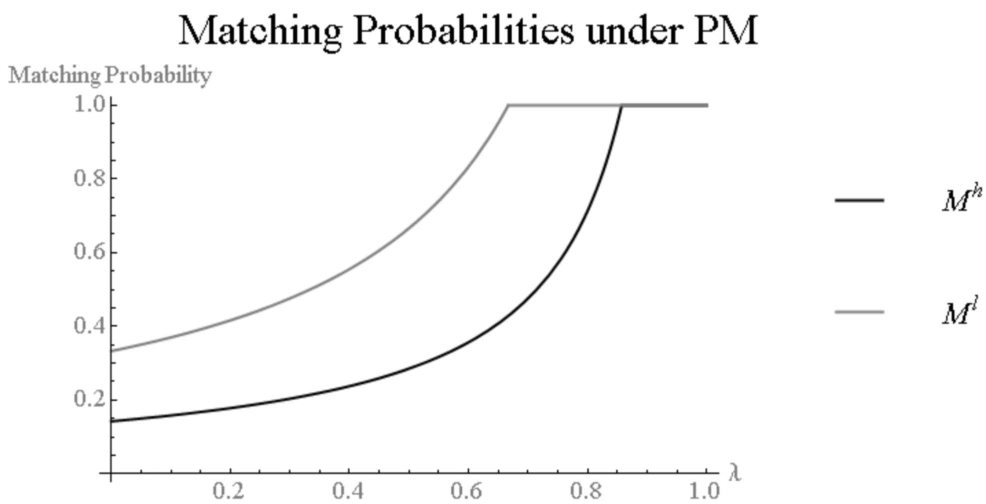
3.2.3 Workers' Decision (Low Productivity)

Workers in low-productive jobs expect a wage of 1–T when the poaching firm is offering a low-productivity type of job. Workers who are poached by a firm that offers a high productivity outside position, in turn, are expected to leave their current firms and receive wage 1. Now, mush as in the foregoing section, we equalize expected wages under search and no-search conditions to obtain the no-search matching policy for a low productivity job, M^l:

$$M^l = Min\left[\frac{c}{(1-\lambda)\left(1-\frac{T}{2}-w_{t=2}^l\right)}, 1\right] \quad (14)$$

Observing the expected-wage equations for low-productivity workers (not presented here for the sake of brevity), we see that the decision of a low-productivity worker is independent of any of parameters that apply to a high-productivity worker in the same workplace. This explains why firms are able to differentiate among employees. M^l is independent of A (the high-productivity parameters), indicating that both no-search matching values are separable. Comparing M^l with M^h, we find that $M^l \geq M^h$ when $w_{t=2}^h = w_{t=2}^l = b$ and under any set of parameters. Figure 1 provides a numerical example of such a comparison (all computations, unless specifically indicated to the contrary, are based on the following parameters: A=2; T=0.2; b=0.6; c=0.1; D=0.99). Obviously, high-productivity workers are matched less at any given λ.

[21] Proof: see Appendix 2.



The corresponding low-productivity value of non-search wage $\bar{w}^l$ is:

$$\bar{w}^l = Max\left[\left(1-\frac{T}{2}\right)-\frac{c}{1-\lambda}, b\right] \tag{15}$$

Again, comparing $\bar{w}^l$ to $\bar{w}^h$, we see that $\bar{w}^h > \bar{w}^l$. Workers in high-productivity jobs gain more by searching and, therefore, demand a higher wage in order not to search.[22] A computed illustration is given in Figure 2.

3.2.4 The Firm's Problem (at Low Productivity)

The firm problem regarding low productivity jobs is different as poaching high productivity firm will always win the Bertrand competition over the worker as they can increase wages above the productivity level in low jobs. Therefore, matching helps the incumbent firm keeps it employees only half the cases. As a result, matching is less appealing for firms under this scenario[23].

The solution to the firm problem follows the same footsteps like the previous section. First, we discuss the possibility of allowing search. Then we prove that paying b is optimal whenever the matching policy is $M^l(w^l_{t=2})$, Last, we calculate the expected profit on strategy $(b, M^l(b))$ and compare it to strategy $(\bar{w}^l, 1)$ and provide the characteristics of the firms' total behavior.

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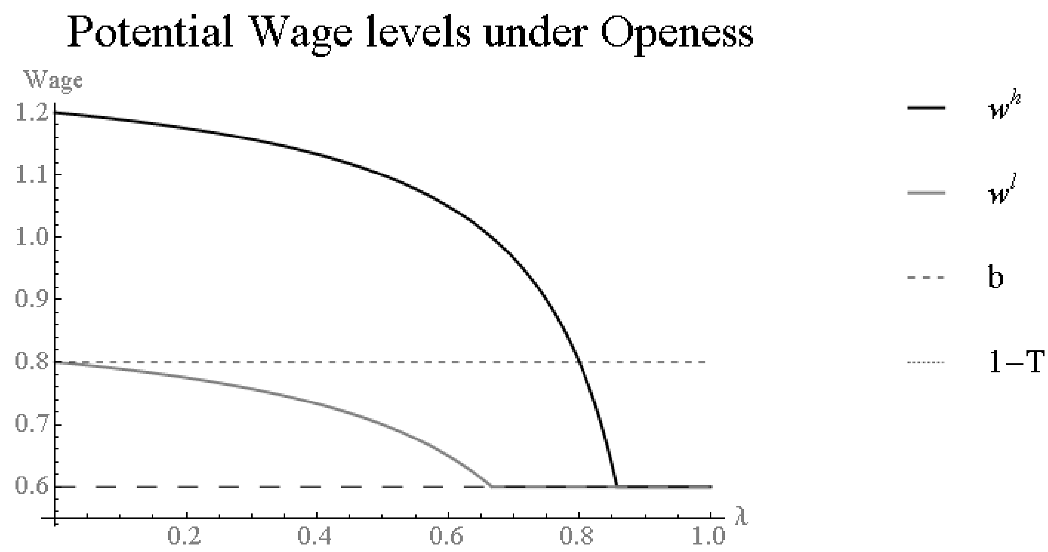
22 Note that this is dependent of the condition that A>1+t, which implies that the difference in productivity is greater than the adjustment cost.

23 This result resembles Postel-Vinay and Robin (2004), who found that high-productivity firms match and low-productivity firm do not match for the same reason: matching is not profitable enough for low-productivity jobs.



Much as in the high-productivity case, it is almost never optimal to allow workers to search. For $\overline{w}^l < 1 - \frac{T}{2}$, allowing search is an inferior strategy. When $\overline{w}^l > 1 - \frac{T}{2}$, allowing search may be optimal at an internal segment of λ where the search cost (c) is very low.[24] Furthermore, when a firm chooses a no-search matching policy of M^l, the optimal wage level is the lowest possible and equals b.[25]

Finally, to determine the firm's equilibrium behavior, we need to compare its expected profit under both possible strategies, $(b, M^l(b))$ and $(\overline{w}^l, 1)$. The expected profit under partial matching behavior is:

$$E\left[\left(\pi_{t=2}^l \middle| NS, b, M^l(b)\right)\right] = E[(1-\theta_i)[(1-\lambda)(1-b) + \frac{\lambda c(\frac{T}{2})}{(1-\lambda)\left(1-\frac{T}{2}-b\right)}] \qquad (16)$$

The expected profit under high wage and full matching is dependent on the value of $\overline{w}^l$ in respect to 1–T. Hence, the profit function contains an internal minimum condition:

$$E\left[\left(\pi_{t=2}^l \middle| NS, \overline{w}^l\right)\right] = E[(1-\theta_i)\left[(1-\lambda)(1-\overline{w}^l) + \frac{\lambda}{2}\, MIN[T, 1-\overline{w}^l]\right] \qquad (17)$$

Again, there are no strict and simple conditions for the preference of one strategy over the other. However, we may describe several general characteristics of the optimal no-search policy for low-productivity jobs:

[24] Proof: see Appendix 3.
[25] Proof: see Appendix 4.

I. There is always a segment of $\lambda \in [0, \lambda_1]$ at which the partial-matching policy is optimal. The size of $\boldsymbol{\lambda_1}$ is dependent on the size of A, which determines the relevant profit function under full matching among the two possible values of $\boldsymbol{\lambda_1}$.

II. For any $1 \geq \lambda \geq \bar{\lambda}^l \equiv 1 - \frac{c}{1-\frac{T}{2}-b}$, all potential matching policies merge. Expected profits as well as matching behaviors and wages are equal.

III. There may not be a segment of λ on which full matching is strictly optimal.

IV. If there exists a value of λ for which full matching is optimal, for any higher $\boldsymbol{\lambda}$, full matching weakly dominates partial matching.

Proof: see Appendix 2a.

3.3 Secrecy Equilibrium

Following our definition of secrecy as a social norm rather than just a policy, to establish the existence of a secrecy equilibrium we need to show that under secrecy both workers and employers support the norm. Following Elster (1989),[26] we assume that a social norm is sustained over time if workers and firms expect to gain by applying it *ex ante*. This means that all agents in the economy favor the norm before knowing what their specific job productivity will be. The difference between a norm and a more traditional concept of action or policy falls within the time framework. Norms are sustained if they are beneficial for society in general. It is usually the case, however, that the norm is against the immediate interest of some or all agents in a short-run setting.[27]

The main features of the equilibrium under secrecy are presented in the proposition below:

Proposition 3:

- *Under secrecy, all workers receive the minimal wage (b).*

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[26] For a comprehensive review of the evolution and persistence of social norms, see Hechter and Opp (2001).

[27] Cleaning is an example: we are all better of if nobody leaves garbage in the park. However, when we finish our picnic and want to go home, our immediate interest is not to invest effort in cleaning but rather to leave the trash untreated. Usually, if a norm is valid most people will observe it even against their immediate interest. In our example, most people would clean up after themselves.

- *Firms discriminate: high-productivity workers are matched more under openness; low productivity workers are matched less (if at all).*
- *There are always some high-productivity workers who search*
- *Fewer high-productivity workers leave the firm (in absolute terms and relative to the full-information case).*

The construction of the secrecy equilibrium and proof for the foregoing propositions entail several steps. First, we define the information structure and the workers' estimation process; second, we define the workers' problem under secrecy and derive the best-response search function; third, we discuss the profit maximization problem; last, we derive the quitting and turnover flows.

3.3.1 Gathering Information

Workers use their individually collected quitting observations to estimate their unit's level of productivity. Each worker estimates to which of the two potential distributions her specific observation belongs. On the basis of this estimation, the worker decides whether to search or not. Quitting is the result of three elements: stochastic job destruction, the ratio of workers who search (per unit), and the firm's matching policy.

Hence, workers' ability to differ between the two types of productivity depends on two elements:

1. The expected difference in quitting due to on-the-job search and matching (the larger the difference, the easier it is to distinguish);
2. The variance of the exogenous job-destruction process (the greater the variance, the greater the vagueness and the weaker the separability).

Denote (s_t^h, s_t^l) as the share of searching workers[28] among high-productivity/low-productivity workers in Period t. (Since the model is fully symmetric in respect of firms, we omit any firms' specific indexation when possible.) The ratio of those who quit (the number of "quitters" divided by total number of second-period workers in the relevant group)[29] at Firm i in Period t in each unit, denoted by $q_{i,t}^k$ $(k = h, l)$, is:

[28] The full information case was a less general case where $s_t^h = s_t^l = 0$

[29] From here on, all calculations in the model are made on the basis of such ratios.

$$q_{i,t}^h = \theta_{i,t} + (1 - \theta_{i,t})[(\lambda + (1-\lambda)s_t^h)(1 - m^h)] \quad (18)$$

$$q_{i,t}^l = \theta_{i,t} + (1 - \theta_{i,t})\left[(\lambda + (1-\lambda)s_t^l)\left(1 - \frac{m^l}{2}\right)\right] \quad (19)$$

where $\theta_{i,t}$ is the share of workers whose jobs were destroyed; $(\lambda + (1-\lambda)s_t^h)$ is the share of workers who receive outside offers; and $(1 - m^h)$ *and* $\left(1 - \frac{m^l}{2}\right)$ indicate he share of workers who stayed with the incumbent firm after matching. We define:

$$Q^h \equiv (\lambda + (1-\lambda)s_t^h)(1 - m^h);\ Q^l \equiv (\lambda + (1-\lambda)s_t^l)\left(1 - \frac{m^l}{2}\right) \quad (20)$$

and find that given s_t^k and m^k:

$$q_{i,t}^h \sim U[Q^h, (1-D)Q^h + D] \quad (21)$$

$$q_{i,t}^l \sim U[Q^l, (1-D)Q^l + D] \quad (22)$$

For any specific worker who observes one sample of quitting information ($\hat{q}_{i,t}$), the estimation problem narrows down into the ability to identify which distribution generated $\hat{q}_{i,t}$. Denote $\hat{p}^h$ as the probability that a worker assigns to her working in a high-productivity unit on the basis of observation $\hat{q}_{i,t}$.

$$\hat{p}^h = prob\ [\hat{q}_{i,t} \in q_{i,t}^h] \quad (23)$$

Due to the nature of the uniform distribution, $\hat{p}^h$ may acquire one of three potential values: 0, 1, or p^h, which is the Bayesian-updated probability when $\hat{q}_{i,t}$ is observed in the segment where both $q_{i,t}^h$ and $q_{i,t}^l$ are feasible:

$$p^h = \frac{1 - Q^l}{2 - Q^h - Q^l} \quad (24)$$

Note that whenever $Q^h < Q^l$, high-productivity workers do not assign $\hat{p}^h = 0$ and low-productivity workers do not hold $\hat{p}^h = 1$.

3.3.2 The Workers' Problem (Secrecy)

Given the estimated probability, we may now write the no-search indifference equations for workers. Generally, workers decide to search if they expect to gain more by searching than by not searching. Formally, this means:

$$E[(u_{t=2}|S, p^h)] > E[(u_{t=2}|NS, p^h)] \quad (25)$$

When $\hat{p}^h = 1$ or $\hat{p}^h = 0$, the problem is identical to the full-information problem and, therefore, the maximal no-search potential matching policies are M^h and M^l, respectively.

When $\hat{p}^h = p^h$, the problem becomes more complex. The utility of searching is constructed mainly from the probability of being in a high-productivity unit multiplied by the expected return to search, plus the probability of being in a low-productivity unit (1–p) multiplied by the return to search under that scenario:

$$E\left[\left(u_{t=2}\middle|S,p^h\right)\right] = E\left[(1-\theta_i\,)\begin{bmatrix} p^h\left(m_s^h\left(\frac{A+1}{2}-T\right)+(1-m_s^h)w_{t=2}\right)+ \\ (1-p^h)\left(m_s^l\left(1-\frac{T}{2}\right)+(1-m_s^l)w_{t=2}\right)-c \end{bmatrix}+\theta_i\ b\right] \tag{26}$$

The expected utility without search is given by:

$$E\left[\left(u_{t=2}\middle|NS,p^h\right)\right] = E\left[(1-\theta_i\,)\left[p^h\left((1-\lambda)w_{t=2}+\lambda m_s^h\left(\frac{A+1}{2}-T\right)+\lambda(1-m_s^h)w_{t=2}\right)+(1-p^h)\left((1-\lambda)w_{t=2}+\lambda m_s^l\left(1-\frac{T}{2}\right)+\lambda(1-m_s^l)w_{t=2}\right)\right]+\theta_i\ b\right] \tag{27}$$

Where m_s^k is the matching policy toward agents with k productivity under secrecy.

Comparing equations (26) and (27) and doing some algebra, we get:

$$p^h m_s^h\left(\frac{A+1}{2}-T-w_{t=2}\right)+(1-p^h)m_s^l\left(1-\frac{T}{2}-w_{t=2}\right)\geq\frac{c}{1-\lambda} \tag{28}$$

For any p^h, when we place $m_s^h = M^h, m_s^l = M^l$, we obtain equality. That is, playing the full-openness policy is always feasible under secrecy. Since no agent will search in such an equilibrium, the outcome is identical to the full-information case. This trivial case shows that secrecy can be attained even when the overall results in the market are equal to those under full information. In this case, however, workers and firms, do not express active support of secrecy. Other alternatives are also possible under the same no-search equation. Using the notation $m_s^h \equiv a^h M^h; m_s^l \equiv a^l M^l$, for any non-negative a^h and a^l we may rewrite Inequality (28) and draw the frontier of non-search matching possibilities given w=b:

$$p^h \mathrm{a}^\mathrm{h} M^h\left(\frac{A+1}{2}-T-b\right)+(1-p^h)\mathrm{a}^\mathrm{l} M^l\ \left(1-\frac{T}{2}-b\right)\geq\frac{c}{1-\lambda} \tag{29}$$

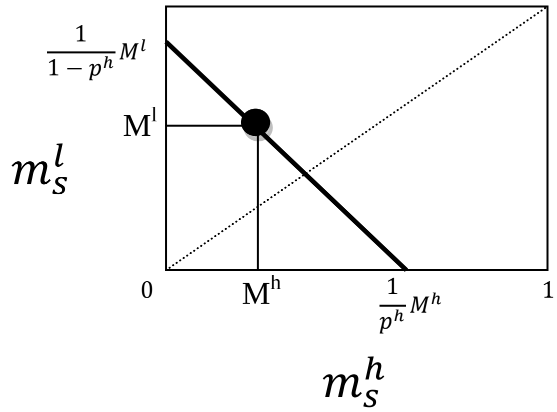
which yields the following search/no-search indifference equation:

$$p^h\mathrm{a}^\mathrm{h}+(1-p^h)\mathrm{a}^\mathrm{l}=1 \tag{30}$$

Equation 30 has an important immediate implication: firms may choose a mixture of matching profiles and workers still will not search. A specific case of interest is the

Chart 1: The frontier of No-Search matching strategies

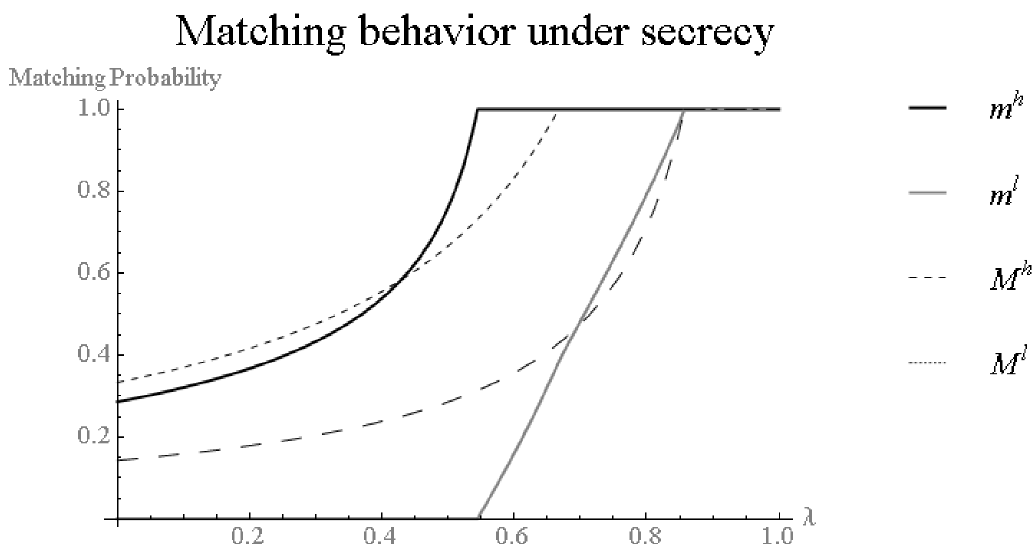
(For a given p^h, M^l, M^h)



corner case of maximum discrimination: firms match high-productivity workers' external offers as much as possible but do not match low-productivity workers at all or match them only after all high-productivity workers are matched. Technically, a^l is set to 0 until m_s^h=1 and only then do firms start matching low-productivity workers. Such behavior is represented by the following equations:

$$\begin{Bmatrix} \frac{1}{p^h}M^h \le 1 & \rightarrow & a^h = \frac{1}{p^h};\ m_s^h = \frac{1}{p^h}M^h;\ a^l = 0;\ m_s^l = 0 \\ \frac{1}{p^h}M^h > 1 & \rightarrow & a^h = \frac{1}{M^h}; m_s^h = 1; a^l = \frac{1-\frac{p^h}{M^h}}{1-p^h};\ m_s^l = \frac{1-\frac{p^h}{M^h}}{1-p^h}M^l \end{Bmatrix} \tag{31}$$

Chart 1 provides a simple graphic illustration of the potential matching strategies. First, note that as $M^h < M^l$ the starting point is always in the upper triangle of the box. The matching frontier is the set of values that keeps workers on their indifference curve. Firm may decide on the matching pair (m^h, m^l) at any point on the boldfaced interior line. The slope of the line depends mainly on the value of p^h. The larger p^h is, the steeper the curve becomes. The corner solution is the case where the indifference line touches the bottom or the right side of the box. When the cross point is at the bottom, $m^l = 0$. When the curve reaches the right side, $m^h = 1$ and $m^l > 0$. Whenever $m_s^h > M^h$ (or a^h>1), it is optimal for any agent who believes that belief $\hat{p}^h > p^h$ to search actively. The reason is that when employers match more high-productivity workers than they would in the full-information case, it makes searching optimal if the employee has sufficient reason (= a high enough $\hat{p}^h$) to believe that she belongs to the high-productivity unit. As a result, all



workers with $\hat{p}^h$=1 search. Note that in the other extreme case, where $\hat{p}^h$=0, searching does not take place because $m_s^l < M^l$.

3.3.3 The Firm's Maximization Problem (Secrecy)

Taking secrecy as a given, the firm's maximization problem follows the same steps as the full-information case with two exceptions: first, firms need to set the combination of matching policies per productivity level (a^h, a^l) as the levels are no longer separable; second, wages are also non-separable. Secrecy demands that workers should not know what their type is. To achieve this, all workers must be paid the same wage in order to sustain secrecy; thus, w^l always equals w^h.

Much as in the openness case, firms need to choose between paying the minimum wage (b)[30] and selecting a matching policy that is compatible with the no-search indifference frontier, or paying a wage that is high enough to eliminate searching even when all outside offers are matched.

Offering high wages under secrecy (denoted by $\overline{w}^s$) is unique because both high- and low-productivity workers earn the same wage (whereas in the full-information case, $\overline{w}^h > \overline{w}^l$). Still, workers who are sure that they belong to a high-productivity unit will

[30] Above we saw that keeping workers on the no-search indifference curves always entails paying minimum wage b. The same principle obtains in the secrecy case.

search even they receive a high wage, as $\bar{w}^s < \bar{w}^h$. By analyzing this equilibrium, however, we find that it is never optimal: firms' profits are always lower under secrecy than when they adopt high-wage full-information policies of {($\bar{w}^h$,1), ($\bar{w}^l$, 1)}. Thus, paying a high wage under secrecy may never be secrecy equilibrium.[31]

We now develop the matching strategy under minimum wage: $w^l = w^h = b$. At this wage level, firms can match, discriminate, or simply follow the full-information matching strategies (which is feasible, as we saw above).

The quasi-full-information strategy [(b, $M^h(b)$] and [b, $M^l(b)$] is the case where a firm matches $M^k(b)$ outside offers and workers never search (because they are on their indifference curve in both productivity units). Indeed, under such behavior, the expected profits, search intensities, and wages are equal to those in the full-information case. However, secrecy is still supported (albeit weakly). One possible important implication of this result is that secrecy *per se* is not a sufficient condition for the existence of matching discrimination.

To articulate the match-discrimination equilibrium, we first need to find the value of a^h is.[32] By construction, it is more profitable for the firm to match an outside offer to a high-productivity worker than to match a low-productivity offer. More specifically, the value ratio (denoted by v) of short-run gains from matching high-productivity outside offers to gains from matching low-productivity outside offers is: $v = \frac{\frac{A-1}{2}+T}{\frac{T}{2}} = 2 + \frac{A-1}{T}$. Under secrecy, a firm may choose any combination of ah and al that satisfies the no-search condition for workers who have the perception of $\hat{p}^h = p^h$ (Equation 30). However, as p^h is upper-bounded by 0.5, we find that a maximal discrimination policy (setting al to zero) is optimal, in the short run, when $va^h(p^h)M^h > a^l(p^h)M^l$. This last inequality yields the condition $A > 1 - \frac{T(1-b)}{(1-b-T)}$, which is always satisfied. Hence, under secrecy,

[31] See proof in Appendix 6.

[32] Note that the level of a^h in a steady-state equilibrium is a result of a two simultaneous equations because the number of "quitters," the driving force of p^h, is affected by the probability of matching, which is a function of p^h.

all matching policies maximize ah given the no-search frontier.33 Having solved the worker problem above, we may rewrite Equation (31) and present the matching coefficients:

$$\mathrm{a}^{h} = \mathrm{Min}\left[\frac{1}{p^{h}},\frac{1}{M^{h}}\right];\ \mathrm{a}^{\mathrm{l}} = Max\left[0,\frac{1-\frac{p^{h}}{M^{h}}}{1-p^{h}}\right] \tag{32}$$

$\mathrm{a}^{h} \geq 1$ and $\mathrm{a}^{l} \leq 1$. Also note that when $M^{h} = 1$, we obtain $\mathrm{a}^{l} = \mathrm{a}^{h} = 1$ — the point where all possible (secrecy and full-information) strategies merge.

The immediate result of discrimination in matching is the initiation of search. When a firm discriminates among its workers, it implies that if high-productivity workers were aware of its matching policy, they would search. Low productive workers, in turn, never search because even when they discover their type, the probability of a matching offer is such that searching would do them no good. Under secrecy, the proportion of searching workers is given by the proportion of high-productivity workers for whom $\hat{p}^{h} = 1$. Using the characteristic of uniform distribution,34 we can work out the volume of searching (in probability terms). This portion, s_{t}^{h}, is a positive function of the distance between Q^{h} and Q^{l}:

$$\left\{\begin{array}{lll} Q^{h} < Q^{l} & \rightarrow & s_{i,t}^{h} = \frac{Q^{l}-Q^{h}}{D(1-Q^{h})} \\ Q^{h} \geq Q^{l} & \rightarrow & s_{i,t}^{h} = \frac{(1-D)(Q^{h}-Q^{l})}{D(1-Q^{h})} \end{array}\right\} \tag{33}$$

Note that in both segments (except the specific point of $Q^{l} = Q^{h}$, which we will take up later in the discussion), the search volume is non-continuous around the no-search point: for any $a^{h} > 1$ search will occur and begin at a sizable extent.

33 Note that this result is the outcome of firms' maximization of profit per period independently. This means that when a firm chooses its matching policy, it disregards the effect of current matching on future information sets. Alternatively, it means that the firm uses full discount rate. This assumption is very common in the research literature, following the initial assumption of Burdett and Mortensen (1998) that firms maximize their steady-state profit flows, i.e., do not discount the future.

34 The use of uniform distribution allows us to simplify our calculations. However, more general distribution functions are expected to elicit similar results. Under normal distribution, for example, the firm needs to set a^{h} on the basis of a threshold level of p^{h}: Workers for whom $\hat{p}^{h}$ is larger than the threshold will search; other will not. The only difference is in the complexity of calculating this threshold, which is much less under uniform distribution.

Whenever a firm fully match-discriminates (in the sense that it sets mh at the highest possible value corner of the frontier of the no-search indifference curve), we find that $Q^h < Q^l$ each time a firm fully discriminates. Therefore, the extent of searching follows: $s_{i,t}^h = \frac{Q^l - Q^h}{D(1-Q^h)}$. Plugging in the values of Q^h and Q^l, we see that the more matching discrimination occurs, the more searching behavior is encouraged.

The final step in articulating the equilibrium requires us to differentiate between the case of $\frac{1}{p^h} M^h \leq 1$, in which only high-productivity workers are matched, and the case of $\frac{1}{p^h} M^h > 1$, in which all high-productivity workers are matched and some low-productivity workers are matched as well. The end of this second segment is at the point where mh=ml=1, which is also the case where alternatives A and B merge. We discuss the two segments separately in the next two subsections.

3.3.3.1 Steady-State Equilibrium: Only High-Productivity Workers are matched

When M^h is relatively small, only high-productivity workers are matched. In this case, $m_s^h = \frac{1}{p^h} M^h$ and low-productivity workers are never matched. Therefore, $m_s^h = 0$, yielding a constant $Q^l = \lambda$. We then insert p^h into the matching equation to get:

$$(m_s^h | p^h \geq M^h) = \frac{2 - s^h}{(1 - (\frac{\lambda}{1-\lambda} + s^h) M^h)} M^h \qquad (34)$$

and the extent of searching is:

$$s^h = \frac{Q^l - Q^h}{D(1 - Q^h)} = \frac{\lambda\, m_s^h - (1-\lambda)(1 - m_s^h) s^h}{D(1 - \lambda(1 - m_s^h) - (1-\lambda)(1 - m_s^h) s^h)} \qquad (35)$$

To find s^h in the steady state we solve the quadratic equation and then plug the result into the m_s^h equation to obtain the value of m_s^h.

3.3.3.2 Steady-State Equilibrium: All High-Productivity Workers and Some Low-Productivity Workers are Matched

The second segment of possible secrecy is where a^h is high enough to make $m_s^h = 1$. As the firm maximizes its profit, it wishes to keep workers at their indifference point and therefore may increase the probability of matching offers that are tendered to low-productivity workers as well.

In this segment, $Q^h = 0$ because no high-productivity workers quit due to outside offers (after all, all outside offers are matched successfully) but searching is still common among them. On the other hand, Ql is no longer constant and equal: $Q^l = \lambda(1 - \frac{m_s^l}{2})$. Therefore, we may derive the search function:

$$s^h = \frac{\lambda}{D}(1 - \frac{m_s^l}{2}) \tag{36}$$

plugging Q^l into p^h, we obtain:

$$p^h = \frac{1-\lambda(1-\frac{m_s^l}{2})}{2-\lambda(1-\frac{m_s^l}{2})} \tag{37}$$

And by using the workers' indifference utility equation, we may derive m_s^l:

$$(m_s^l | p^h < M^h) = \frac{1-\frac{p^h}{M^h}}{(1-p^h)} M^l \tag{38}$$

Substituting p^h and doing some algebra, we find that for M^l<1:

$$m_s^l = \frac{2-\lambda-\frac{1-\lambda}{M^h}}{1+M^l\frac{\lambda}{2}(\frac{1}{M^h}-1)} M^l \tag{39}$$

and for M^l=1, M^h<1:

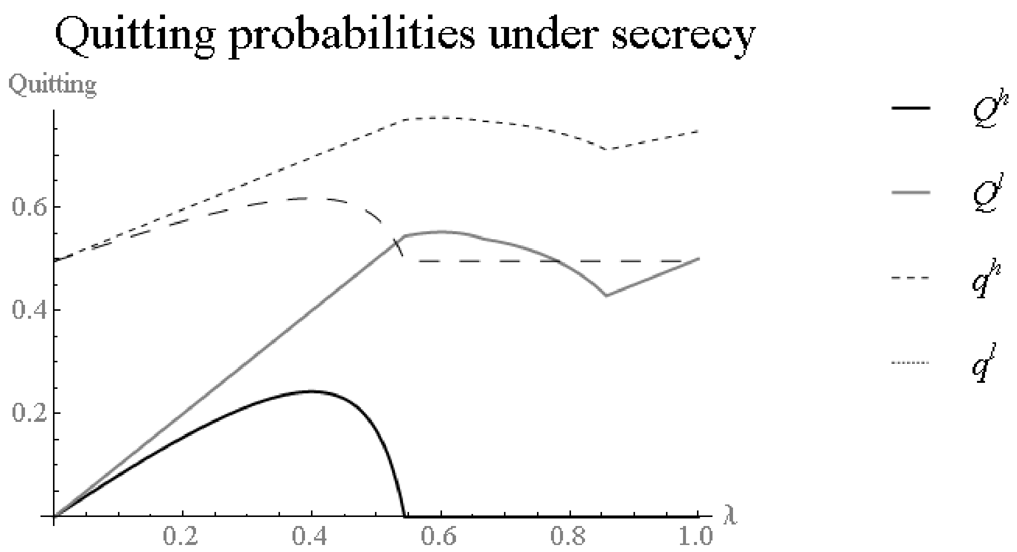
$$m_s^l = 2(1 - \frac{1}{M^h(2-\lambda)+\lambda}) \tag{40}$$

3.3.4 Workers Mobility and Quitting

The number of workers who quit the firm and move to another workplace is strongly affected by the secrecy strategy. Q^h and Q^l represent the total number of workers that leave a firm at a single period (without job destruction). For low-productivity workers, secrecy always means a higher quitting rate because $m_s^l < M^l$. For high-productivity workers, the probability of matching is always higher but the likelihood of quitting increases because some workers of this caliber search. Obviously, whenever m^h=1, no high-productivity worker quits and$Q^{h,s} < Q^{h,fi}$. The difference in quitting between the full information case and the secrecy case for $m^h < 1$ is:

$$Q^{h,fi} - Q^{h,s} = \lambda M^h(a^h - 1) - (1-\lambda)s_{i,t}^h(1 - a^h M^h) \tag{41}$$

As we see, $Q^{h,fi} > Q^{h,s}$ when M^h is not too small (the intuition for this is the discontinuity of workers' search decision). The definition of the equilibrium, however, shows that matching discrimination in secrecy (the only case that exists when $s_{i,t}^h > 0$)



occurs only when secrecy is optimal for the firm, i.e., $\mathrm{E}[(\pi^{\mathrm{s}}_{\mathrm{t=2}}|\mathrm{NS,b})] > E\left[\left(\pi^{\mathrm{fi}}_{\mathrm{t=2}}\middle|\mathrm{NS,b}\right)\right]$. Where this condition is met, Equation (41) is always positive.[35] Hence, high-productivity workers do less job-switching under secrecy.

Finally, we may derive total turnover expressions under secrecy. The probability of changing workplaces (without job destruction) is given by:

$$Q^s = \frac{Q^{h,s}+Q^{l,s}}{2} = \frac{1}{2}\left[\left(\lambda + (1-\lambda)s^h_{i,t}\right)(1-\ m^h_s) + \lambda(1-\frac{m^l_s}{2})\right] \tag{42}$$

To simplify this, we may use the distinction between the segment on which $m^h_s < 1$ and that on which $m^h_s = 1$ and obtain:

$$Q^s(\ m^h_s < 1,\ m^l_s = 0) = \frac{1}{2}\left[\left(\lambda + (1-\lambda)s^h_{i,t}\right)(1 - a^h M^h) + \lambda\right] \tag{43}$$

$$Q^s(\ m^h_s = 1,\ m^l_s > 0) = \frac{1}{2}\left[\lambda(1 - \frac{m^l_s}{2}\right] \tag{44}$$

3.4 Wage Secrecy Dominance

After establishing the characteristic of the wage-secrecy matching-discrimination equilibrium (hereinafter, for brevity’s sake, “wage secrecy”), we now describe the condition under which wage secrecy is supported by both workers and employers.

[35] See proof in Appendix 7.

3.4.1 Workers' Support

We study workers' support for secrecy on the basis of *ex ante* support for secrecy, expressed by the difference in expected utility between secrecy and openness under a specific set of known parameters (including market competitiveness, λ). In other words, we assume that workers compare their expected wages under secrecy with their expected gains under the second-best firm policy, i.e., the strategy that the firm would use if secrecy is rejected.

3.4.1.1 Matching Discrimination vs. Partial Matching

Our model predicts that given the wage level, workers will always prefer secrecy to partial matching. The main driving force for this result is the higher probability of matching offers tendered to high-productivity workers. As our model focuses on matching-driven wage changes, the only source of a wage increase in our setting is the matching of outside offers. From the worker's standpoint, a matching offer brings a higher return when she is employed in a high-productivity job. Hence, any shift in the matching probabilities toward more matching for high-productivity workers increases workers' expected utility. In addition, searching, when performed, also yields positive value and increases utility. The following proposition illustrates workers' attitudes toward secrecy.

Proposition 4:

Relative to the full-information partial-matching equilibrium:

- *High-productivity workers earn more on average due to secrecy; low productivity workers' average wage is lower.*
- *Secrecy results in higher ex ante expected wages; all workers favor secrecy ex-ante.*
- *Given the individual signal regarding worker productivity, most workers have higher wage expectations under secrecy; most workers favor the secrecy norm during their second period of work.*
- *However, workers who do not know what their productivity is have an incentive to reveal their own type without breaking the secrecy norm during their second period of work.*

Proof:

All agents earn the minimum wage in the first period. In the second period, the expected utility (i.e., wages) of high-productivity and low-productivity workers under full information, given initial wage b, is identical and equal to:

$$E\left[\left(u_{t=2}^{h}\middle|NS,b,M^{h}\right)\right]=E\left[\left(u_{t=2}^{l}\middle|NS,b,M^{l}\right)\right]=b+\left(1-\frac{D}{2}\right)\frac{\lambda c}{1-\lambda} \quad (45)$$

Where secrecy is in effect, the expected utility of high-productivity workers is:

$$E\left[\left(u_{t=2}^{h}\middle|Se\right)\right]=\left(1-\frac{D}{2}\right)\left[\begin{array}{c}(1-\lambda)(1-s^{h})b-(1-\lambda)s^{h}c+\\ \left((1-\lambda)s^{h}+\lambda\right)\left(\frac{a^{h}M^{h}(A+1-2T)}{2}+(1-a^{h}M)b\right)\end{array}\right]+\frac{D}{2}b \quad (46)$$

where the first expression inside the brackets is the probability of receiving wage b without any outside offer; the second term is the cost of searching multiplied by the probability of a successful search, $(1-\lambda)s^{h}$; and the last expression is the probability of receiving an outside offer (a combination of unsolicited offers and searching) multiplied by the return to such outside offers, which depends on the secrecy matching probability. After arranging the expressions, we get:

$$E\left[\left(u_{t=2}^{h}\middle|Se\right)\right]=b+\left(1-\frac{D}{2}\right)c\left[\frac{\lambda a^{h}}{1-\lambda}+s^{h}(a^{h}-1)\right] \quad (47)$$

Obviously, since $a^{h}>1$, the expected wage under secrecy is higher (as $s^{h}(a^{h}-1)$ is always positive). The opposite occurs for low-productivity workers since $a^{l}<1$, and the expected profit under secrecy equals:

$$E\left[\left(u_{t=2}^{l}\middle|Se\right)\right]=b+\left(1-\frac{D}{2}\right)a^{l}\frac{\lambda c}{1-\lambda} \quad (48)$$

When secrecy is practiced, however, workers are not aware of their actual productivity. Their support of the norm is based on their *ex ante* expected wages in the second period (before knowing what their productivity is):

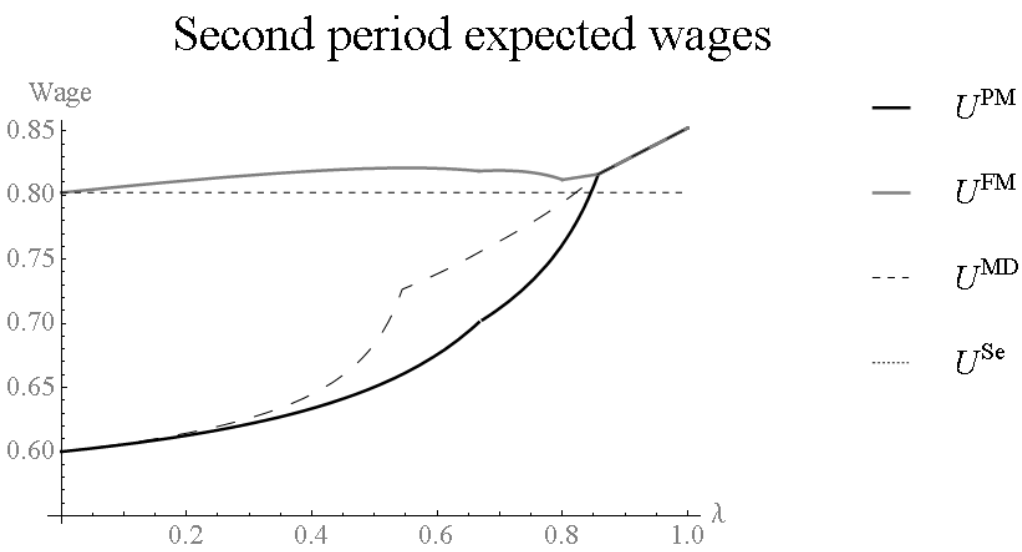
$$E\left[\left(u_{t=2}\middle|Se,NS,b,m^{h},m^{l}\right)\right]=b+\left(1-\frac{D}{2}\right)c\left(\frac{\lambda}{1-\lambda}\frac{(a^{l}+a^{h})}{2}+\frac{s^{h}}{2}(a^{h}-1)\right) \quad (49)$$

The equivalent expected utility under full information is:

$$E\left[\left(u_{t=2}\middle|fi,NS,b,M^{h},M^{l}\right)\right]=b+\left(1-\frac{D}{2}\right)\frac{\lambda c}{1-\lambda} \quad (50)$$

and, as we see, the expected secrecy wage is higher than the full information expected wage i.f.f:

$$\frac{\lambda}{1-\lambda}\frac{(a^{l}+a^{h})}{2}+\frac{s^{h}}{2}(a^{h}-1)>\frac{\lambda}{1-\lambda} \quad (51)$$



Specifically, whenever $a^l + a^h > 2$ the above inequality is always true. Following Equation 31, we need to check both cases: first, when $\frac{1}{p^h}M^h \leq 1$, $\mathrm{a}^h = \frac{1}{p^h}$ as p^h is upper-bounded by $\frac{1}{2}$ (see Equation 24), a^h itself is always greater than 2. When $\frac{1}{p^h}M^h > 1$, $\mathrm{a}^h = \frac{1}{M^h}$ and $\mathrm{a}^\mathrm{l} = \frac{1-\frac{p^h}{M^h}}{1-p^h}$. We may rewrite the condition as $\frac{1}{M^h} + \frac{1-\frac{p^h}{M^h}}{1-p^h} > 2$. After some arrangement, we get: $1 + \frac{1-p^h-1+M^h}{1-p^h} > 2M^h$ which gives $2(1-M^h) > \frac{1-M^h}{1-p^h}$. Again,as p^h is bounded by $\frac{1}{2}$ the condition is always satisfied. ∎

An additional interesting case might include asking workers whether they support the norm after discovering the outcome of the quitting observations at the end of the first period. At this point, workers are divided into three groups:

1. A proportion of the population of workers, $\frac{s^h}{2}$, believes (correctly) that they belong to the high-productivity unit. For these workers, secrecy provided higher wages than full information as$m^h > M^h$. Remember that these workers also search.
2. The majority of workers in both low- and high-productivity units hold the belief of p^h. By construction, these workers are indifferent between searching and not searching under secrecy equilibrium. As we showed above, the full-information matching probabilities also satisfy the no-search condition; thus, the expected

profit is equal to the expected profit under full information. Hence, this group has no strict preference in openness vs. secrecy, but given the common assumption the breaking a norm is somewhat costly, this group will also favor secrecy.

3. The last segment of workers believes (correctly) that they belong to a low-productivity unit. These workers strictly prefer the full-information case over the secrecy case because $m^l > M^l$. The share of this group in the workforce is relatively low: $\frac{1}{2}\frac{(1-D)(Q^l-Q^h)}{D(1-Q^l)} < \frac{1}{2}$.

Interestingly, the group of workers that opposes secrecy actually does not truly experience secrecy, as their signal was informative enough to allow them to understand they belong to the low-productivity unit. Note also that breaking the norm of secrecy during the second period may only be performed by workers from the first group (the ones who are sure they belong to the high productivity unit). These workers are the only workers that posses a valuable information for their co-workers. If group 1 workers will reveal their belief to the other workers in the same unit, all workers in the unit will update their preference toward $p^h = 1$. When that is the case, secrecy breaks and all high-productivity workers tend to search. This will force the firm to immediately move into full information matching policy and to limit matching probabilities for high-productivity workers while increasing the matching probabilities of low productivity workers. But clearly, workers from the first group enjoy the most from secrecy and hence have no incentive to break the norm. Others, who have such incentive, simply can't.

The last part of the proposition is devoted to the perceived incentives of workers in the second period. We now address only workers who hold the belief of $\hat{p}^h = p^h$, as both other groups of workers gain no extra information by immediate openness. As we show before this group has no interest to break the secrecy norm as a whole, however, any individual is expected to be better off if only he/she would get a better signal by knowing other workers wages. Again, this is true only if revealing the wage is a secret itself and does not affect firm's matching behavior.

When workers holding $\hat{p}^h = p^h$ receive information about their true productivity they might find out that they are high or low. If high, workers immediately search. If low, workers do nothing. Note that the expected utility under such a case is higher that the expected utility of such workers without additional information as:

$$p^h E\left(u_{t=2}^h \middle| Se, b, m^h\right) + (1 - p^h) E\left(u_{t=2}^l \middle| Se, b, m^l\right) > E\left[\left(u_{t=2} \middle| Se,\ b, m^h, m^l\right)\right] \quad (52)$$

3.4.1.1 Matching Discrimination Vs. Full Matching

Full matching strategy (either with or without search) provides higher expected utility for workers relative to Partial or discrimination matching (for any $\lambda \leq \bar{\lambda}^h$).In both cases, this is the result of the high matching probability (=1) that increases workers wage dramatically and the higher initial wage (in the case of no search). Full analysis is available in Appendix 8.

As a result, workers will never favor switching from openness to secrecy when it involves changing from full matching to matching discrimination. Hence, the secrecy norm may be rejected when firm try to imply it instead of Openness with full matching strategy (note that in this case workers can easily break the norm simply by actively search). It is clear to us that norm formation is much more complicated than simple decision making and that it might be the case that firm could force workers to adopt secrecy. However, using strict expected utility consideration, we suggest that secrecy cannot last when the second best available policy is Full matching as worker have positive incentive to break the norm, and firm's cannot credibly threaten workers.

3.4.2 Firms' Optimal Information Policy

Based on the parameters of the model and, especially, on the probability of outside offers, firms may choose their optimal steady-state information policy. In previous sections (3.2.2 and 3.2.4), we saw that under a full-information regime, partial matching is always optimal when λ is small. Paying a high wage could be optimal for a higher λ and, from a certain point on ($\lambda > \bar{\lambda}$), M(b)=1 and all matching behaviors merge. In our study thus far, the complexity of the model did not allow us to draw a simple rule to distinguish among alternative matching policies. Similarly, in this section, we will derive a simple sufficient condition for the existence of wage-secrecy equilibrium, but a simple representation of points of transition among information policies does not exist. In the next chapter of this study, we will try to fill this gap using few intuitive simulations.

Proposition 5:

- *A segment in λ where discriminatory matching under secrecy is more profitable than partial matching under full information always exists if the costs of searching are low enough $\boldsymbol{c} < \bar{\boldsymbol{c}}$.*

Proof:

Our proof will follow several steps. First, we articulate the firm's expected profit function. Second, we show the condition under which secrecy is optimal at a specific point on the path of λ. Third, we describe the segment of λ for which we may extend the optimality of secrecy.

The firm's expected profit per worker under secrecy in a high-productivity job is:

$$E\left[\left(\pi_{t=2}^{h,s} \middle| NS, b\right)\right] = E\left(1-\theta_{\mathrm{i,t}}\right)\begin{bmatrix}(1-\lambda)\left(1-s_{i,t}^{h}\right)(A-b) \\ +\left(\lambda+(1-\lambda)s_{i,t}^{h}\right)m^{h}\left(\frac{A-1}{2}+T\right)\end{bmatrix} \tag{53}$$

The corresponding expected per-worker profit in a low productivity job is:

$$E\left[\left(\pi_{t=2}^{l,s} \middle| NS, b\right)\right] = E\left(1-\theta_{\mathrm{i,t}}\right)\begin{bmatrix}(1-\lambda)\left(1-s_{i,t}^{l}\right)(1-b) \\ +\left(\lambda+(1-\lambda)s_{i,t}^{l}\right)m^{l}\left(\frac{T}{2}\right)\end{bmatrix} \tag{54}$$

Finally, the combined profit per worker (given$s_{i,t}^{l} = 0$, as low-productivity workers never search in equilibrium) is:

$$E[(\pi_{t=2}^{s}|NS,b)] = \frac{1}{2}E\left(1-\theta_{\mathrm{i,t}}\right)\begin{bmatrix}(1-\lambda)(A+1-2b)+\lambda a^{h}M^{h}\left(\frac{A-1}{2}+T\right) \\ +\lambda a^{l}M^{l}\frac{T}{2}-s_{i,t}^{h}(1-\lambda)\left[A-b-a^{h}M^{h}\left(\frac{A-1}{2}+T\right)\right]\end{bmatrix} \tag{55}$$

The profit-per-worker function under full information equals:

$$E\left[\left(\pi_{t=2}^{fi} \middle| NS, b\right)\right] = \frac{1}{2}E\left(1-\theta_{\mathrm{i,t}}\right)\begin{bmatrix}(1-\lambda)(A+1-2b)+ \\ \lambda M^{h}\left(\frac{A-1}{2}+T\right)+\lambda M^{l}\frac{T}{2}\end{bmatrix} \tag{56}$$

We use $\Delta_{s,fi} \equiv E[(T\pi_{t=2}^{s}|NS,b)] - E\left[\left(T\pi_{t=2}^{fi}\middle|NS,b\right)\right]$ to denote the difference in per-worker profit between a secrecy policy and a full-information policy. We may write:

$$\Delta_{s,fi} = \frac{1}{2}\left(1-\frac{D}{2}\right)\begin{bmatrix}\lambda M^{h}(a^{h}-1)\left(\frac{A-1}{2}+T\right)-\lambda M^{l}(1-a^{l})\frac{T}{2} \\ -s_{i,t}^{h}(1-\lambda)\left[\frac{A+1}{2}-T-b\right]\end{bmatrix} \tag{57}$$

Equation 57 clearly presents the pros and cons of secrecy. Secrecy allows a firm to match outside offers received by a larger number of high-productivity workers. Therefore, the first term is positive as $a^h > 1$. However, secrecy decreases the matching of low-productive workers and encourages searching behavior that decreases the firm's profits.

When λ is small and M^h is minimal, the potential gains from secrecy are also small and cannot offset the losses engendered by the additional searching that takes place. Similarly, when λ verges on $\bar{\lambda}^h$ (note that at $\bar{\lambda}^h > \bar{\lambda}^l$) , the secrecy behavior converges with the full-information behaviors as both discriminatory-matching coefficients (a^h and a^l) draw closer to 1. Again, searching makes secrecy unprofitable (note that at $\lambda = \bar{\lambda}^h$ no searching takes place and the profits of secrecy and of full information are equal).

Hence, the potential environment in which secrecy may be optimal is inside the interval $\bar{\lambda}^h > \lambda > 0$. Due to the richness and complexity of the model, we cannot draw a simple condition that elicits the optimality of secrecy. We can, however, produce a sufficient condition for a secrecy equilibrium. We start our analysis at the pivotal point where $m^h = 1$. This is the point where all high-productivity workers are matched and no low-productivity workers are matched ($m^l = 0$). At this point, $M^h = p^h = \frac{1-\lambda}{2-\lambda}$ and we find that $\frac{1-\lambda}{2-\lambda} = \frac{c}{(1-\lambda)\left(\frac{A+1}{2} - T - b\right)}$, which we use to derive the value of λ as a function of all other parameters of the model:

$$\lambda(m^h = 1) \equiv \lambda_{m^h=1} = 1 - \frac{c + \sqrt{c^2 + 4c\left(\frac{A+1}{2} - T - b\right)}}{2\left(\frac{A+1}{2} - T - b\right)} \tag{58}$$

In addition, for $m^h = 1$ we find that $Q^h = 0$, allowing us to write the search volume as : $s^h_{i,t}(m^h = 1) = \frac{\lambda}{D}$. Hence, we may rewrite Equation 54 into:

$$E[(\pi^s_{t=2}|NS, b)] = \frac{1}{2}(1 - \frac{D}{2})\begin{bmatrix} (1-\lambda)(A + 1 - 2b) + \lambda\left(\frac{A-1}{2} + T\right) \\ -\frac{\lambda}{D}(1-\lambda)\left[\frac{A+1}{2} - T - b\right] \end{bmatrix} \tag{59}$$

and the difference in expected profit between secrecy and full information becomes:

$$\Delta_{s,fi}(m^h = 1) = \frac{1}{2}(1 - \frac{D}{2})\begin{bmatrix} \lambda(1 - M^h)\left(\frac{A-1}{2} + T\right) - \lambda M^l \frac{T}{2} \\ -\frac{\lambda}{D}(1-\lambda)\left[\frac{A+1}{2} - T - b\right] \end{bmatrix} \tag{60}$$

We may use $(1-\lambda)\left(\frac{A+1}{2}-T-b\right)=\frac{c}{M^h}$ and $M^h=\frac{1-\lambda}{2-\lambda}$ to get:

$$\Delta_{s,fi}(m^h=1)=\frac{\lambda}{2}(1-\frac{D}{2})\left[\frac{\frac{A-1}{2}+T}{2-\lambda}-\frac{c}{1-\lambda}\left(\frac{T}{2-T-2b}+\frac{2-\lambda}{D}\right)\right] \quad (61)$$

Clearly, the $\Delta_{s,fi}(m^h=1)$ is positive i.f.f $\frac{\frac{A-1}{2}+T}{2-\lambda}>c\left(\frac{T}{2-T-2b}+\frac{2-\lambda}{D}\right)$, which result in the following condition for the value of c:

$$c<\frac{\frac{1-\lambda}{2-\lambda}\left(\frac{A-1}{2}+T\right)}{\left(\frac{T}{2-T-2b}+\frac{2-\lambda}{D}\right)}\equiv\bar{c} \quad (62)$$

This condition reflects several additional important features of the model:

First, $\bar{c}$ and D are negatively correlated. This means that more noise in the quitting information widens the segment under which secrecy may be optimal. Obviously, when D is small, secrecy will never be optimal because the quitting signal is not vague enough. Since $\bar{c}$ is always positive, we may always find $c\in\{0,\bar{c}\}$ such that secrecy will be more profitable than a full-information strategy. This means that for any set of parameters there exists some segment of c $\{0,\bar{c}\}$ for which secrecy is preferable to partial matching in the inner segment around $\lambda_{m^h=1}$.

In economic terms, the foregoing condition reflects the fact that secrecy can be optimal only when workers have enough bargaining power and when searching is a reasonable option. When c is high, firms need to invest relatively less effort in preventing workers from searching; when this is the case, there is rarely much to gain by imposing secrecy. However, when c is relatively low and searching is more threatening to firms, secrecy may play a role in equilibrium.

Clearly, the condition in Equation 62 includes $\lambda_{m^h=1}$, itself a function of c. However, $\lambda_{m^h=1}$ is upper-bounded and a more limiting sufficient condition for the value of c can be presented. We start with the upper bound of $\lambda_{m^h=1}$: since $\frac{A+1}{2}-T-b>c$ by construction, we find that $\lambda_{m^h=1}<1-\frac{1+\sqrt{5}}{2}\frac{c}{\left(\frac{A+1}{2}-T-b\right)}$. Placing $\lambda^*=1-\frac{1+\sqrt{5}}{2}\frac{c}{\left(\frac{A+1}{2}-T-b\right)}$ in Condition 62, we finally get[36]:

[36] For full details, see Appendix 9.

$$\bar{c}^* = \frac{\frac{A+1}{2}-T-b}{1+\sqrt{5}}\left(-2-\frac{DT}{2-T-2b}+\sqrt{\left(\frac{DT}{2-T-2b}\right)^2+\frac{2D(1+\sqrt{5})\left(\frac{A-1}{2}+T\right)}{\left(\frac{A+1}{2}-T-b\right)}}\right) \tag{63}$$

Note that due to the complexity and the relatively unconstrained parameterization structure of our model, the foregoing condition is more limiting than the actual limitation. This happens mainly because the profit function under secrecy reaches its peak at the point where $\lambda > \lambda_{m^h=1}$ (the pivotal point that we used for our calculations). Therefore, our result proves the existence of the secrecy equilibrium and provides a sufficient but not a necessary condition for such an equilibrium. Below in this study, we will try to fill this gap by using a straightforward simulation.

To conclude the foregoing result, we see that secrecy is optimal for the firm in a wider segment of λ than the segment in which it is also favored by workers. Hence, if secrecy is only a policy (i.e., subject to the firm's decision and with no need for workers' consent), we would expect firms to implemented it more frequently. If, however, we treat secrecy as a norm (i.e., requiring workers' long-term consent), we see that it may still be optimal but under more severe conditions.

3.5 Partial Equilibrium Conclusions

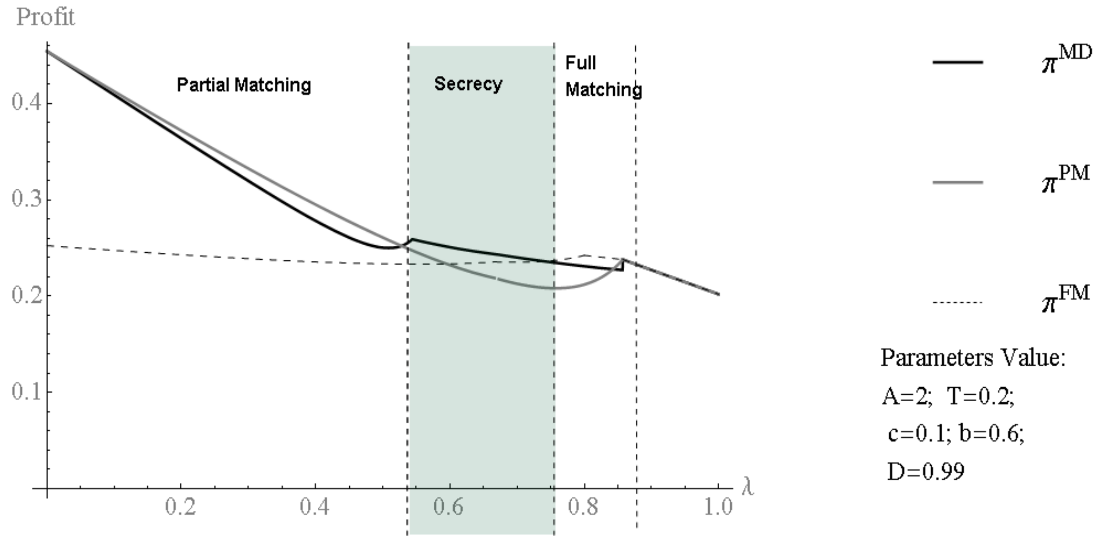
Denote λ_1 as the value that satisfies $\mathrm{E}\left[\left(\pi_{t=2}^{fi}\middle|\mathrm{NS},\mathrm{b}\right)\right] = \mathrm{E}\left[\left(\pi_{t=2}^{fi}\middle|\mathrm{NS},\bar{w}^h,\bar{w}^l\right)\right]$, then the partial-equilibrium behavior along the path of the increasing λ is summarized by the following proposition:

Proposition 6:

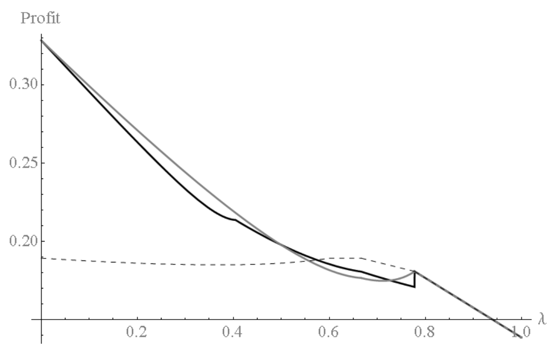
- *Under full information: partial matching equilibrium is supported for weak employer competition* $(0 \le \lambda \le \lambda_1)$*; full matching equilibrium is supported for strong employer competition values*$(\lambda_1 \le \lambda \le 1)$.
- *Where a secrecy equilibrium exists, it is supported for an intermediate level of employer competition (an internal segment of* λ*).*

The proof is immediate, based on the proofs in Appendix 2 and Proposition 4 and 5. Note that firms do not necessarily switch to a full matching policy before the point where

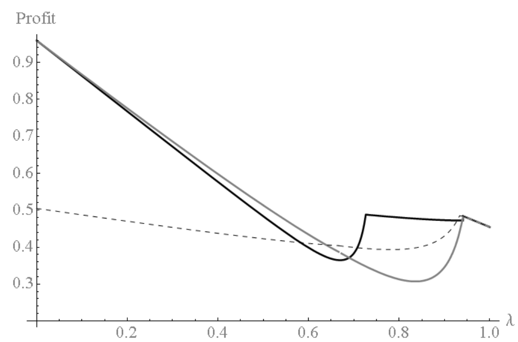
Comparison: Profits per Worker



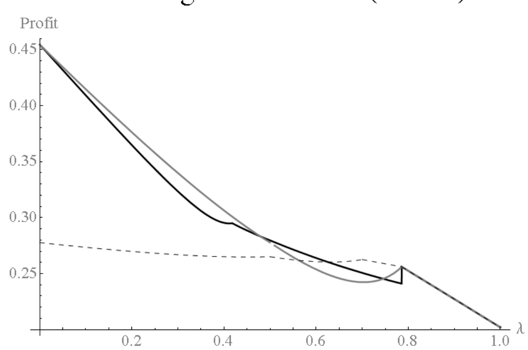
EX' 2: Lower productivity gap (A=1.5)



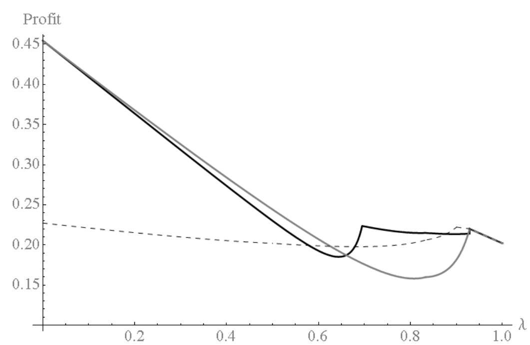
EX' 3: higher productivity gap (A=4)



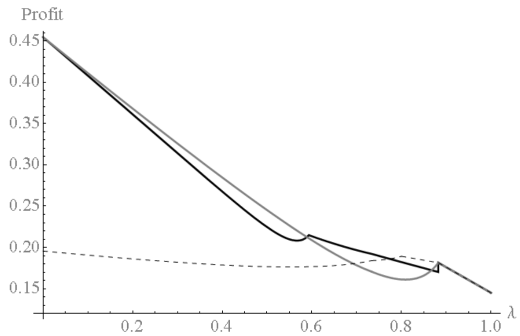
EX' 4: higher search cost (c=0.15)



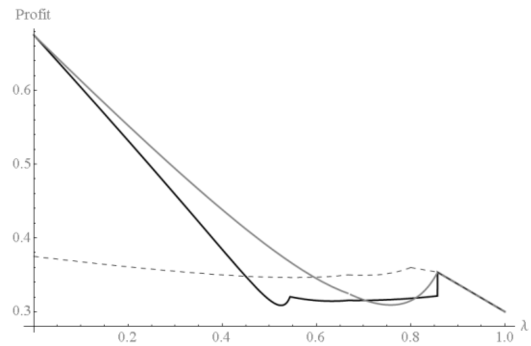
EX' 5: Lower search cost (c=0.5)



EX' 6: Lower adjustment cost (T=0.05)



EX' 7: Lower Job destruction variance (D=0.5)



$\lambda_1 = \bar{\lambda}^h$, but from this point on all firms fully match. Therefore, the market always has a segment of full matching. (Sometimes, however, this segment starts only at the point where all strategies merge.)

For further discussion in this study, we use the following notation to describe the segment of λ in which secrecy is optimal over other matching behaviors$[\underline{\lambda}_s, \bar{\lambda}_s]$, where $\underline{\lambda}_s > 0$ and $\bar{\lambda}_s < \bar{\lambda}^h$. Again, this segment exists only under the condition that we expressed above.

The following computed examples provide a general sense of the model's behavior under partial equilibrium. They show clearly that secrecy produces higher expected profits in an internal segment of λ. Workers favor the norm only when profits are greater under partial matching than under full matching. The first graph shows that this happens only at the beginning of the secrecy segment.

Note that a larger productivity difference (a higher A) increases the firm's gain from secrecy but also makes workers unsupportive of secrecy. The reason is trivial: high-productivity workers rationally expect their firm to raise their wages under openness and, therefore, oppose secrecy. A lower search cost promotes a similar shift of the curves. Finally, a lower adjustment cost (T) increases the benefits of secrecy and lower variance in the noise parameter (D) makes secrecy undesirable (due to the better signal that workers receive, resulting in a greater amount of searching).

4. A General Equilibrium Extension

The volume of outside offers is determined as part of the general equilibrium in the labor market. We use h to denote the initial cost for an outside firm to approach an employed worker. This cost is common to all firms in the market and is incurred irrespective of the outcome of the poaching process. We need to differ between two main scenarios based on the ratio of vacancies to workers in the market. When demand for workers outstrips the available labor supply, it implies that $\lambda = 1$. Consequently, all employed workers are expected to receive an outside offer and poaching firms may be able to get in touch with a worker at a lower-than-1 probability. This scenario invokes most of the special features of our model, as the best matching policy in this case is always to match all outside offers and to pay the minimum wage. The second and more realistic scenario is the one in which the poaching firm has fewer vacancies than the total number of available employed workers.[37] In this case, $0 < \lambda < 1$.

The free-entry condition reflects poaching firms' profit maximization in respect to active labor search. Note that it is possible (and reasonable) for a firm to appear twice in the market, once as an employer and once as a poacher. Each firm, however, is a price taker and disregards any general-equilibrium effect of its actions. The market-clearance condition is given simply by equalizing the marginal expected profit per active search to the cost of initiating an active search:

$$h = V(\lambda) \tag{64}$$

where:

$$V(\lambda) \equiv \frac{1}{2} E\left[(1-m^h)\left(\frac{A+1}{2} - T - w_2^h\right) + (1-m^l)\left(\frac{A+1}{2} - T - w_2^l\right) + m^l\left(\frac{A-1-T}{2}\right)\right] \tag{65}$$

The value of actively searching for a worker is a function of the employer-competitiveness of the market, which triggers the matching behaviors of firms. The actual poaching value is the expected gain from an unmatched approach to a high-productivity worker plus the expected gain from an unmatched approach to a low productivity worker plus the expected gain from poaching a low-productivity worker (when the current match is of high productivity).

[37] Remember that unemployed workers (and some employed workers) search actively. Therefore, the firm does not face a vacancy maximization problem (due to the constant return-to-scale technology).

4.1 Poaching Value Function and Incumbents' Matching Strategy

The value of poaching may be also described as a function of current employers' (incumbents') matching behaviors. Importantly, from the standpoint of poaching firms, current wages are orthogonal to the poaching value upon matching. As a result, the value in a case of full matching under high wages $(\bar{w}^l, \bar{w}^h)$ equals the poaching value under an equilibrium in which searching is allowed. Therefore, the rest of this study will not differentiate between these two types of equilibria; we will term them in the aggregate "full matching." The following equations provide the V function for partial matching (V_{pm}), full matching (V_{fm}) and discriminatory matching (V_{md}), respectively. (The expected value of approaching high- and low-productivity workers separately is also presented.)

$$\left\{\begin{matrix} V_{pm}^l(\lambda \leq \bar{\lambda}^l) = \frac{A+1}{2} - T - b - \frac{c}{1-\lambda}; V_{pm}^l(\lambda > \bar{\lambda}^l) = \frac{A-1-T}{2} \\ V_{pm}^h(\lambda \leq \bar{\lambda}^h) = \frac{A+1}{2} - T - b - \frac{c}{1-\lambda}; V_{pm}^h(\lambda > \bar{\lambda}^h) = 0 \\ V_{pm}(\lambda \leq \bar{\lambda}^l) = \frac{A+1}{2} - T - b - \frac{c}{1-\lambda}; V_{pm}(\bar{\lambda}^l < \lambda \leq \bar{\lambda}^h) = \frac{A}{2} - \frac{3T}{4} - \frac{b}{2} - \frac{c}{2(1-\lambda)} \end{matrix}\right\} \quad (66)$$

$$V_{fm} = \frac{A-1-T}{4}; V_{fm}^l = \frac{A-1-T}{2}; V_{fm}^h = 0 \quad (67)$$

$$\left\{\begin{matrix} V_{md}(\lambda \leq \lambda_{m^h=1}) = \frac{A+1}{2} - T - b - \frac{a^h c}{2(1-\lambda)} \\ V_{md}(\lambda_{m^h=1} < \lambda \leq \bar{\lambda}^l) = \frac{1}{2}\left(\frac{A+1}{2} - T - b - \frac{a^l c}{1-\lambda}\right); \\ V_{md}(\bar{\lambda}^l < \lambda \leq \bar{\lambda}^h) = \frac{1}{2}\left(\frac{A+1}{2} - T - b - 2\left(1 - \frac{1}{M^h(2-\lambda)+\lambda}\right)\left(1 - \frac{T}{2} - b\right)\right) \end{matrix}\right\} \quad (68)$$

These poaching value functions have three important features:

- For any firm's matching behavior, we get $\frac{\partial v}{\partial \lambda} \leq 0$. In addition, for any non-full matching behavior, $\frac{\partial v}{\partial \lambda} < 0$ as long as $\lambda \leq \bar{\lambda}^h$. This feature is important because it ensures the existence and uniqueness of the steady-state equilibrium in the poaching market.
- From $\lambda > \bar{\lambda}^h$, as all matching behaviors merge, the value function is constant and equals: $\frac{A-1-T}{4}$.
- At the point of transition from partial matching under full information to discriminatory matching under secrecy, the value function drops and is

discontinuous at the point of the regime change.[38] Switching from and to full matching also involves discontinuity in the value function (unless it occurs exactly at $\bar{\lambda}^h$).

4.2 Defining the General Equilibrium

The general equilibrium is the set composed of a "poaching decision rule," wages and matching policies, and search decisions under a specific supported information structure. Where outside firms optimally choose the "poaching decision rule" (which sets the number and ratio of poaching vacancies in the market) in respect to the incumbents; matching policy, incumbent firms choose wages and matching policies to maximize their profit in respect of the intensity of their workers' searching behavior and the poachers' decision rule. Workers, in turn, maximize their utility by setting their search intensity in respect to their employers' policy.

4.3 The General Equilibrium Outline

Using the description of the poaching value function and the characteristic of the partial-equilibrium framework given in Proposition 6, we may now articulate the general equilibrium characteristics.

Proposition 7

When secrecy equilibrium exists under partial equilibrium, for any h there exists a unique equilibrium in steady state:

- *If* $h > h_0$, *there is no competition among employers* ($\lambda = 0$) *. Incumbent employers do not match outside offers and pay the minimum wage; workers do not search.*
- *If* $h_0 \geq h > h_1$, *employer competition is low, incumbent employers partly match and pay the minimum wage, workers do not search, and wage information is open.*

[38] Note that $p^h < 0.5$ and hence $a^h > 2$ which means that $V_{md}(\lambda \leq \lambda_{m^h=1}) < V_{pm}(\lambda \leq \bar{\lambda}^l)$.

- *If* $h_1 \geq h > h_2$ *, employer competition is intermediate, marginal incumbent employers match-discriminate and pay the minimum wage, some high productivity workers search, and wage information at the marginal firm is secret.*
- *If* $h_3 \geq h > \underline{h}$ *, employer competition is high, marginal incumbent employers fully match and pay either* $w = \overline{w}$ *or* $w = b$*, workers search or do not search depending on their wages, and wage information at the marginal firm is open.*
- *Under some additional limiting conditions, there is another partial-matching segment for* $h_2 \geq h > h_3$.
- *If* $\underline{h} \geq h$ *, employer competition is intensive*$(\lambda = 1)$*, firms fully match and pay the minimum wage, workers do not search, and information is open.*

Proposition 8

When a secrecy equilibrium does not exist under partial equilibrium, for any h there exists a unique singular equilibrium in steady state:

- *If* $h > h_0$*, there is no employer competition (* $\lambda = 0$*) incumbent employers do not match, incumbent employers pay the minimum wage, workers do not search, and information is open.*
- *If* $h_0 \geq h > h_3$*, employer competition is low, incumbent employers partly match and pay the minimum wage, workers do not search, and wage information is open.*
- *If* $h_3 \geq h > \underline{h}$*, employer competition is high, marginal incumbent employers fully match and pay either* $w = \overline{w}$ *or* $w = b$*, workers search or do not search depending on their wages, and wage information is open.*
- *If* $\underline{h} \geq h$ *, employers' competition is intensive* $(\lambda = 1)$*, firms fully match and pay the minimum wage, workers do not search, and information is open.*

All of which, where:

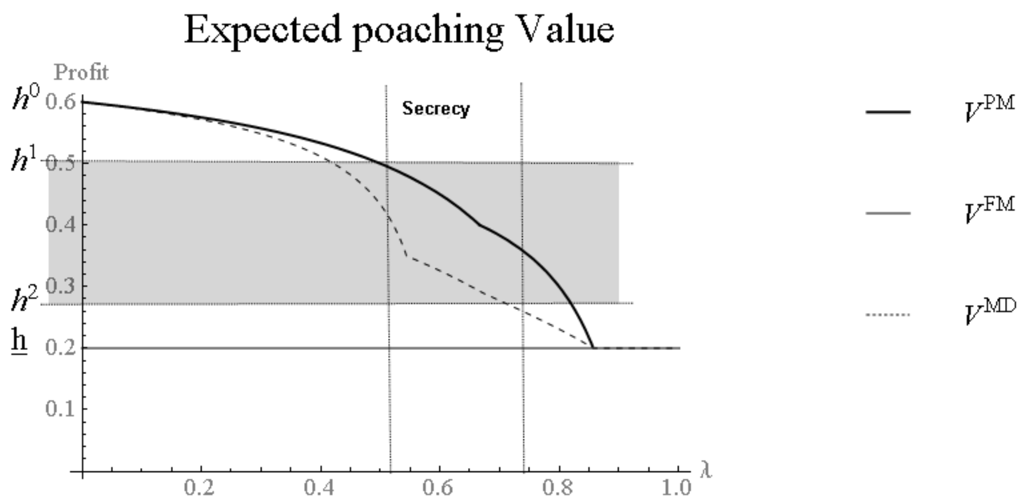
$h_0 \equiv V_{PM}(\lambda = 0); h_1 \equiv V_{PM}(\underline{\lambda}_s); h_2 \equiv V_{MD}(\bar{\lambda}_s);\ h_3 \equiv\ Min[V_{PM}(\lambda_1), V_{MD}(\bar{\lambda}_s)];$
$\underline{h} \equiv V_{FM}.$

Analysis and proof:

At a very high poaching cost $h > h_0$ outside firms never operate in the market. At any lower level of h until $\underline{h}$, a unique equilibrium exists since $\frac{\partial v}{\partial \lambda} \leq 0$ inside each segment and the shift between segments is characterized by a discontinuous decrease in the value function. Note that when the value of h falls in the middle of such a discontinuity, the shift from one strategy to the other is done gradually. Our definition includes this mixed-strategy case under the definition of the spreading strategy (i.e., when $h_1 \geq h > V_{MD}(\underline{\lambda}_s)$) we consider it a secrecy equilibrium and when $h_3 \geq h > \underline{h}$ we consider it a full-matching equilibrium). Note that at the point of transition, the expected profits from both switching strategies are equal. Hence, firms are indifferent to changing or not changing their matching strategy. Where such an internal equilibrium prevails, a proportion of firms in the market switches until the steady-state point of $h = V(\lambda)$ is reached. This explains why the above proposition uses the concept of "marginal firm." This result implies that the market should show evidence of firms that operate under similar market conditions but use different matching strategies and information policies. When $\underline{h} \geq h$, outside firms profit from poaching even under full matching; in this case, employer competition becomes intensive, λ reaches 1, and we should expect equilibrium only at the point where the ratio between vacancies and employed workers is greater than 1.

Finally, we need to address the possibility of a second segment of partial matching after the secrecy segment. The formal condition for such a case is that: $h_3 < h_2$. Note that at the point of transition from secrecy to openness, the value of poaching increases. This, however, cannot be a general equilibrium, since otherwise the market would stay at the previous segment, in which $h = V(\lambda)$. Since the case without search equilibrium is equal in all respects other than the search segment, the market switches at one point from partial matching to full matching.

The graph below illustrates the various poaching value functions.



5. Discussion and Further Research

We have presented a general-equilibrium job-search model in which workers perform on-the-job searching and firms and workers may adopt a wage-secrecy norm. In equilibrium, firms choose the information set (with workers' consent), the wage contract, and their behavior in matching outside offers to their workers, while workers choose the intensity of their searching behavior. Our model proposes an endogenous mechanism that deals with the typical moral-hazard problem that arises in matching and provides a general framework that combines wage contract and matching. We also show that under some provided conditions, firms and workers would be better off by adopting a wage-secrecy norm. Secrecy mitigates the negative effect of the moral-hazard problem of matching: it allows firms to match only a selected sub-population of workers and limits workers' search intensity by diminishing their ability to accurately estimate the return to search.

Our results, much like those of Burdett and Coles (2003), also support two different driving forces behind workers' wages: workers may increase their wages either by changing jobs or by means of wage–tenure effects. In Burdett and Coles' model, there is a nondegenerate distribution of initial wage offers by firms in the market with a positive mass offering the lowest initial wage in a search model that features constantly searching workers. In our results, the existence of wage–tenure contracts is driven by the degree of competition in the demand market. When competition is brisk enough, workers experience two positive effects: matching and tenure pay.

The model also evokes interesting questions about efficiency considerations that we wish to address here. If we consider the problem of a central planner, the optimal solution for the market (given $\frac{A-1}{2} > c$, which ensures that the difference in productivities is large enough) is to allow all low-productivity workers to receive outside offers. This is because efficiency demands that no "rent-seeking" transitions take place (since they involve some cost). Such a transition occurs when a low-productivity worker moves to another low-productivity job. The more welcomed transition is of workers who experience a positive shock when they switch to the poaching firm, i.e., when they move from low productivity to high productivity. This optimal solution is achieved when firms apply full matching strategies and when employer competitiveness is intensive ($\lambda = 1$). Any shift away from this equilibrium will involve some efficiency loss. Hence, the secrecy equilibrium is always dominated by the full-matching strategy. When we compare secrecy with partial matching, however, the picture is less obvious. The matching of outside offers to a larger number of high-productivity workers encourages efficiency by preventing wasteful workplace-switching among high-productivity workers. However, it also increases wasteful transitions among low-productivity workers and, by decreasing the poaching value, it mitigates steady-state employer competition in the market.

Another potential efficiency issue involves possible steady-state equilibria that are opposed by workers or forbidden by law. Under this umbrella we find, for example, "anti-competition agreements": if workers credibly commit not to search, firms may fully match, to the benefit of both sides. Another example is the outgrowth of a previous analysis. In Section 3.3.3.2, we assumed that firms maximize profit only on the basis of the current generation's behavior. We can relax this assumption and allow firms to actively set matching values in order to influence the information set of future generations.

As noted above, the driving force behind OTJ searching in our model is the informative signal that some workers receive. The signal depends mainly on the extent of quitting; the amount of searching done is a direct function of the difference between Q^h and Q^l. Under secrecy, we find that Q^l is always greater than Q^h. However, $Q^h > Q^l$ may be obtained under full information. This happens when low-productivity workers are matched at more than twice the extent of high-productivity workers ($m^l \geq 2m^h$). As a result, even though only half of the matches of low-productivity workers end with the retention of the worker, a higher proportion of high-productivity workers than of low-productivity workers quit. As we saw above, the condition for the existence of such an equilibrium is $A \geq 3 - 2b$. Note that this is a relatively high A value, which reflects a larger difference in the productivity of low-productivity and high-productivity jobs and seems suitable in limited cases only.

The next statement to prove is that $Q^h = Q^l$ can also be obtained only under full information.

When $A \geq 3 - 2b$ and secrecy is introduced, it may be optimal for the firm to manipulate the weights of M^h, M^l. By increasing the matching probability of high-productivity workers (m^h), the firm lowers the value of $Q^h - Q^l$ and therefore mitigates searching behavior. Firms may increase a^h until the point at which $Q^h = Q^l$. At this point, workers cannot gain any information from the quitting observation regardless of the variance of job destruction. As a result, all workers share the same $\hat{p}^h = 0.5$. To identify the matching policy, we need to solve the $Q^h - Q^l$ equality given $\hat{p}^h = 0.5$:

$$m^l = a^l M^l = (2 - a^h)M^l = 2M^h = a^h M^h$$

After arranging the expressions somewhat, we get: $m^h = \left(1 + \frac{M^l - 2M^h}{2M^h + M^l}\right) M^h$; $m^l = \left(1 - \frac{M^l - 2M^h}{2M^h + M^l}\right) M^l$

Under such an equilibrium, the firm's expected profit is:

$$E\left[(\pi_{t=2}^{s,ns} \middle| NS, b)\right] = E\left(1 - \theta_{i,t}\right)\frac{1}{2}\left[(1-\lambda)(A+1-2b) + \lambda m^h\left(\frac{A-1}{2} + T\right) + \lambda m^l \frac{T}{2}\right]$$

while the corresponding profit under full information is:

$$E\left[\left(\pi_{t=2}^{fi} \middle| NS, b\right)\right] = E\left(1 - \theta_{i,t}\right)\frac{1}{2}\left[(1-\lambda)(A+1-2b) + \lambda M^h\left(\frac{A-1}{2} + T\right) + \lambda M^l \frac{T}{2}\right]$$

and the difference is:

$$E\left[(\pi_{t=2}^{s,ns} \middle| NS, b)\right] - E\left[\left(\pi_{t=2}^{fi} \middle| NS, b\right)\right] = \left(1 - \frac{D}{2}\right)\frac{\lambda}{2}\left(\frac{M^l - 2M^h}{2M^h + M^l}\right)\left[M^h\left(\frac{A-1}{2} + T\right) - M^l \frac{T}{2}\right]$$

The condition for the supremacy of secrecy is $A > \frac{1 - T(2-b) - b}{1 - T - b}$, which is always true and, notably, does not depend on the level of job destruction. Actually, even when there is no “noise” at all, it is optimal for the firm to force secrecy. Absent job-destruction noise, the source of vagueness is simply the fact that both flows of quitting are of the same magnitude and, therefore, provide the worker with no information.

The equilibrium described above is valid under the standard assumption that the firm can impose secrecy without the workers’ consent. However, according to our definition of the secrecy equilibrium, workers must support the secrecy norm ex ante. Such support is achieved if the unconditional expected wage of a worker is higher under such an equilibrium than under a full-information equilibrium with the same parameters and wage level. As we can see, the expected wage gap between the secrecy and full-information cases is negative, i.e., the expected wage is always lower under secrecy than under full openness:

$$E\left[\left(u(b)_{t=2}^{s,ns}\middle|NS,b\right)\right]-E\left[\left(u(b)_{t=2}^{fi}\middle|NS,b\right)\right]=\left(1-\frac{D}{2}\right)\lambda\left(\frac{M^l-2M^h}{2M^h+M^l}\right)\left[M^h\left(\frac{A+1}{2}-T\right)-M^l\left(1-\frac{T}{2}\right)\right]=\left(1-\frac{D}{2}\right)\lambda\left(\frac{M^l-2M^h}{2M^h+M^l}\right)\left[\frac{c}{1-\lambda}\frac{\left(\frac{A+1}{2}-T\right)\left(1-\frac{T}{2}-b\right)-\left(1-\frac{T}{2}\right)\left(\frac{A+1}{2}-T-b\right)}{\left(\frac{A+1}{2}-T-b\right)\left(1-\frac{T}{2}-b\right)}\right]=$$

$$\left(1-\frac{D}{2}\right)\lambda\left(\frac{M^l-2M^h}{2M^h+M^l}\right)\left[\frac{c}{1-\lambda}\frac{-b\left(\frac{A-1-T}{2}\right)}{\left(\frac{A+1}{2}-T-b\right)\left(1-\frac{T}{2}-b\right)}\right]<0$$

The intuition behind this result is the zero-sum game that takes place between a firm and its workers. Obviously, since this policy fails to produce a surplus by mitigating frictions, the total size of the “pie” does not change. When this is true, any positive gain for employers causes a loss to the workers. This result rules out the possibility of wage-secrecy equilibrium under such a policy. Still, the obvious advantage of this policy for the firm suggests that whenever a firm can impose secrecy on its employees, we should expect to see this policy widely implemented under similar circumstances.

5.1 Directions of Future Research

Current models introduce two different policy tools against workers’ mobility: wages and matching. While wages are set before search, however, matching is preformed after search. Hence, even though both policies have the same effect, the timing is different. In our current setting, assuming rational expectations and full symmetry, the different timings are rather unimportant. In a more realistic setting, however, a firm may choose to use both policies differently. The probability of matching can react quickly to changes in workers' search intensity: if the firm enjoys any level of credibility, it may fight a high search intensity (which may occur in waves) by introducing a sharp decrease in wage-matching. By the same token, a general upturn in competitiveness in a labor market may result in an overall wage increase, which would make the firm's employees less vulnerable to outside poachers. The study of the dynamic management of wages and matching behaviors seems to be a very fruitful direction of future studies, one that may also elicit more practical and useful results.

A traditional labor-market model with decreasing return to scale may suggest that as workers leave the workplace (for whatever reason) the marginal value of any worker who stays increases. (See, for example, Stole and Zwiebel, 1996.) One may argue that when a worker observes an upturn in the quitting ratio, she may be inspired to search more (and not less as our model suggests, since higher quitting means lower matching and, in turn, a lower return to search). If this is the case, a greater incidence of quitting increases the value and, hence, the bargaining power of any worker who remains. Since our model suggests a constant return to scale, this problem is not valid. In this sense, we ignore the indirect effect of quitting on the firm's production function. Thus, a more complicated structure that includes such a mechanism may be of interest in future research.

To some extent, this study minimizes the importance of matching probability as an option like device. Actually, part of the value of a specific job is the matching policy that comes with it. In this sense, the ability to search in the future adds value to the current wage. This is why in Postel-Vinay and Robin (2002), workers accept lower wages when they move from non-matching firms to matching firms. In the current context, we limit the analysis to a case in which a minimum wage applies; therefore, wage cannot fall below a certain threshold of b, which plays a crucial role in the analysis. Under a more general framework, we might expect wages to fall when workers switch jobs and move to a firm that employs matching more aggressively. When this happens, matching and wages have a similar complementary effect: matching increases the worker's option value and, therefore, allows the firm to lower wages. Note that the existence of frictions in the system (c, T, and h) makes it socially non-optimal to allow extensive search and the exercise of this option. Such considerations also underlie the benefits of secrecy for workers: secrecy allows firms to match more high-productivity workers, thereby making search (on average) more profitable for employees, which increases the option value of searching. However, since b is lower-bounded by the minimum wage, , firms cannot extract the entire added surplus of secrecy from their workers; therefore, workers enjoy positive gains from secrecy. Clearly, workers may support secrecy only if they may obtain a share of the benefits that the firm gains from secrecy. When this condition is satisfied by means of some kind of bargaining mechanism, secrecy may be strictly optimal.

A Appendix:

A.1: Proof - the only two possible wage levels are the corner solutions

First, we need to maximize the expected profit using $w_{t=2}^{h}$ when m^h=M^h:

$$\max_{w_{t=2}^{h}} E\left[\left(\pi_{t=2}^{h}\middle|NS, m^h = M^h\right)\right] = E\left[(1-\theta_i)\left[(1-\lambda)\left(A - w_{t=2}^{h}\right) + \frac{\lambda c\left(\frac{A-1}{2}+T\right)}{(1-\lambda)\left(\frac{A+1}{2}-T-w_{t=2}^{h}\right)}\right]\right]$$

$$subject\ to:\quad \overline{w}^h \geq w_{t=2}^{h} \geq b$$

And we get the FOC:

$$\left(1-\frac{D}{2}\right)\left[-(1-\lambda) + \frac{\lambda c\left(\frac{A-1}{2}+T\right)}{(1-\lambda)\left(\frac{A+1}{2}-T-w_{t=2}^{h}\right)^2}\right] = 0$$

This yields:

$$w_{t=2}^{h} = \frac{A+1}{2} - T - \sqrt{\frac{\lambda c\left(\frac{A-1}{2}+T\right)}{(1-\lambda)^2}} \equiv \varphi^h$$

But from the second derivation we can see that this is a minimum[39]. Hence, when $\overline{w}^h > \varphi^h$ the expected profit is decreasing in the segment [b, φ^h] and increasing in the segment $[\varphi^h, \overline{w}^h]$ so the only two potential wages are b and $\overline{w}^h$. When $\overline{w}^h \leq \varphi^h$, it means that $\overline{w}^h$ may not be the optimal policy as it is inside the decrease profit segment. In this case firm will always prefer paying b. ■

More technically this implies that in order to consider the strategy of paying $\overline{w}^h$ we demand that: $\left(\frac{A+1}{2}-T\right) - \frac{c}{(1-\lambda)} > \frac{A+1}{2} - T - \sqrt{\frac{\lambda c\left(\frac{A-1}{2}+T\right)}{(1-\lambda)^2}}$ Or: $c < \lambda\left(\frac{A-1}{2}+T\right)$. When $\lambda^h = 1 - \frac{c}{\frac{A-1}{2}-T-b}$, we get: $c < \frac{\frac{A-1}{2}+T}{\frac{A+3}{2}-T-b}$ which is a sufficient condition for FM to be an optimal policy in a segment of $\lambda^h > \lambda > 0$.

[39] note that the other solution $w_{t=2}^{h} = \frac{A+1}{2} - T + \sqrt{\frac{\lambda c\left(\frac{A-1}{2}+T\right)}{(1-\lambda)^2}}$ is larger than $\overline{w}^h$.

A.2: Characteristics of an Optimal No-Search Policy for High-Productivity Jobs

Below are the proofs for statements i-iv:

I. When $\lambda = 0$, inequality 11 and 12 becomes: $(A-b) > \left(T + \frac{A-1}{2}\right) + c$. This can be transformed into: $A + 1 > 2(b + T + c)$. But by assumption: $1 > b + \frac{T}{2} + c$ and $A > 1 + T$ and therefore the inequality is true. ■

II. Proof: placing $\bar{\lambda}^h$ into equation (4) we get that $\overline{w}^h_{t=2}(\bar{\lambda}^h) = b$. This means that at wage b workers do not search even if the firm matches all outside offers. When this is the case, the minimum wage becomes a bounding constraint on $\overline{w}^h_{t=2}$, and from that point $\overline{w}^h_{t=2}$ stays at b for any $1 \geq \lambda \geq \bar{\lambda}^h$. In this segment firms always play $\{w^h_{t=2} = b, m^h = 1\}$. ■

III. Proof: see as part of Appendix 1.

IV. We start with the profit function of full matching when $\overline{w}^h_{t=2} \leq 1 - T$. This is a constant function in respect to λ. The profit function under partial matching is a quadratic function in λ which is continues in the relevant segment. As we saw above, for $\lambda = 1 - \frac{c}{\frac{A+1}{2} - T - b}$, we get that both policies yields the same expected profit. Because of the single peak attribute of quadratic functions, If full matching is superior under a lower λ, it means that for any λ in between, full matching is also superior. Otherwise, we get that partial matching is always optimal.

When $\overline{w}^h_{t=2} \leq 1 - T$, the profit function breaks into two parts, because for a high enough λ, $\overline{w}^h_{t=2}$ decreases and becomes lower than $1 - T$. However, the function $E[(1-\theta_i)\left[(1-\lambda)(A - \overline{w}^h) + \lambda\frac{1}{2}\left(T + (A - \overline{w}^h)\right)\right]$ is larger than the partial matching profit function at $\lambda = 1 - \frac{c}{\frac{A+1}{2} - T - b}$. This means that the cross point is always under a higher λ. And again, If full matching is superior under a lower λ than $\lambda = 1 - \frac{c}{\frac{A+1}{2} - T - b}$, it means that for any λ in between, full matching must be also superior. ■

A.2.1: Characteristics of optimal no search policy for low productivity jobs

Below are the proofs for statements i-iv:

I. Proof: for λ=0, $E\left[\left(\pi_{t=2}^{l}\middle|NS,b,M^{l}(b)\right)\right] > E\left[\left(\pi_{t=2}^{l}\middle|NS,w_{t=2}^{l}=\overline{w}^{l}\right)\right]$ since: $1-b > \frac{T}{2}+c$. All profit functions are continuous in the segment $\lambda \in [0,1]$ and therefore a segment of λ in which partial matching is optimal exists. ■

II. Identical to the equivalent proof in appendix 2 as $\overline{w}^{l}\left(\bar{\lambda}^{l}\right)=b$

III. Following the notation in appendix 4, note that when $\overline{w}^{l} \leq \varphi^{l}$, it means that $\overline{w}^{h}$ may not be the optimal policy as it lies within the decreasing-profit segment. In this case, the firm will always prefer to pay b.

IV. Similar to the equivalent proof in appendix 2.

A.3: when search is optimal

The expected profit from low productivity job on the second period with search and full matching:

$$E\left[\left(\pi_{t=2}^{l}\middle|S,m^{l}=1\right)\right]=E[(1-\theta_{i})\frac{T}{2}]$$

When the firm pays non-search high wage[40] where $\overline{w}^{l} \leq 1-T$ and matches all outside offers the profit function is given by:

$$E\left[\left(\pi_{t=2}^{l}\middle|NS,w_{t=2}^{l}=\overline{w}^{l} \leq 1-T\right)\right]=E[(1-\theta_{i})\left[(1-\lambda)(1-\overline{w}^{l})+\lambda\frac{T}{2}\right]$$

Assigning $\overline{w}^{l}$ into the above equation, we get:

$$E\left[\left(\pi_{t=2}^{l}\middle|NS,w_{t=2}^{l}=\overline{w}^{l}\right)\right]=E[(1-\theta_{i})\left[\frac{T}{2}+c\right]$$

And for any positive c it is better not to allow workers to search.

When $\overline{w}^{l} > 1-T$ the profit function becomes:

$$E\left[\left(\pi_{t=2}^{l}\middle|NS,w_{t=2}^{l}=\overline{w}^{l} > 1-T\right)\right]=E[(1-\theta_{i})\left[(1-\lambda)(1-\overline{w}^{l})+\lambda\frac{(1-\overline{w}^{l})}{2}\right]$$

Allowing search is optimal if (but not only) profit under search is higher than profit under partial matching:

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[40] Assuming $\left(1-\frac{T}{2}\right)-\frac{c}{1-\lambda} > b$. however, the above statement is true even when $\overline{w}^{l}$=b.

$$E\left[\left(\pi_{t=2}^{l}\middle|S, m^{l}=1\right)\right] > E\left[\left(\pi_{t=2}^{l}\middle|NS, b, m^{l}=M^{l}\right)\right]$$

This gives:

$$\frac{T}{2} > (1-\lambda)(1-b) + \lambda M^{l}\frac{T}{2} > (1-\lambda)T$$

Which might be considered only for $\lambda > 0.5$.

A.4:

To see that whenever a firm chooses M^l, the optimal wage level is the lowest possible and equals b, we need to maximize the expected profit using $w_{t=2}^{l}$:

$\max_{w_{t=2}^{l}} E\left[\left(\pi_{t=2}^{l}\middle|NS, m^{l}=M^{l}\right)\right] = E[(1-\theta_i)[(1-\lambda)\left(1-w_{t=2}^{l}\right) + \frac{\lambda c(\frac{T}{2})}{(1-\lambda)\left(1-\frac{T}{2}-w_{t=2}^{l}\right)}]$

$subject\ to$:

$\overline{w}^{l} \geq w_{t=2}^{l} \geq b$

And we get the FOC: $\left(1-\frac{D}{2}\right)\left[-(1-\lambda) + \frac{\lambda c\left(\frac{T}{2}\right)}{(1-\lambda)\left(1-\frac{T}{2}-w_{t=2}^{l}\right)^{2}}\right] = 0$

After some algebra: $w_{t=2}^{l} = 1-\frac{T}{2}-\sqrt{\frac{\lambda c\left(\frac{T}{2}\right)}{(1-\lambda)^{2}}} \equiv \varphi^{l}$

The second derivation, however, shows that this is a minimum point. Hence, under the condition $\overline{w}^{l} > \varphi^{l}$ the expected profit is decreasing in the segment [b, φ^{l}] and increasing in the segment [$\varphi^{l}, \overline{w}^{l}$] so the only two potential wages are b and $\overline{w}^{l}$. ■

Again, for even considering $\overline{w}^{l}$ it needs to fulfill the following condition:

$$\left(1-\frac{T}{2}\right) - \frac{c}{1-\lambda} > 1-\frac{T}{2}-\sqrt{\frac{\lambda c\left(\frac{T}{2}\right)}{(1-\lambda)^{2}}}$$

Or:

$$c < \frac{\lambda T}{2}$$

Comparing this with the condition of a high-productivity job ($c < \lambda\left(\frac{A-1}{2}+T\right)$), we can see that paying $\overline{w}$ is much more feasible under high productivity and may occur at a higher c than in the low-productivity case. This is true for all A and T. The reason is that low-productivity workers tend not to search when c is high, but when the return for search increases, worker may search even at a higher c. In this case, firms sometimes find it better to use the strategy of high wage and no search, which is not optimal under the same c in regard to low-productivity workers. This also means that there exists a class of cases in which a firm will use (b, M^l(b)) for low productivity workers and $(\overline{w}^h, 1)$ for high productivity workers.

A.5: proof for second part of proposition 2 about quitting.

Under partial matching: the expected quitting probability of high productive worker is: $q^{h,pm} = \frac{D}{2} + \left(1 - \frac{D}{2}\right)\lambda(1 - M^h(b))$, the equivalent quitting probability for low productive workers is: $q^{l,pm} = \frac{D}{2} + \left(1 - \frac{D}{2}\right)\lambda(1 - \frac{M^l(b)}{2})$. Comparing the two, we get that higher productivity workers quit more than lo productivity workers only if:

$$2\left(1 - \frac{T}{2} - b\right) > \left(\frac{A+1}{2} - T - b\right)$$

After some arrangement we get that the upper inequality is satisfy for any $A < \bar{A} = 3 - b$. For any such A, more high productivity worker quit. Clearly, such segment always exists as b is smaller than 1. ■

The proof for third part of proposition 2 about expected wages

The second part of our proof, regards the expected wages of workers. The expected wage of high productivity workers under partial matching is:

$$E\left[\left(u^h_{t=2}\middle|NS, b, m^h\right)\right] = E\left[(1-\theta_i)\left[(1-\lambda)b + \lambda\begin{bmatrix} m^h\left(\frac{A-T}{2} + \frac{1-T}{2}\right) \\ +(1-m^h)b \end{bmatrix}\right] + \theta_i\, b\right]$$

The expected wage for low productive worker is:

$$E\left[\left(u^l_{t=2}\middle|NS, b, m^l\right)\right] = E\left[(1-\theta_i)\left[(1-\lambda)b + \lambda\begin{bmatrix} m^l\left(\frac{1}{2} + \frac{1-T}{2}\right) \\ +(1-m^l)b \end{bmatrix}\right] + \theta_i\, b\right]$$

Comparing the two we can see that $E\left[\left(u^h_{t=2}\middle|NS, b, m^h\right)\right] = E\left[\left(u^l_{t=2}\middle|NS, b, m^l\right)\right]$ only if:

$$m^h\left(\frac{A+1}{2} - T - b\right) = m^l\left(1 - \frac{T}{2} - b\right)$$

But after placing the matching behaviors we see that both sides are always equal. ■

A.6: why paying high wage to all workers under secrecy is not optimal

First we generate the value of $\bar{w}^s$ (the wage level under secrecy that allow firm to match all outside offers without promoting search). The value of $\bar{w}^s$ may be calculated by equalizing the expected utility under search and without search for m=1 :

$$E\left[\left(u_{t=2}\middle|S,p^h,m=1\right)\right]$$
$$=E\left[(1-\theta_i)\left[p^h\left(\frac{A+1}{2}-T\right)+(1-p^h)\left(1-\frac{T}{2}\right)-c\right]+\theta_i\, b\right]$$

$$E\left[\left(u_{t=2}\middle|NS,p^h,m=1\right)\right]=E\left[(1-\theta_i)\left[p^h\left((1-\lambda)\,\bar{w}^s+\lambda\left(\frac{A+1}{2}-T\right)\right)+\right.\right.$$
$$\left.\left.(1-p^h)\left((1-\lambda)\,\bar{w}^s+\lambda\left(1-\frac{T}{2}\right)\right)\right]+\theta_i\, b\right]$$

Putting the above two values into one equation and after some arrangements we get:

$$\bar{w}^s=p^h\left(\frac{A+1}{2}-T\right)+(1-p^h)\left(1-\frac{T}{2}\right)-\frac{c}{1-\lambda}=p^h\,\bar{w}^h+(1-p^h)\,\bar{w}^l$$

But: when m=1 we get that $p^h=\frac{2-\lambda}{4-\lambda}$ and $s^h=\frac{\lambda}{2D}$. And we can rewrite $\bar{w}^s$:

$$\bar{w}^s=\frac{1}{2}(\bar{w}^h+\bar{w}^l)-\frac{\lambda}{4(4-\lambda)}(A-1-T)$$

The firm expected profit per worker is:

$$E[(\pi^s_{t=2}|NS,\bar{w}^s)]=E\left(1-\theta_{i,t}\right)\frac{1}{2}\left[\begin{array}{c}(1-\lambda)(1-s^h)(A-\bar{w}^s)\\+(\lambda+(1-\lambda)s^h)\left(\frac{A-1}{2}+T\right)+\\(1-\lambda)(1-\bar{w}^s)+\lambda\frac{T}{2}\end{array}\right]$$

After some assignments and arrangement we get:

$$=E\left(1-\theta_{i,t}\right)\frac{1}{2}\left[\begin{array}{c}(1-\lambda)(A+1-\bar{w}^h-\bar{w}^l)\\+(1-\lambda)\frac{\lambda}{2(4-\lambda)}(A-1-T)\\+\lambda\left(\frac{A-1}{2}+\frac{3T}{2}\right)-\frac{\lambda}{2D}(c+\frac{1-\lambda}{4-\lambda}(A-1-T)\end{array}\right]$$

Assigning $\bar{w}^h$ and $\bar{w}^l$ we get:

$$E\left(1-\theta_{i,t}\right)\frac{1}{2}\left[\frac{A-1}{2}+\frac{3T}{2}+2c+\frac{\lambda(1-\lambda)}{2(4-\lambda)}(A-1-T)\left(1-\frac{1}{D}\right)-\frac{c\lambda}{2D}\right]$$

When we compare it to the expected profit under high wage with full information we get:

$$E\left[\left(\pi^{fi}_{t=2}\middle|NS,\{\bar{w}^h,\bar{w}^l\},m=1\right)\right]=E[(1-\theta_i)\frac{1}{2}\left[\frac{A-1}{2}+\frac{3T}{2}+2c\right]$$

We see that :

$$E\left[\left(\pi_{t=2}^{fi}\middle|NS,\{\overline{w}^h,\overline{w}^l\}\right)\right]-E[(\pi_{t=2}^{s}|NS,\ \overline{w}^s)]=$$

$E[(1-\theta_i)\frac{1}{2}\left[\frac{\lambda(1-\lambda)}{2(4-\lambda)}(A-1-T)\left(\frac{1-D}{D}\right)+\frac{c\lambda}{2D}\right]$

Which is always positive as D≤1 and A≥1+T. ■

A.7: Proof - high productivity workers quit less under secrecy than they do under full information.

When $\left[\left(\pi_{t=2}^{h,s}\middle|NS,b\right)\right]>E\left[\left(\pi_{t=2}^{h,fi}\middle|NS,b\right)\right]$ it implies that:

$(1-\lambda)\left(1-s_{i,t}^h\right)(A-b)+\left(\lambda+(1-\lambda)s_{i,t}^h\right)m^h\left(\frac{A-1+2T}{2}\right)>(1-\lambda)(A-b)+\lambda M^h\left(\frac{A-1+2T}{2}\right)$

We can rearrange it into:

$$\lambda M^h\left(\frac{A-1+2T}{2}\right)(a^h-1)-(1-\lambda)s_{i,t}^h\left(A-b+a^hM^h\frac{A-1+2T}{2}\right)>0$$

However as $A-b>\frac{A-1+2T}{2}$ (because $A+1>2(b+T)$), we can write:

$$\lambda M^h\left(\frac{A-1+2T}{2}\right)(a^h-1)-(1-\lambda)s_{i,t}^h(1+a^hM^h)\frac{A-1+2T}{2}>0$$

And:

$$\lambda M^h(a^h-1)-(1-\lambda)s_{i,t}^h(1+a^hM^h)>0$$

Again, as $1+a^hM^h>1-a^hM^h$ we can write:

$$\lambda M^h(a^h-1)-(1-\lambda)s_{i,t}^h(1-a^hM^h)>0$$

And hence, equation (41) is positive. ■

A.8: comparing utilities under MD with FM

When search is promoted by the firm, the expected wage is constant in respect to λ, and we get that: $E\left[\left(u_{t=2}^h\middle|search\right)\right]=\left(1-\frac{D}{2}\right)\left(\frac{A+1}{2}-T-c\right)+\frac{D}{2}b$ and: $E\left[\left(u_{t=2}^l\middle|search\right)\right]=\left(1-\frac{D}{2}\right)\left(1-\frac{T}{2}-c\right)+\frac{D}{2}b$. The result is equal for full matching strategy without search when $\overline{w}^h\le 1-T$ and $\overline{w}^l\le 1-\frac{T}{2}$ respectively: $E\left[\left(u_{t=2}^h\middle|\overline{w}^h,NS,\lambda\le\bar{\lambda}^h\right)\right]=\left(1-\frac{D}{2}\right)\left(\frac{A+1}{2}-T-c\right)+\frac{D}{2}b$ and $E\left[\left(u_{t=2}^l\middle|\overline{w}^l,NS,\lambda\le\bar{\lambda}^l\right)\right]=\left(1-\frac{D}{2}\right)\left(1-\frac{T}{2}-c\right)+\frac{D}{2}b$. However, when $\lambda>\bar{\lambda}^k$, not searching produces higher expected earnings as: $E\left[\left(u_{t=2}^h\middle|\overline{w}^h,NS,\lambda>\bar{\lambda}^h\right)\right]=b+$

$\left(1-\frac{D}{2}\right)\lambda\left(\frac{A+1}{2}-T\right) > E\left[\left(u_{t=2}^{h} \middle| \bar{w}^{h}, NS, \lambda \leq \bar{\lambda}^{h}\right)\right]$ and: $E\left[\left(u_{t=2}^{l} \middle| \bar{w}^{l}, NS, \lambda > \bar{\lambda}^{l}\right)\right] = b + \left(1-\frac{D}{2}\right)\lambda\left(1-\frac{T}{2}\right) > E\left[\left(u_{t=2}^{l} \middle| \bar{w}^{l}, NS, \lambda \leq \bar{\lambda}^{l}\right)\right]$. This result may change when $\bar{w}^{h} > 1 - T$ or $\bar{w}^{l} > 1 - \frac{T}{2}$ as the active-search expected wage is strictly dominated by high wage and full matching. In comparison with partial matching strategies, it is clear that no search with full matching always results in a higher expected wage because both the initial wage (for both low- and high-productivity workers) and the matching probability are higher under FM. This is also the case for the secrecy equilibrium

A 9: More detailed way to reach condition 62

We start with the upper bound of $\lambda_{m^h=1}$: since $\frac{A+1}{2} - T - b > c$ by construction, we get that: $\lambda_{m^h=1} < 1 - \frac{1+\sqrt{5}}{2}\frac{c}{\left(\frac{A+1}{2}-T-b\right)}$. Placing $\lambda^* = 1 - \frac{1+\sqrt{5}}{2}\frac{c}{\left(\frac{A+1}{2}-T-b\right)}$ in condition 61 we get:

$$\frac{\frac{1+\sqrt{5}}{2}\frac{c}{\left(\frac{A+1}{2}-T-b\right)}}{1+\frac{1+\sqrt{5}}{2}\frac{c}{\left(\frac{A+1}{2}-T-b\right)}}\left(\frac{A-1}{2}+T\right)\frac{1}{\frac{T}{2-T-2b}+\frac{1+\frac{1+\sqrt{5}}{2}\frac{c}{\left(\frac{A+1}{2}-T-b\right)}}{D}} \equiv \bar{c}^*$$

And after some algebra:

$$\frac{\frac{1+\sqrt{5}}{2}\frac{1}{\left(\frac{A+1}{2}-T-b\right)}}{1+\frac{1+\sqrt{5}}{2}\frac{\bar{c}^*}{\left(\frac{A+1}{2}-T-b\right)}}\left(\frac{A-1}{2}+T\right) = \frac{T}{2-T-2b} + \frac{1+\frac{1+\sqrt{5}}{2}\frac{\bar{c}^*}{\left(\frac{A+1}{2}-T-b\right)}}{D}$$

And even more:

$$\left(1+\sqrt{5}\right)\left(\frac{A-1}{2}+T\right) = \left(2\left(\frac{A+1}{2}-T-b\right)+(1+\sqrt{5})\bar{c}^*\right)\left(\frac{T}{2-T-2b}+\frac{1}{D}+\frac{(1+\sqrt{5})\bar{c}^*}{2D\left(\frac{A+1}{2}-T-b\right)}\right)$$

Final stage:

$$\left(1+\sqrt{5}\right)\left(\frac{A-1}{2}+T\right) = 2\left(\frac{A+1}{2}-T-b\right)\left(\frac{T}{2-T-2b}+\frac{1}{D}\right) + (1+\sqrt{5})\bar{c}^*\left(\frac{T}{2-T-2b}+\frac{1}{D}\right) + \frac{(1+\sqrt{5})\bar{c}^*}{2D\left(\frac{A+1}{2}-T-b\right)}2\left(\frac{A+1}{2}-T-b\right) + \frac{(1+\sqrt{5})^2\bar{c}^{*2}}{2D\left(\frac{A+1}{2}-T-b\right)}$$

And we can write the quadratic equation:

$$\frac{(1+\sqrt{5})^2}{2D\left(\frac{A+1}{2}-T-b\right)}\bar{c}^{*2} + \left(1+\sqrt{5}\right)\left(\frac{T}{2-T-2b}+\frac{2}{D}\right)\bar{c}^* - \begin{pmatrix} \left(1+\sqrt{5}\right)\left(\frac{A-1}{2}+T\right) \\ -2\left(\frac{A+1}{2}-T-b\right)\left(\frac{T}{2-T-2b}+\frac{1}{D}\right) \end{pmatrix} = 0$$

Or:

$$\frac{\left(1+\sqrt{5}\right)^2}{2\left(\frac{A+1}{2}-T-b\right)}\bar{c}^{*2}+\left(1+\sqrt{5}\right)\left(\frac{DT}{2-T-2b}+2\right)\bar{c}^{*}-\begin{pmatrix} D\left(1+\sqrt{5}\right)\left(\frac{A-1}{2}+T\right)- \\ 2\left(\frac{A+1}{2}-T-b\right)\left(\frac{DT}{2-T-2b}+1\right)\end{pmatrix}=0$$

We solve the quadratic equation to get:

$$\bar{c}^{*}=\frac{-\left(\frac{DT}{2-T-2b}+2\right)+\sqrt{\left(\frac{DT}{2-T-2b}+2\right)^2+\frac{2\left(D\left(1+\sqrt{5}\right)\left(\frac{A-1}{2}+T\right)-2\left(\frac{A+1}{2}-T-b\right)\left(\frac{DT}{2-T-2b}+1\right)\right)}{\left(\frac{A+1}{2}-T-b\right)}}}{\frac{\left(1+\sqrt{5}\right)}{\left(\frac{A+1}{2}-T-b\right)}}$$

Or with simplification:

$$\bar{c}^{*}=\frac{\frac{A+1}{2}-T-b}{1+\sqrt{5}}\left(-2-\frac{DT}{2-T-2b}+\sqrt{\left(\frac{DT}{2-T-2b}\right)^2+\frac{2D\left(1+\sqrt{5}\right)\left(\frac{A-1}{2}+T\right)}{\left(\frac{A+1}{2}-T-b\right)}}\right)$$

Now, we would like to show that the derivative in respect to D is positive:

For shortness we assign: $a=1+\sqrt{5}$; $x\equiv\frac{T}{2-T-2b}$; $y\equiv 2\left(1+\sqrt{5}\right)\left(\frac{A-1}{2}+T\right)$;

$z\equiv\left(\frac{A+1}{2}-T-b\right)$.

Note that x,y and z are all positive.

And we can derive $\frac{\partial\bar{c}^{*}}{\partial D}$ and we get that $\frac{\partial\bar{c}^{*}}{\partial D}>0$ i.f.f:

$\frac{\partial\left(-Dx+\sqrt{(Dx)^2+\frac{DY}{Z}}\right)}{\partial D}>0$ or after we do the derivation: $-x+\frac{2x^2\text{D}+\frac{Y}{Z}}{2\sqrt{(Dx)^2+\frac{DY}{Z}}}>0.$

Which we change into: $\frac{2x^2\text{D}+\frac{Y}{Z}}{\sqrt{(Dx)^2+\frac{DY}{Z}}}>2x.$ we multiple and power to get:

$$4x^4D^2+\ 4x^2\text{D}\frac{Y}{Z}+\frac{Y^2}{Z^2}>4x^2(Dx)^2+\frac{DY}{Z})=4x^4\text{D}^2+4x^2\frac{DY}{Z}$$

And we subtract in both sides to get: $\frac{Y^2}{Z^2}>0$ which is always true. ■

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