Secrets & Lies: Topics in
Wage Secrecy and Conspicuous Consumption

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Abstract

One of the characteristics of modern societies is the “salary taboo”. Surprisingly, although wage-related issues are fundamental to the capitalistic way of life and to modern labor markets, the size of individuals’ paychecks is usually kept private. On the other hand, most people externalize their wealth and other attributes by adopting various forms of behaviors and conspicuous consumption. Following these notions, this dissertation constructs 3 theoretical models of wage secrecy and conspicuous consumption.

The first chapter examines why people in a society honor the wage taboo and explains the role of the secrecy norm in a growing-inequality economy. Assuming that people do take their relative position on the pay ladder into consideration, the model shows how secrecy affects the utility of underpaid workers and their willingness to cooperate in the workplace. Secrecy also decreases workers’ ability to monitor their firms’ pay scheme and, hence, allows firms to attain greater managers-workers pay inequality. By the same token, secrecy impairs firms’ ability to cut wages reliably when they experience a negative shock. In the model, senior and junior agents who display a fairness-oriented utility function work in an environment where the secrecy norm is practiced. In this setting, stronger secrecy corresponds to greater income inequality. In equilibrium, both types of agents favor a certain level of wage secrecy over full information, i.e., all agents follow the secrecy norm and do not wish to deviate. By allowing agents to continue to cooperate under rising income inequality, the wage-secrecy norm decreases the social disharmony that is evoked by a widening gap in pay and, therefore, prevents rage and revenge reactions by underpaid agents.

The second chapter, which is a joint work with Prof. Jean-Marc Robin (PSE), 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 intermediate, 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.

The third chapter presents a general model of conspicuous consumption in which two partially visible goods serve as a signal of individual’s dual unobserved attributes (Namely: wealth and wisdom). In addition to a classic Veblen good, a more sophisticated cultural conspicuous consumption good is introduced. The ability of agents to use this sophisticated good is mediated through their wisdom level: smart agents are able to choose and send a better signal and, evenly important, to interpret such signals. In contrast, other agents lack the ability to differ between high and low signals and therefore cannot use the sophisticated good signal properly. Two possible extreme equilibria are mainly analyzed: Elite (smart agents buy the conspicuous good) and nouveau riche (rich agents buy the conspicuous good). Under both equilibria, a selected group uses the signal to distinguish themselves, enabling the formation of an upper social class. We provide existence and uniqueness conditions for such equilibria and show that the introducing of cultural conspicuous consumption product enables the existence of the elite equilibrium that can't be supported in a classic conspicuous consumption product environment. The chapter shows that higher inequality and materialism are associated with nouveau riche equilibrium while lower inequality and intellectualism are linked with an elite equilibrium.
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Preface

Take a moment to think about the person in the next office: How much money does s/he earn? Although the answer to this question is usually highly interesting and sometimes even valuable, it is rarely known unambiguously. One may know almost everything about one’s co-worker—most recent vacations, marital issues, and secret habits—but nothing about his or her paycheck. We all estimate, of course, but do we really know for sure?

Wage-secrecy policies are widespread in the labor market.\(^1\) Although secrecy seems to be particularly prevalent with respect to management pay, it characterizes nearly all labor markets. Wage secrecy, however, is more than a formal business policy; it is a norm. Surprisingly, employees tend to be as keen as employers about protecting the secrecy of their wages. In addition to formal policies, societies adopt non-formal practices to keep pay information from leaking out. To some extent, it is rude to ask someone “How much do you earn?” and impolite to be outspoken in public about one’s income or wealth. The strength of these norms, however, varies across cultures, groups, and circumstances.

In what may be seen as a contradiction, people also show growing interest on indirect ways to signal their wealth and other good qualities. Conspicuous consumption, individuals’ consumption of highly priced goods in order to advertise their wealth, is a typical result of social limitation regarding directly externalizing wealth and income.

The current dissertation addresses the issues of the wage secrecy and conspicuous consumption. The first two chapters provide possible theoretical support to the existence of wage secrecy norms in firms. The third chapter discusses conspicuous consumption:

The first chapter, “Don't ask don't tell: fairness, inequality and wage secrecy”, tries to model and to explain the evolution of wage-secrecy norm and to demonstrate its effects on the labor market and income distribution. The chapter suggests that by imposing a wage secrecy norm, society may protect itself from potential disharmony and allow for better cooperation and satisfaction. On the one hand, wage ambiguity relieves underpaid employees of inferiority feelings and may generate utility surplus. On the other hand, it

\(^1\) Lawler (1990) provides a review of evidence and analyses.
allows firms to increase the remuneration of executives, owners, or any group of employees whom it selects.

The model follows the notion of the inequality aversion model by Fehr and Schmidt (1999). In our model, senior (managers) and junior agents who display a fairness-oriented utility function work in a cooperative environment where the secrecy norm may be practiced. Assuming productivity is volatile, wage-secrecy norm reduces the accuracy of information in the economy. Secrecy decreases workers’ ability to monitor their firms’ pay scheme and, hence, allows firms to attain greater managers-workers pay inequality. But, secrecy also involves a credibility issue: it impairs firms’ ability to cut wages reliably when they experience a negative shock. The equilibrium results of the model suggest that for an intermediate level of secrecy, the utility of both junior workers and managers exceeds the full information utilities levels.

The model contributes to the current scarce wage secrecy literature by providing a simple rational expectations labor market model in which secrecy is the optimal (and stable) market structure. Additionally, it contributes to the personnel literature by suggesting the possible link between inequality aversion and salaries’ information structure.

The second chapter, “Match me if you can: wage secrecy and matching in a search model”, which is a joint work with Prof. Jean-Marc Robin (PSE), introduces the possibility of the adoption of a “wage secrecy norm” by both workers and firms in a general-equilibrium job-search model with on-the-job search. Using a search and counter-offers matching model we show that 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.

The study makes two main contributions to this line of literature: First, it provides a setting within which the workers’ information set shapes the outcome of the market in

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2 The two immediate relevant papers are Postal-Vinay and Robin (2002, 2004).
respect to wages, wage profiles, and search intensity. Second, 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).

The third chapter, “Show me the money: status, cultural capital, and conspicuous consumption”, departs from the wage secrecy norm and discusses conspicuous consumption. It presents a general model of conspicuous consumption in which two partly visible goods signal the presence of dual unobserved attributes (wealth and wisdom). In addition to a classic Veblen (1899) good, a more sophisticated conspicuous-consumption good is introduced and modeled on the basis of Bourdieu’s (1979) conceptualization of cultural capital. Agents’ ability to use this sophisticated good is mediated by their level of wisdom: smart agents can choose and send a better signal and, just as important, are better able to interpret such signals. Other agents lack the ability to differentiate between high and low signals and, therefore, cannot use the sophisticated good properly.

The outcome of the discrete signaling game allows us to derive the status level of all individuals in society and to map the potential linkage between various initial characteristics of the market and the status distribution of the society. The analysis pertains mainly to two possible extreme equilibria: elite equilibrium (smart agents buy the conspicuous-consumption good) and nouveau riche equilibrium (rich agents buy the conspicuous-consumption good). In both equilibria, a select group uses the signal to distinguish itself from others, thereby allowing a social upper class to take shape. Our study provides existence and uniqueness conditions for such equilibria and outlines their main features. While only a nouveau riche equilibrium can be supported under the typical conspicuous-consumption product setting, the introduction of the cultural conspicuous-consumption product allows both equilibria, the elite and the nouveau riche, to exist. Our results suggest that low income inequality and high relative importance of intellectualism are associated with an elite equilibrium while high income inequality and relative importance of materialism lead to a nouveau riche equilibrium.
The major contribution of this chapter is the introduction of ability-based conspicuous consumption: i.e., cultural consumption. By doing that, the model links the traditional conspicuous consumption literature in economics with the capital culture capital literature in sociology. In addition, the model contributes to the growing body of literature on multidimensional signaling. I establish agents’ status on the basis of their perceived levels of wisdom and wealth. Since the model also contains two signaling devices, the signaling game is two-dimensional in both signals and information. Multidimensional signaling models of that type are more common in the principal-agent literature and, especially, in studies of financial markets, however they are commonly restrained to only one output dimension. The current study incorporates multidimensional signaling into the conspicuous consumption literature and adds the complexity of two dimensions of outputs.
Reference


Chapter 1

Don't Ask Don't Tell: Fairness, Inequality and Wage Secrecy\(^1\)

1.1 Introduction

One of the characteristics of modern societies is the “salary taboo”. Surprisingly, although wage-related issues are fundamental to the capitalistic way of life, the size of individuals’ paychecks is usually kept private.

Wages are the outcome of economic interaction between employers and employees. Basically, wages are expected to express the value of workers to firms. Theoretically, under perfect competition wages are expected to equal the marginal product of labor. Actual pay, however, seldom directly satisfies this condition because it is set under various economic, social, and regulatory constraints. Frank (1984) showed that status concerns among workers causes the wage structure to be such that individual wage differences understate individual differences in marginal product. As with any other price in a market mechanism, full information is believed to increase overall efficiency and improve labor-market performance. Therefore, information asymmetry in the labor market corresponds to inefficient allocation of human resources and suboptimal production. Moreover, wages give employees a powerful incentive to exert themselves. In this context, openness about wage levels is crucial to a firm’s incentive scheme.\(^2\)

Additionally, wages provide an indication of employees’ abilities and skills. Therefore, other agents may find wage information helpful in taking economic decisions (e.g., hiring, firing, or otherwise dealing with a worker). It is therefore a puzzle: Why do profit-maximizing firms and rational workers adopt various practices of wage secrecy to preserve the salary taboo?

The purpose of this chapter is to model and to explain the evolution of wage-secrecy norm and demonstrate its effects on the labor market and income distribution. In the

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\(^1\) Additional Financial support for this project was provided by SHVIL (Transparency International- TI) ISRAEL (AR).

\(^2\) Tournament models (Lazear and Rosen, 1981) are one of many examples of the importance of wage openness in a firm’s incentive scheme.
model, senior and junior agents who display a fairness-oriented utility function work in a cooperative environment where the secrecy norm may be practiced. When some level of variability is introduced (productivity shocks, in this model), the wage-secrecy norm reduces the accuracy of information in the economy. Thus, secrecy affects the utility of underpaid workers and their willingness to cooperate in the workplace. Secrecy also decreases workers’ ability to monitor their firms’ pay scheme and, hence, allows firms to attain greater pay inequality. By the same token, secrecy involves a credibility issue: it impairs firms’ ability to cut wages reliably when they experience a negative shock.

The results of this paper suggest that stronger secrecy corresponds to greater income inequality. However, in equilibrium, both types of agents favor a common certain level of wage secrecy over full information, i.e., all agents follow the secrecy norm and do not wish to deviate regardless of their relative standings. Therefore, the paper provides a possible explanation for the wide adoption of the wage-secrecy norm even in the absence of strict formal enforcement.

The chapter is organized as follows. Section 2 presents the motivation and discusses the related literature. Section 3 presents the model, Section 4 presents the analysis and examines its' results. Section 5 concludes.

1.2 Motivation and related Literature

1.2.1 The wage secrecy norm

The 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 maintain the norm. For example, since people consider pay information very intimate, 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 (See Lawler (1990) for a review of evidence and analyses). In the U.S,

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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. Similar effects were suggested by Trachtman (1999)
for example, although unlawful under the NLRA (National Labor Relations Act), pay-
secrecy policies are implicitly permitted and are very common in employment contracts.

Surprisingly, employees tend to be as keen as employers about protecting the secrecy of their wages. When DuPont employees were asked whether their company should adopt a wage openness policy, only 18 percent answered in the affirmative (Dolan and Schuler, 1987). Although secrecy seems to be particularly prevalent in respect of management pay (Lawler, 1971), it is characteristic of nearly all levels of labor markets. The strength of the secrecy norm, however, varies across cultures, groups, and circumstances.

In economic terms, the main effect of wage secrecy is disruption of workers’ ability to accurately estimate co-workers’ wages (another alternative that is based on the informational value of co-workers' wage changes is presented on the second chapter of this work). The notion that workers suffer disutility and, for this reason, will withhold effort or even quit their jobs when they perceived their wage to be relatively low is a key component of most efficiency-wage models (Akerlof and Yellen, 1990) and fairness-oriented models (Frank, 1984; Fehr and Schmidt, 1999). This assumption has been supported by many scholars (see Gächter and Fehr, 2002, for a review) but not all (Charness and Kuhn, 2007).

Naturally, employees are still concerned about co-workers’ wages even where the wage-secrecy norm exists. Therefore, they need to estimate each other’s wages. The estimation process may produce skewed results (i.e. an estimated wage that is higher/lower than the real wage). The research evidence about the direction of such a bias effect, however, is mixed: According to a brief survey by Gan (2002), employees tend to underestimate superiors’ pay and overestimate the pay of peers and, more so, of subordinates. An earlier study by Lawler (1971) showed that employees who undertake to maintain secrecy tend

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4 The NLRA is not enforced until a covered employee registers an objection by filing an unfair labor practice claim—an action rarely taken (Edwards, 2005).


6 To the best of my knowledge, there are no available data on the differences in secrecy levels among countries. According to my own limited field investigation, however, the wage-secrecy norm seems to be very strong among US firms and somewhat weaker in Europe.

7 Interestingly, Charness and Kuhn (2007) used laboratory experiments to show that while workers’ effort choices are highly sensitive to their own wages, effort is not affected by co-workers’ wages.
to overestimate any pay raise given to co-workers and, for this reason, consider their own raises insufficient and disappointing. To attain non-trivial results, this paper adopts the rational-expectations framework (i.e., it does not assume that secrecy causes workers to under- or over-estimate others’ wage). Thus, in this paper, secrecy affects only workers’ ambiguity about their relative positions. Following Kahneman and Tversky’s (1979) Prospect Theory that suggested risk loving of negative payoff, it is assumed that, under some circumstances, ambiguity decreases the disutility that inferior pay causes.⁸

1.2.2 Fairness and relative pay

Extensive empirical work has shown that remuneration is not the only motive behind people’s actions. A growing body of experimental and theoretical evidence suggests that people’s wellbeing is strongly affected by their relative positioning (McBride, 2001).⁹ Moreover, a large mass of evidence supports the claim that concerns about fairness and reciprocity are important in social interaction (see Fehr and Schmidt (2001) for an overview). The notion of fairness is normally invoked in families, business life, sports, and interaction with neighbors, friends, and even strangers. In the context of personnel economics, it means that employees’ wellbeing and, in turn, their motivation are largely based on their perceptions of the fairness of their relationships with all other agents in the workplace—superiors, peers, and subordinates (see Gächter and Fehr (2002) for a review).

In the context of labor markets and according to equity theory, fairness is achieved when the value of the compensation received is equivalent to the value of the labor preformed. Adams (1963) states that employees constantly monitor their exchange relationship with their employer. Thus, employees expect to be paid commensurate with their efforts and skills, i.e., they feel that equal work is worth equal pay.¹⁰ The right level of compensation

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⁸ A simple intuition that backs this assumption is the difference in disutility of a person who knows that his co-worker earns $10 more than he does, as against one who knows that the average estimated pay gap is $10 but the standard deviation of the estimation is $20.

⁹ The *Journal of Economic Behavior and Organization* devoted an entire issue (Vol. 45, No. 3) to this topic in 2001.

¹⁰ In the following anecdotal example, when the six cast members of NBC hit series “Friends” decided to negotiate their salaries jointly, their action was reportedly based on the notion that all were equally
for one worker is supported by the compensation given to other workers under similar circumstances. Hence, the availability of information about other employees’ salaries and terms is highly relevant to the notion of fairness in the workplace. Akerlof and Yellen (1990) offer several additional possible sources of the fair-wage expectation: “The fair wage depends the on wage of other workers who are salient in the worker’s life, the profit accruing to the firm’s owner, or the worker’s past wage history” (p. 269).

It has been widely observed that unfair circumstances cause people to feel anger and rage. When these feelings are evoked, people usually take antisocial and destructive actions (Homans, 1961). A common laboratory experiment, the Ultimatum Game (UG), elicits a similar result, showing that people act in contrast to their immediate monetary self-interest (Camerer and Thaler, 1995). Most participants in this game reject a monetary transfer if it is too low relative to the sender’s payoff. Surprisingly, people act in contrast to what is the immediate monetary self-interest. Such behavior may be interpreted as attempts to restore fairness to an unfair situation. In another laboratory experiment, Zizzo and Oswald (2001) allowed players to decrease their opponent’s payoff by reducing their own.

1.2.3 Models of relative pay

In recent years, several economists have modeled fairness and relative-pay considerations into the utility function. Rabin (1993) was the first to introduce reciprocity and altruism into the modeling of fairness-oriented motivations. Fehr and Schmidt (1999) contributed by modeling fairness as a self-centered inequality aversion and augmenting their model with a (less dominant) superiority aversion. In the labor market context, the model suggests that an underpaid employee may be willing to incur a cost in order to punish an

responsible for the success of the series and should therefore be offered the same wage [http://www.eonline.com/News/Items/0,1,56,00.html].

11 The actual way in which people construct fairness consideration and compare wages is discussed extensively in the continuation of this section.

12 Several additional empirical studies demonstrate how employees may harm their firms if they experience what they consider unfair circumstances. Subordinates who feel they have been treated unfairly are less supportive of their managers; less likely to engage in cooperative organizational behavior (Moorman, 1991), and more likely to leave their organizations (Colquitt, Conlon, Wesson, Porter, and Ng, 2001). They are also more apt to engage in improper behavior such as theft and revenge at the workplace (Skarlicki and Folger, 1997).
overpaid co-worker and, due to the superiority aversion, to forfeit part of one paycheck to equalize with a co-worker. Our model uses similar setting and derives the utility function using Fehr and Schmidt approach. Alternative modeling approaches to relative pay includes The Fair Wage Theory (FWT) (Akerlof and Yellen (1990)) and the status concerns model of Fershtman and Weiss (1993).

While Fehr and Schmidt (1999), Akerlof and Yellen (1990), and Fershtman et al. (2006) generally agree on the negative effect on utility of wage inferiority, they differ on the effect of wage superiority. According to inequality-aversion models, superiority has a negative utility effect. The FWT disregards any overpay effect, the effort of an overpaid worker has no upward influence on his/her wage. In social-status models, a wage advantage does have a positive effect. Thus, a wage increase enhances utility for two reasons: the direct supplement to income and the higher status attained.

Empirical end experimental evidence suggests that all three hypotheses are reasonable. This paper uses a utility function that is based on Fehr and Schmidt (1999) but is closer to Akerlof and Yellen (1990) model in that it omits the negative effect of wage superiority.¹³

1.3 The Model

Consider a simple economy in which wage-secrecy norm may exists. According to the norm, agents are not supposed to reveal their pay. The wage-secrecy norm, therefore, reduces the accuracy of information in the economy. Thus, the norm influences the employee’s information set and his/her perception of relative pay. The strength of the norm is set by the percentage of the population that follows the norm. In the basic form of the model I assume that the secrecy norm level is exogenously determined.

1.3.1 Setting of the Model

Players: two types of agents participate in the economy—juniors and seniors. The model is a one-period static model, i.e., players live and work for one period only.¹⁴ Firms,

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¹³ Nevertheless, the main results of the model are robust to the effects of some superiority aversion or some superiority advantage.
however, have an infinite time horizon with \( \delta \) discount. \( N^s \) and \( N^j \) denote the quantity of each agent type. I assume \( N^s \geq N^j \).\(^{15}\) Both agents and firms are risk-neutral.

**Heterogeneity:** Junior agents are heterogeneous in their ability level.\(^{16}\) Their ability is normally distributed with expectancy of \( A^j \) and variance of \( \sigma^2_{A^j} \). Senior workers’ ability is constant and normalized to 1. Abilities are observable to agents and to co-workers but not to others.

**Labor market:** Junior agents may work for firms or be self-employed. Senior agents own firms and thus can work only in firms.\(^{17}\) However, cooperation is beneficial in respect to production, i.e., the expected production level of an agent is higher in a firm than in self-employment. The sectors in the economy are organized in the following way:

1. **Self-employment sector:** Junior agents may be self-employed. Each agent’s product is expressed as:

   \[
   z^j_i = a^j_i M^d
   \]

   Where \( a^j_i \) is the ability of indexed \( i \) junior agent and \( M^d \) is the productivity parameter for all self-employed agents.\(^{18}\)

2. **Firms sector:** The firms in the economy are divided to \( G \) separate industries \((b=1\ldots g)\), so that each industry contains \( N_b \) firms and \( \sum N_b = N \). The productivity parameter of each firm is determined by a shock at the industry

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\(^{14}\) Since information is transferred from one generation to another, it is somewhat more intuitive to describe the economy as an overlapping generation model. However, the one-period setting was chosen for the sake of simplicity and because the difference in outcome is negligible.

\(^{15}\) The intuition: due to market failures, it is impossible for a sufficient number of juniors to acquire the schooling or the capital needed to become seniors.

\(^{16}\) The assumption that the distribution of the ability level is exogenous may be relaxed in a future model.

\(^{17}\) In this paper, the intuition about seniors is that they own the firms. However, several other intuitions are possible. There may be a shortage of seniors in the economy, so that some juniors are self-employed and earn less but cannot become seniors because it is too costly or simply impossible. Alternatively, the firms’ owners may have shared interests, values, and/or background with the senior agents and not with junior agents (e.g., men vs. women); therefore, the goal of the firm’s owner is to maximize the senior agent’s wage. Notably, according to empirical findings (Blount, 1995) the effect of the relative-pay consideration is not dependent on whether the senior agent is the owner or just a preferred co-worker.

\(^{18}\) In the case of self-employment, the agent’s wage is \( z^j_i \) and, since no relative-pay consideration is taking place, the total utility also equals \( z^j_i \). Thus, \( z^j_i \) is the outside option value for all junior agents.
level. Hence, all firms in the industry have the same productivity parameter in each period which can be either low ($M^d$) or high ($M^u$). The industry’s productivity follows a symmetric two-state Markov chain. The probability for a shift from one productivity level to another is given by $(1-\rho)$. We assume that $\rho$ is large than $0.5$ ($1 \geq \rho > 0.5$) so the productivity is somewhat consistent. This stochastic process specification is needed to enable the agent to use the information that is revealed in the previous period. Thus, the probabilities in each period are:

$$m_{b,t}^d (m_{b,t-1}^u = M^u) = \begin{cases} \text{prob} (m_{b,t} = M^u) = \rho \\ \text{prob} (m_{b,t} = M^d) = (1-\rho) \end{cases}$$ (2)

Both a junior agent and a senior agent are necessary for the manufacture of a single good of monetary value $Y$. Each pair of agents is organized in a firm so that each firm has only two workers. The total production value of the firm is dependent on the agents’ aggregate ability and the productivity parameter. When the firm fails to employ a junior agent, however, production cannot be completed and total output becomes zero.

We assume that the lower bound of the productivity in firms, $M^d$, is equal to the self-employment productivity parameter. The intuition is that if cooperation generates no added value, agents will manufacture as well in a firm as when self-employed. The higher productivity parameter is achieved when cooperation does improve productivity.

To conclude, the total output value of firm $i$ in sector $b$ at time $t$ is denoted by:

$$y_{b,t,i} = (a_i^j + a_i^s)m_{b,t}$$ (3)

**The firm problem and wage setting**: The firm distributes all its output to the employees (zero profit, but remember that senior workers actually run the firms). Therefore, for each period and at each productivity level, the risk-neutral firm chooses a wage offer ($w_{i,t}^j$) that maximizes the senior employee’s expected utility. The wage of the senior agents is the residual wage:

$$y_{i,j} = w_{i,t}^j + w_{i,t}^f$$ (4)
**Matching:** Junior agents are randomly matched to senior agents in a specific firm and a specific industry. Since $N^s \geq N^j$, some junior agents may be unmatched and, therefore, should become self-employed. The matching has a binding effect: once the match is made, a junior agent may choose to work only for the matched senior agent or to become self-employed. Correspondently, senior agents may not be re-matched.

1.3.2 The Utility Function

The fundamental structure of the utility function in this model is based on the fairness-oriented utility function introduced by Fehr and Schmidt (1999). The utility function also includes some adjustments for the incomplete information and equity theory (Adams, 1965).

**Junior agents' utility function:** Each junior agent’s utility is based on a direct utility from his/her income and an indirect utility based on the relative positioning in the workplace.\(^{19}\)

The utility function is therefore:

\[
U_i^j = w_i^j - a q_i \max(0, \left( \frac{w_i^s}{a_i} - \frac{w_i^j}{a_i^j} \right))
\]  

(5)

Where $w_i^j$ is the wage of agent of type $J$ in pair $i$, $w_i^s$ is the wage of co-worker of type $S$ in pair $i$, $a_i^j$ is the agent’s ability, and $a_i^j$ is the co-worker’s ability. Furthermore:

\[
q_i = \text{prob}\left( \frac{w_i^j}{a_i^j} > \frac{w_i^j}{a_i^j} \right)
\]  

(6)

The relative pay component is composed of three elements. The first two are identical to Fehr and Schmidt’s (1999) fairness model and the third is using the result of “risk loving” in negative payoff of Kahneman and Tversky’s (1979) Prospect Theory):

1. The size of the gap between the agent’s wage and his/her co-worker’s wage.\(^{20}\)

The wages are normalized to each worker’s level of ability ($a$).

---

\(^{19}\) The agent’s exertion of effort is normalized to 0 since effort is discrete and is always exerted.
2. The parameter $\alpha$ ($0<\alpha<1$) represents the level of resentment of inferiority. Note that $\alpha$ is equal for all agents.

3. The probability of inferiority ($q$) multiplies the expression representing the dislike of wage inferiority. Hence, when $q=1$ the agent is positive that the standardized co-worker’s wage exceeds his/her own standardized wage. When $q=0$, there is no wage inferiority.\footnote{Prospect Theory (Kahneman and Tversky, 1979) may imply that the effect of the certainty level changes along the scale of probabilities. If this is the case, it means that there is discontinuity in the utility function around the point where $q=1$. Since the model captures the effect of vagueness quite successfully, I omitted this kind of supplement from the model for the sake of simplicity.}

This utility function contains several important features: First, the agent’s utility corresponds positively to his/her wage and corresponds negatively to wage inequality. However, the agent’s utility does not change when a one dollar increase in the co-worker’s wage is matched with a smaller increase, $(\alpha/(1+\alpha))$ dollar, in the agent’s wage.\footnote{In case of certain inferiority ($q=1$) and equal ability level.} Thus, it is feasible to achieve higher inequality without harming the underpaid agents’ utility. But when the relative increase in the co-workers’ wage exceeds a certain magnitude, the agent’s utility decreases. Thus, under some circumstances, agents may sacrifice a wage increase due to relative pay considerations. More specifically, an agent may sacrifice some income by becoming self-employed rather than in a firm that offers a better nominal wage but high inequality.\footnote{This result is supported by the empirical findings made by Schmitt and Marwell (1972, 1975).}

Second, where inferiority exists, a decrease in the co-worker’s wage increases the agent’s utility. Moreover, whenever the decrease in the co-worker’s wage is large enough, an underpaid agent may experience a pay cut but exhibit higher utility.

Third, where ambiguity exists, greater variance in the co-worker’s wage estimator decreases the probability of inferiority ($q$) and, therefore, improves the agent’s utility. In other words, the agent is indifferent between a situation in which minor inequality is combined with low variability and a situation in which higher expected inequality is coupled with higher variability.

\footnote{Agents estimate their relative position by comparing their wage with the reference wage. Following empirical evidence (Rees, 1993), I assume that agents compare themselves with the nearest similar agent—a co-worker. (When the agent is self-employed, I assume that no relative positioning effect takes place.)}
Senior agents' utility function: Senior agents are the firm’s owners; therefore, they simply maximize their own profit (i.e., the residual wage after paying the junior agent). Thus, the utility function of a senior agent is:

\[ U_i^s = w_i^s \]  

(7)

1.3.3 Secrecy Norm and Information

The agents in the economy may share a wage-secrecy norm (SN). The norm is basically a socially imposed limitation on a certain behavior (information transmission, in this model). Like any other convention, the norm and its strength are the result of continuous public behaviors and beliefs and are subject to constant negotiation and evolution over time. In the short run, however, agents experience the norm as an exogenous rule that is not subject to changes or policy decisions.

The SN is modeled by assigning a probability \( p \) (\( 0 \leq p \leq 1 \)) to wage disclosure. In each period, in \( p \) of the firms there is a disclosure of information. When \( p=0 \), the secrecy norm is absolute and the probability of wage disclosure is zero. When \( p=1 \), there is no secrecy at all, i.e., in every firm all wage data are revealed in every period. The revealed information is the aggregate wage level (intuition: outsiders disclose the average wage level in the firm) which is actually the total production of the firm. When a wage disclosure happens, the information becomes common knowledge to outsiders only at the end of the period. Thus, this information has different effects on insiders and outsiders: For an insider, wage disclosure means that the agents know exactly what their co-workers earn. However, outsiders may use the wage information only to estimate the expected productivity parameter for the next generation.

Another modeling possibility is that only the junior agent’s wage is disclosed (instead of the average wage in the firm). In this case, the junior employee may extract some more accurate information regarding the PM and, therefore, lowers the variance of the productivity estimator in some cases. This way of modeling, however, does not change the results of the model dramatically. (Its major effect is to decrease the variances of the estimators.)
The information structure: All agents know their own ability and observe their co-worker ability \( (a'_i \text{ and } a'_j) \).\(^{25}\) However, agents cannot observe the ability of workers in other firms and of self-employed agents; all they can know is the distribution of abilities in the economy. Additionally, agents are familiar with the parameters of the model \( (\alpha, \rho, M^d, M^u) \) and its design.

In the firm’s sector, only senior agents know the industry’s aggregate shock. Therefore, only they know their industry’s (and thus firm’s) productivity parameter. Due to the SN, junior employees do not know the wages in their firms or in any other firm when they are matched and receive a contract offer. Due to the fairness consideration, however, the utility of each junior agent depends on co-workers’ wages. Therefore, each junior worker has to generate an estimate of the senior agent’s wage, denoted by \( \hat{w}^s_i \). A junior employee can estimate a senior employee’s wage by estimating the total output of the firm and subtracting his/her own wage. Still, a junior worker is ignorant of his/her industry’s productivity parameter and has to estimate it on the basis of available information on production in the industry. For each industry, \( pN_b \) firms go through wage revelation in each period. This means that, the only available public information in period \( t \) about the industry’s productivity parameters is the revealed \( pN_b \) observations of the total wages (or production) in the industry from period \( t-1 \). The agents use this information in order to generate their estimation regarding the total production in their firm in the current period.

1.3.4 Scheduling

1. At the beginning of period \( t \), \( N^s \) junior agents are randomly matched with firms that have a senior agent. Unmatched junior agents become self-employed.

2. Each junior agent generates a rational expectation estimator for the productivity parameter of the industry, based on the period \( t-1 \) wage disclosure.

\(^{25}\) Other works (e.g., Gan (2002)) introduce some bias in people’s perception of their own ability. Although this effect is important and may exist under various circumstances, it falls outside the scope of this model. Just the same, biased self-perception may be another strong driving force in favor of wage secrecy within the setting of this model.
3. Based on the junior agent ability and the productivity parameter each firm offers its junior agent a contract at a certain wage level.

4. Each junior agent adjusts his/her expectation in view of the firm’s wage offer.

5. Each junior agent decides whether to accept the contract or to leave the firm and become self-employed.

6. Wage disclosure occurs in \( p \) of the firms. In these firms, junior employees immediately revalue their contracts and have to decide whether to honor them or to “stop playing by the rules” and move to the self-employment sector. When they quit, production is irreparably damaged and the firm’s output value falls to zero.\(^{26}\)

7. Production is finished and the agents receive their remuneration.

8. At the end of period \( t \), a new generation replaces the old one.

### 1.4. Analysis

First, we analyze firms and workers behaviors under the two extreme cases: full information and absolute secrecy. Later, we construct the equilibrium under partial secrecy and discuss the possible wage strategies of the firm. Lastly, we discuss the formation and support of the secrecy norm.

### 1.4.1 Wage and Production under Full Information (no secrecy norm, \( p=1 \))

When there is no SN (\( p=1 \)), the agent and the firm know the actual production level and the co-worker’s actual wage is revealed. Therefore, when making its contract offer, the firm acts as if the agent already knows its total wage scheme. The firm’s aim, then, is to make sure that the employee will not quit after the wage disclosure. To attain its goal, it has to equalize the utility of the junior agents to the reservation utility in the self-employment sector.

---

\(^{26}\) One may regard this setting as two periods of production. In the first period, the firm offers a contract and production begins. In the second, the employee may discover the true co-worker wage and quit. For simplicity’s sake, I omitted this extension.
Low productivity: When productivity is low \((m_{b,t}=M_d)\), the firm has to pay the junior agent at least his alternative value. We denote \(w^{j}_{i,t}(M_d)\) as the minimum acceptable wage of the junior agent when productivity is low.

\[
w^{j}_{i,t}(M_d) = a^{j}_{i,t}M_d
\]

(8)

Consequently, the senior-agent wage is:

\[
w^{d}_{i,t}(M_d) = M_d
\]

(9)

In this case, the senior agent’s wage (normalized to ability) is equal to the junior agent’s wage. Since \(q=0\), no inferiority feelings are aroused.

High productivity: When productivity is high \((m_{b,t}=M_u)\), the firm may increase the senior agent wage more than the wage of the junior agent and therefore, the senior agent’s (ability-normalized) wage certainly exceeds the junior agent’s wage \((q=1)\). Therefore, the junior agent’s utility function becomes:

\[
U^{j}_{i,t} = w^{j}_{i,t} - \alpha \left( \frac{w^{j}_{i,t}}{1} - \frac{w^{j}_{i,t}}{a^{j}_{i,t}} \right)
\]

(10)

Hence, a junior agent will quit unless his/her utility is as high as the utility in the self-employment sector:

\[
w^{j}_{i,t} - \alpha \left( \frac{w^{j}_{i,t}}{1} - \frac{w^{j}_{i,t}}{a^{j}_{i,t}} \right) \geq a^{j}_{i,t}M^d
\]

(11)

We denote \(w^{j}_{i,t}(M_u)\) as the minimum acceptable wage of the junior agent when productivity is high:

\[
w^{j}_{i,t}(M_u) = \left( \frac{a^{j}_{i,t} \alpha}{(a^{j}_{i,t} + \alpha)} \right)w^{s}_{i,t} + \frac{(a^{j}_{i,t})^2}{(a^{j}_{i,t} + \alpha)}M_d
\]

(12)

When the firm pays \(w^{j}_{i,t}\) the residual senior-employee wage is:

\[
w^{j}_{i,t}(M_u) = Y_{b,i} - w^{j}_{i,t} = (a^{j}_{i,t} + 1)M_u - w^{j}_{i,t}
\]

(13)
Thus:

\[
\frac{w_{i,j}^r(M^u)}{w_{i,j}^r(M^u)} = \left(\frac{a_{i,j}^r + \alpha}{a_{i,j}^r (1 + \alpha) + \alpha}\right)(a_{i,j}^r + 1)M^u - \frac{(a_{i,j}^r)^2}{a_{i,j}^r (1 + \alpha) + \alpha}M^d
\]  

(14)

By placing Equation (14) into Equation (12), we obtain:

\[
\frac{w_{i,j}^j(M^u)}{w_{i,j}^j(M^u)} = \left(\frac{a_{i,j}^j + \alpha}{a_{i,j}^j (1 + \alpha) + \alpha}\right)(a_{i,j}^j + 1)M^u + \frac{(a_{i,j}^j)^2}{a_{i,j}^j (1 + \alpha) + \alpha}M^d
\]  

(15)

Therefore, when the firm pays \( w_{i,j}^j \), the residual senior-employee wage is:

\[
\frac{w_{i,j}^s(M^u)}{w_{i,j}^s(M^u)} = Y_{b,i} - \frac{w_{i,j}^j}{w_{i,j}^j} = \left(\frac{a_{i,j}^s + \alpha}{a_{i,j}^s (1 + \alpha) + \alpha}\right)(a_{i,j}^s + 1)M^u - \frac{(a_{i,j}^s)^2}{a_{i,j}^s (1 + \alpha) + \alpha}M^d
\]  

(16)

Note that for all \( M^u > M^d \) the normalized senior-employee wage exceeds the normalized junior-employee wage.

\[
\frac{w_{i,j}^s(M^u)}{w_{i,j}^s(M^u)} > \frac{w_{i,j}^j(M^u)}{w_{i,j}^j(M^u)} \frac{1}{a_{i,j}^j}
\]  

(17)

1.4.2 Wage and Production under Absolute Secrecy (p=0)

In the other extreme case, the secrecy norm is absolute. Employees receive no information about wages in the previous generation and the probability of wage disclosure is zero. Thus, the estimated productivity parameter (\( \hat{m}_{b,i} \)) for each industry is simply given by the prior probabilities (0.5):

\[
\hat{m}_{b,i}(p = 0) = \bar{m}_{b,i} = (0.5M^d + 0.5M^u)
\]  

(18)

Notably, under this circumstance the probability of inferiority (\( q \)) is also constant and equals 0.5.\(^{27}\) Based on his/her utility function (Equation 5), a junior worker will accept a job contract only if the expected utility is as high as the expected utility in the self-
employment sector. We express as $w_{i,t}^j$ the minimum acceptable wage for a junior agent when the SN is absolute and the corresponding senior-employee wage as $w_{i,t}^s$. Thus, the minimal acceptable wage has to satisfy the following condition:

$$w_{i,t}^j - 0.5\alpha \left(\frac{w_{i,t}^s}{a_{i,t}^j} - \frac{w_{i,t}^j}{a_{i,t}^j}\right) - a_{i,t}^j M^d = 0 \quad (19)$$

This may be rewritten into:

$$w_{i,t}^j = \left(\frac{0.5a_{i,t}^j\alpha}{a_{i,t}^j + 0.5\alpha}\right)\check{w}_{i,t}^j + \left(\frac{(a_{i,t}^j)^2}{a_{i,t}^j (1 + 0.5\alpha) + 0.5\alpha}\right)M^d \quad (20)$$

Therefore, the minimal acceptable junior wage is:

$$w_{i,t}^j = \left(\frac{0.5a_{i,t}^j\alpha}{a_{i,t}^j (1 + 0.5\alpha) + 0.5\alpha}\right)(1 + a_{i,t}^j)\bar{m}_{b,t} + \frac{(a_{i,t}^j)^2}{a_{i,t}^j (1 + 0.5\alpha) + 0.5\alpha}M^d \quad (21)$$

Equation 20 indicates that under conditions of absolute secrecy the wage of a junior agent is constant. Moreover, the utility of a junior agent is set to equal his/her utility under the outside option (utility in the self-employed sector). However, the corresponding senior-agent wage is dependent on actual productivity. Since the junior-agent wage is constant, all volatility in total production is transferred to the senior agent.\(^{28}\) Interestingly, in cases of low productivity, the lack of information gives the junior employee a rent. This rent is feasible, in part, because the outside-option value of senior employees is zero. For this reason, senior agents have to compensate junior agents for the ambiguity in perceived relative pay, even if this means earning less than the junior agent when productivity is low.

We can now use (20) to calculate the residual wages of seniors in the case of secrecy. The senior-employee wage when the productivity parameter is high is the following:

$$w_{i,t}^s(M^u) = \left(\frac{a_{i,t}^j}{a_{i,t}^j (1 + 0.5\alpha) + 0.5\alpha}\right)(1 + a_{i,t}^j)\bar{m}_{b,t} + (1 + a_{i,t}^j)\left[M^u - \bar{m}_{b,t}\right] - \frac{(a_{i,t}^j)^2}{a_{i,t}^j (1 + 0.5\alpha) + 0.5\alpha}M^d \quad (21)$$

\(^{28}\) Note that both agents are assumed to be risk-neutral.
When productivity is low the senior-employee wage is:

\[ w^*_j(M^d) = \left( \frac{a'_j + 0.5\alpha}{a'_j(1+0.5\alpha)+0.5\alpha} \right) (1+a'_j)m_{h,j} + (1+a'_j) \left[ M^d - \overline{m}_{h,j} \right] - \frac{(a'_j)^2}{a'_j(1+0.5\alpha)+0.5\alpha} M^d \]  

(22)

Note that the ex ante expectancy value of \((m_{h,j} - \overline{m}_{h,j})(a_j + 1)\) is zero. Therefore, the wage estimated by a junior agent of the senior-employee satisfies the rational expectations framework.

**Proposition 1:**

The wage expectancy of a junior agent is lower under absolute secrecy than under full information. The wage expectancy of a senior agent is higher under absolute secrecy than under full information.

Proof: see Appendix, part 1. ■

**Proposition 2:**

The utility of a senior agent is higher under full secrecy than under full information. The utility of a junior agent is equal in both cases and adds up to \(a'_j M^d\) — the alternative reservation value.

Proof (intuition): the utility of the senior agent is higher under full secrecy because his/her wage expectancy is higher (Equation 22 versus Equation 23). The junior agent’s utility is constant because the contract in both cases is based on leveling the employee’s outside-option value. This is why junior-employee utility rests at its lower bound.

Propositions 1 and 2 indicate that the model satisfies the immediate intuition about secrecy. An absolute secrecy norm allows the firm to widen the actual wage gap at no cost to the junior employee’s utility. Thus, secrecy aggravates inequality in income distribution. Note that since cooperation is always achieved in both cases, the firm achieves maximal production. Moreover, secrecy produces a pseudo-surplus in the utility.

---

29 Equation 22 must be \( > 0 \) to prevent negative utility for the senior agent and, hence, no-production. This condition is largely satisfied unless \((M^d - M')\) is very large, e.g., \(M^d > 5 M'\), when abilities are equal and \(\alpha = 1\).
of junior agents - on average they achieve equal utility on a lower wage level. The
distribution of this surplus is, of course, an outcome of the bargaining positions and
relative outside options of both agents. In our model, due to the bargaining positions of
the agents, this entire surplus is distributed to the senior agents and results in a higher
average wages.

In another dimension, the transfer from full information to secrecy may also be
interpreted as a shift from one bargaining position to another. The junior agent loses the
ability to monitor the firm’s production and, for this reason, forfeits potential bargaining
power in the case of high productivity. Under secrecy, however, the junior agent refuses
any wage under \( w^j \) – and therefore receives a rent for lack of information in the case of
low productivity.

Lastly, another aspect is risk transfer: when the economy shifts from full information to
absolute secrecy, all the risk is transferred to the firm and, hence, to the senior agents.
Since both agents and firms are risk-neutral in this model, the risk transfer itself has no
effect on the outcomes. In the common scenario, however, in which the employee is more
risk-averse than the firm (or the more affluent player), secrecy may produce an additional
utility surplus.

### 1.4.3 Productivity and Relative-Wage Estimation under Partial Secrecy (1<p<0)

When the secrecy norm is partial, there is some intergenerational information about
wages and production. As stated, the information set in each period includes the average
wages (=output) that were revealed in period \( t-1 \). Output is a function of the productivity
parameter and the employees’ levels of ability, but since the abilities of other employees
are unknown, the junior agent uses the mean value. As a result the estimated productivity
is given by:

\[
\hat{m}_{h,t-1} = \left[ \frac{1}{pN_b} \sum_{t=1}^{N_b} \left( \frac{w^h_{b,t-1} + w^j_{b,t-1}}{E[a_{j,f} + 1]} \right) \right] = \left[ \left( \frac{1}{A' + 1} \right) \bar{Y}_{b,t-1} \right]
\]

(23)

Where \( \bar{Y}_{b,t-1} \) is the average revealed production value (=total wages) in industry \( b \) in
period \( t-1 \).
According to the Central Limit Theorem, $\hat{m}_{b,t-1}$ is a normally distributed stochastic variable with an expectancy of $m_{b,t-1}$ and variance that depends on $p$. Note that $p$ corresponds negatively to the variance of the estimator. The stronger the secrecy norm, the less information is revealed and less accurate the estimated productivity parameter is. As $p$ increases, however, there are more samples of firms’ outcomes and the variance of the previous productivity parameter estimator decreases.

$$\hat{m}_{b,t-1} \sim N (m_{b,t-1}, \sigma_{\hat{m}_{b,t-1}}^2)$$  \hfill (24)

Where:

$$\sigma_{\hat{m}_{b,t-1}}^2 = \frac{(m_{b,t-1} \sigma^2_{A^j} + (A^j + 1)(pN_b))}{(A^j + 1)(pN_b)}$$  \hfill (25)

The agent knows, however, that the wage observations are derived from one of the two possible distributions ($M^u$ expectancy or $M^d$ expectancy) that display the following corresponding variances:

$$\sigma_{\hat{m}_{b,t-1}}^2 (m_{b,t-1} = M^u) = \sigma^2_{M^u,t-1}(p) = \frac{(M^u \sigma^2_{A^j} + (A^j + 1)(pN_b))}{(A^j + 1)(pN_b)}$$  \hfill (26)

$$\sigma_{\hat{m}_{b,t-1}}^2 (m_{b,t-1} = M^d) = \sigma^2_{M^d,t-1}(p) = \frac{(M^d \sigma^2_{A^j} + (A^j + 1)(pN_b))}{(A^j + 1)(pN_b)}$$  \hfill (27)

Since there are only two optional productivity parameters, the agent uses $\hat{m}_{b,t-1}$ to determine what the productivity parameter was in the last period. Denote $v_{b,t}(p)$ as the probability that $m_{b,t-1} = M^u$. Then, $v_{b,t}(p)$ is calculated using the density functions of the two alternative wage observation distributions from period $t-1$. Clearly, the accuracy of $v$ depends on the secrecy level, the relative gap between high and low productivity and the heterogeneity in the abilities among junior agents. Technically, $v_{b,t}(p)$ is given by:

$$v_{b,t}(p) = \frac{1 - e^{-\frac{1}{2} \left( \frac{\hat{m}_{b,t-1} - M^u}{\sigma_{M^u,t-1}(p)} \right)^2}}{e^{-\frac{1}{2} \left( \frac{\hat{m}_{b,t-1} - M^u}{\sigma_{M^u,t-1}(p)} \right)^2}} + \frac{1 - e^{-\frac{1}{2} \left( \frac{\hat{m}_{b,t-1} - M^d}{\sigma_{M^d,t-1}(p)} \right)^2}}{e^{-\frac{1}{2} \left( \frac{\hat{m}_{b,t-1} - M^d}{\sigma_{M^d,t-1}(p)} \right)^2}}$$  \hfill (28)

30 Since $m_{b,t-1}$ is unknown, the values of $\hat{m}_{b,t-1}$ are used to calculate the variance.
Less secrecy (a higher probability of wage disclosure) helps employees to improve their estimations of actual productivity. Thus, for \( v(p) > 0.5 \), \( p \) is positively correlated to \( v \), i.e., whenever high productivity is more likely, less secrecy increases \( v \) but when \( v(p) < 0.5 \), higher \( p \) causes the value of \( v(p) \) to decrease. \(^{31}\)

The current-period productivity parameter estimation is based on the last-period estimated productivity parameter and the Markov chain’s coefficient, \( \rho \). \(^{32}\) Hence, the probability of a high productivity parameter in the current period in industry \( b \) is:

\[
q_{b,t}(p) = \rho q_{b,t-1}(p) + [1 - q_{b,t}(p)](1 - \rho)
\]

(29)

Note that the probability of high productivity is also the probability of wage inferiority (Equation 2). Since the outside option of a junior agent (self-employment) is equal to his/her wage in a low-production firm under full information, any higher productivity causes wage inferiority.

The Construction of Wage Expectations: When a junior agent receives a contract offer, his/her information set includes his/her ability, the co-worker’s ability, and an estimation of the probability of wage inferiority (=of a high production parameter). Therefore, the rational-expectations value of the senior-employee wage is given by:

\[
\hat{w}^j_{b,t} = \bar{m}_{b,t}(a_j + 1) - w^j_{b,t}
\]

(30)

Where:

\[
\bar{m}_{b,t}(p) = [(1 - q_{b,t})M^d + q_{b,t}M^f]
\]

Thus, the lowest acceptable wage offer for a junior agent ex ante is:

\[
w^j_{b,t}(q) = \left( \frac{q_{b,t}(p)a_t^j\alpha}{a_t^j(1 + q_{b,t}(p)\alpha) + q_{b,t}(p)\alpha} \right)(1 + a_t^j)\bar{m}_{b,t} + \frac{(a_t^j)^2}{a_t^j(1 + q_{b,t}(p)\alpha) + q_{b,t}(p)\alpha}M^d
\]

(31)

Note that the determination of the minimal acceptable junior-employee wage under absolute secrecy is a private case of the foregoing equation when \( p=0, q_{b,t}(p)=0.5 \) and

\(^{31}\) In this range, \( v \) also corresponds positively to the size of each industry and it is negatively connected to the ability variance \( (\sigma^2_{A,j}) \).  

\(^{32}\) In the extreme case where \( \rho = 1, q_{b,t}(p) = 0, q_{b,t}(p) \). Note that \( \rho \) must be larger than zero; otherwise the information revealed in period \( t-1 \) would be irrelevant to any estimation about period \( t \). As stated, \( \rho \) is assumed to be larger than 0.5 in order to evoke a positive serial correlation.
\[ \bar{m}_{b,t} = (0.5M^d + 0.5M^u) \]. Moreover, the determination of the minimum acceptable wage under full information is another private case of the foregoing equation when \( p=1 \), \( q_{b,t}(p)=1 \) and \( m_{b,t}=M^u \) or \( p=1 \), \( q_{b,t}(p)=0 \) and \( m_{b,t}=M^d \).

**Proposition 3**

In the event of wage disclosure in high-productivity firms, junior agents who are paid the ex-ante minimum acceptable wage will quit. In the event of wage disclosure in low-productivity firms, junior agents who are paid the ex ante minimum acceptable wage will not quit.

**Proof:** immediate from \( \frac{\partial w_j^i}{\partial q_{b,t}} > 0 \). For the complete derivative, see Part 2 of the Appendix, intuition is given below.

The derivative of the minimum acceptable wage to the probability of inferiority (\( q \)) is positive. When \( q \) decreases the acceptable wage decreases. Therefore, for any \( q<1 \) the minimum acceptable wage is lower than the minimum acceptable wage under full information (\( q=1 \)). Thus, when a junior agent discovers the actual wage information and the firm’s productivity level is high (\( q=1 \)), the ex ante wage will cause outside utility to exceed current utility and he/she will quit. When the same wage disclosure occurs at low productivity (\( q=0 \)), the ex ante wage remains higher than the minimum acceptable wage under full information and low productivity; thus, the junior agent will stay with the firm and enjoy higher utility than the ex ante (and outside-option) utility.

The following example illustrates this proposition: a worker who is satisfied with his/her work and wage and estimates the co-worker’s wage suddenly discovers the co-worker’s actual wage. If the wage is higher than the estimate, the worker is offended and possibly quit. If the actual o-worker’s wage is lower than the estimate, the worker will probably feel better about his/her own compensation and will surely stay with the firm.

Note that a key feature of the model, one that allows this preposition to stand, is the asymmetry in the bindingness of a job contract. The firm can not change the contract during the employment period but the employee is free to quit at the time of his/her
choosing. Thus, the contract offer is binding on the employer but conditioned on the employee’s approval.

1.4.4 Equilibrium

Equilibrium is defined as the couple of a wage contract offered by any identical firm and the corresponding junior worker behavior (acceptance or not). The contract is set in accordance with the strength of the secrecy norm \( p \) and is based on the junior worker’s specific ability \( a_i \) and the common estimated industry productivity parameter — \( \bar{m}_b(p) \). The contract is optimal; i.e., it maximizes the expected utility of each firm according to its productivity parameter. In equilibrium, all junior employees are best advised to accept the contract. Some, however, may quit after wage disclosure. The solution concept in this paper is strictly dominated pure strategies.

1.4.5 Wage Strategies

Wage contracts imply two possible signaling outcomes: “separation” and “pooling”. A wage contract is separating if the employee can infer correctly what the firm's productivity is given the offered wage. A wage contract is tagged “pooling” if the wage that is offered doesn't provide any additional information to the worker. Each is practiced within a different range of wage secrecy.

**Proposition 4**

For every \( p (1>p>0) \) a unique equilibrium exists in which the firm invokes one of two strategies. When \( (1>p>\Phi_1) \) the strategy is separation (FS). When \( (\Phi_1>p>\Phi_2) \), the strategy is separation with reliability costs (RS), and when \( (\Phi_2>p\geq0) \) the strategy is pooling (FP).

Definitions and proofs are given in the following sub sections.

1.4.5.1 Separation Strategy (FS)

A firm may choose to disclose its productivity by offering a job contract that signals the actual level of the industry productivity parameter to the junior agent. Thus, the firm offers wage \( w_{j,t}(M^d) \) when \( M_b=M^d \) and offers wage \( w_{j,t}(M^s) \) when \( M_b=M^s \). In this case,
the ambiguity disappears; the junior agent has full information about the firm’s productivity even without disclosure of actual wage. Where this strategy is used, wage disclosure does not affect the junior agent.

The implementation of the FS strategy, however, involves a credibility issue. The junior agent has to trust the firm when s/he is offered a low contract \([w^j_i(M^d)]\) since the firm may signal low productivity but achieve high production. Of course, no similar problem occurs when the firm offers a high contract \([w^j_i(M^u)]\). When the probability of wage disclosure \(p\) is high enough, the junior employee knows that deception is not worth the firm’s while because, in the likely event of discovery, s/he will quit and the firm’s utility will drop to zero. When \(p\) decreases, however, the employee loses the monitoring device and may be susceptible to deception.

Thus, the FS strategy is credible only if the loss of the senior employee in the case of wage disclosure (which happens in probability \(p\)) and of quitting exceeds the benefit of paying the junior employee a lower wage by means of deceptive signaling. Therefore, the technical condition:

\[
p\tilde{w}^x_{i,d} (M^u) \geq w^x_{i,d} (M^u) - w^x_{i,d} (M^d)
\]

(32)

Where:

\[
\tilde{w}^x_{i,d} (M^u) = (1 + a^x_{i,d})M^u - w^x_{i,d} (M^d).
\]

The expression on the left side of Equation 30 denotes the expectancy of wage loss for the senior employee upon high-productivity shock when the junior employee is given a low-productivity-scenario wage and wage disclosure follows. The expression on the right is the loss incurred by paying junior agents a minimum acceptable wage at high productivity rather than the lower minimum acceptable wage at low productivity. We use \(\Phi_1\) to denote the minimum wage revealing probability that satisfies the above condition:

\[
\Phi_1 = \left(\frac{w^x_{i,d} (M^u) - w^x_{i,d} (M^d)}{\tilde{w}^x_{i,d} (M^u)}\right)
\]

(33)

Since \((1 \geq p \geq 0)\), whenever \(\Phi_1 \leq 1\), a credible separation exists.
Notably, as $p$ rises toward 1, the probability of disclosure grows and it is increasingly ill-advised for the firm to deceive the agent. When $p=1$, disclosure takes place in every period and the separation policy is always reliable. Thus, a separation policy is invoked when: $1 \geq p \geq \Phi_1$

Under this strategy, the junior agent is fully aware of the firm’s actual productivity when offered the contract. Thus, wage disclosure has no effect on his/her utility.

### 1.4.5.2 Separation Strategy with Reliability Problem (RS)

When $p<\Phi_1$, the firm cannot invoke an FS strategy due to lack of reliability (the junior agent cannot trust a wage offer of $\left[ w^j_i(M^d) \right]$ because the firm enjoys a positive return for deceiving). In the case of a low productivity parameter, however, it may raise a junior worker’s wage to a level at which s/he is convinced that it is optimal for the firm to signal the productivity parameter correctly. Thus, the firm pays a “trust premium” that compensates the junior agent for the loss of the ability to monitor actual productivity.

When $p<\Phi_1$, Equation 30 becomes:

$$p \tilde{w}^s_{i,t} (M^u) < w^j_{i,t} (M^u) - w^j_{i,t} (M^d)$$

Hence, the way to regain the junior agent’s trust is by paying a “trust premium,” denoted by $r_{i,t}$. The “trust premium” has to satisfy the following equivalence:

$$p \left( \tilde{w}^s_{i,t} (M^u) - r_{i,t} \right) = w^j_{i,t} (M^u) - \left( w^j_{i,t} (M^d) + r_{i,t} \right)$$

Which implies: $r_{i,t} = \frac{w^j_{i,t} (M^u)}{1-p} - a^j_{i,t} M^d - \frac{p}{1-p} (1 + a^j_{i,t}) M^u$. The expressions $\tilde{w}^j_{i,t} (M^d) = w^j_{i,t} (M^d) + r_{i,t}$ and $\tilde{w}^s_{i,t} (M^u) = (1 + a^j_{i,t}) M^u - \tilde{w}^j_{i,t} (M^d)$ denote the corresponding wages including the “trust premium”. Thus, Equation 33 may be rewritten as:

$$\tilde{w}^j_{i,t} (M^d) = w^j_{i,t} (M^u) - p \tilde{w}^s_{i,t} (M^u)$$

29
Thus, $\tilde{w}_{i,j}^d(M^d)$ is the lowest acceptable reliable wage for a junior agent when productivity is low. A wage of $\tilde{w}_{i,j}^d$ deters the firm from making false claims. The corresponding senior-agent wage is:

$$\tilde{w}_{i,s}^d(M^d) = (1 + a_{i,t}^j)M^d - \tilde{w}_{i,d}^j(M^d)$$ \hspace{1cm} (37)

When productivity is high, however, the firm offers the junior agent $[w_{\tilde{w}_{i,j}}^d(M^f)]$ and signals that productivity is high. Therefore, under this strategy, the junior agent is fully aware of the firm’s actual productivity when the contract offer is made. Thus, wage disclosure has no effect on his/her utility.

Note that since $\frac{\partial r_{i,j}}{\partial p} < 0$, $\tilde{w}_{i,j}^f(M^d)$ rises as $p$ decreases toward higher secrecy levels. Thus, the stronger the secrecy norm is and the less able the junior agent is to monitor the firm’s productivity, the higher the price the firm must pay to gain reliability. At a certain point, denoted by $\Phi_2$, the price becomes too high and the firm shifts to a pooling strategy.

**1.4.5.3. Full Pooling Strategy**

In pooling, the firm does not signal its actual productivity and, therefore, pays the ex ante minimum acceptable junior-agent wage under uncertainty: $w_{i,j}(q)$. The transition condition is given by:

$$\tilde{w}_{i,j}^f(M^d) \geq w_{i,j}(q)$$ \hspace{1cm} (38)

When $p < \Phi_2(q)$, the reliable separation wage at low productivity is larger than the minimum acceptable wage under ambiguity. Thus, when productivity is low, the firm would rather pay the lower wage, $w_{i,j}(q)$. When productivity is high, since $w_{i,j}(q)$ is lower than the reliable wage, the firm would find it more profitable to pay the junior agent the lower wage and to risk wage loss in the case of wage disclosure. Thus, the firm acts in the same manner at both high and low productivity and the firm’s contract offer sends the junior employee no signal at all.
In the pooling strategy, the firm pays $w_{i,t}^j(q)$ irrespective of its actual productivity parameter. When wage disclosure occurs (in probability $p$), the junior employee quits if $m^h=M^u$ and stays if $m^h=M^d$. Note that under the pooling strategy, there is a positive probability of the junior employee’s departure. When the actual productivity parameter is low, however, the junior employee stays after wage disclosure and his/her utility increases because $q$ falls to zero. In this case, the junior agent receives a wage that is higher than the minimum acceptable wage due to the wage compensation that was given by the potential wage inferiority.

Note that $\Phi_2$ is a function of $q$, which itself depends on $p$. The influence is negative: the higher the $q$, the lower the $\Phi_2$. This is why, surprisingly, a firm with negative productivity shock is more likely to employ a pooling strategy (this, however, depends on the equilibrium concept we use). Additionally, it is possible that a firm would choose different strategies in response to different $q$ levels even though the secrecy level is the same. Although $q$ is dependent on $p$, it is also the outcome of specific observation from period $t-1$; thus, one secrecy level may result in different $q$ values.

The firm continues to invoke the pooling strategy as long as the secrecy norm satisfies:

$$0 \leq p \leq \Phi_2(q)$$  \hspace{1cm} (39)

In the extreme case of $p=0$, $q$ is determined to $0.5$ and the firm always offers $w_{i,t}^j(q = 0.5)$. In this case, no disclosure occurs and the employee always stays with the firm.

**Proposition 5**

For each type of agent, there is a segment of the secrecy norm at which secrecy elicits higher utility than full information (no secrecy norm).

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33 Our equilibrium concept doesn’t include second and third round of strategic dominance that could dismiss such behaviors (since if only under low productivity pooling is chosen, it reveals a relevant information to the junior agent and introduce us the a second level of credibility considerations). However, since from a certain secrecy level, it is optimal to a firm under any productivity level to adopt pooling, the existence of previous segment of pooling is not crucial to our results.
Proof:

First we consider the Junior-agent utility level under the different wage strategies:

Separation strategy: For $1 \geq p \geq \Phi_1$, the junior agent is signaled and therefore knows the actual productivity. The wages are identical to those offered at full information (Equations 8 and 15). Thus, utility is constant and equals that in the self-employment sector.

$$E(u_j^i \mid 1 > p \geq \Phi_1 ) = a_{i,t}^j M^d$$

When $\Phi_1 > p \geq \Phi_2$, the firm pays a “trust premium” when its productivity parameter is low. Thus, the employee gains some extra utility. When productivity is high, the junior agent’s utility is $a_{i,t}^j M^d$.

$$E(u_j^i \mid \Phi_1 > p \geq \Phi_2 ) = 0.5(a_{i,t}^j M^d + r_{i,t}^j) + 0.5a_{i,t}^j M^d = a_{i,t}^j M^d + 0.5r_{i,t}^j$$

Since $\frac{\partial r_{i,t}^j}{\partial p} < 0$, $\frac{\partial E(u_j^i)}{\partial p} < 0$ and the utility of a junior agent in this segment increases as $p$ decreases.
**Pooling strategy:** For $\Phi_2 > p \geq 0$, the wage is $w_{j,t}^j(q)$ generating an ex ante utility of $a_{i,t}^j M^d$.

At probability $p$, however, wage disclosure occurs. When the production parameter is high, the agent quits but the utility is unchanged. When production is low, the employee gains extra utility because s/he realizes that s/he has overestimated the co-worker’s wage. Thus:

$$E(u_i^j \mid \Phi_2 > p \geq 0) = a_{i,t}^j M^d + 0.5 p (w_{j,t}^j(q) - a_{i,t}^j M^d)$$ (42)

Since $\frac{\partial E(u_i^j)}{\partial p} > 0$ in this segment, the utility decreases commensurate with $p$. Note that as $p$ approaches 0 the utility converges with the utility at absolute secrecy, which is equal to the reservation utility ($a_{i,t}^j M^d$). However, in the entire segment up to $\Phi_2$, the utility expectancy of a junior agent surpasses the utility expectancy under full information.

Second, we calculate the senior agent utility under the different wage strategies (remember that a senior agent’s utility is equal to his/her wage):

**Separation strategy:** For $1 \geq p \geq \Phi_1$, the agent receives constant wages and does not quit (maximum production). Thus, the utility expectancy is also constant:

$$E(u_i^s \mid 1 > p \geq \Phi_1) = 0.5 w_{s,t}^s (M^u) + 0.5 w_{s,t}^s (M^d)$$ (43)

However, when $\Phi_1 > p \geq \Phi_2$ the firm pays a “trust premium” whenever productivity is low. Still, some signaling takes place and the agent does not quit in the case of wage disclosure. Therefore, production is at its peak.

$$E(u_i^s \mid \Phi_1 > p \geq \Phi_2) = 0.5 w_{s,t}^s (M^u) + 0.5 \left( w_{s,t}^s (M^d) - r_{i,t} \right)$$ (44)

In this segment, $\frac{\partial E(u_i^s)}{\partial p} > 0$. Thus, the agent’s utility expectancy decreases as $p$ decreases and as the SN strengthens. In this segment of the secrecy norm, then, the utility of a senior agent is lower than it would be under full information.

---

34 See Proposition 2.
**Pooling strategy**: For $\Phi_2 > p \geq 0$, the firm pays $w^s_{i,t}(q)$ and the ex ante senior wage expectancy is $0.5(1 + a_{i,j})(M^u + M^d) - w^s_{i,t}(q)$. When high productivity is revealed, however, the junior employee quits and the senior wage drops to zero. Thus, the total utility expectancy becomes:

$$E(u^s_i \mid \Phi_2 > p \geq 0) = 0.5w^s_{i,t}(M^d) + 0.5(1 - p)w^s_{i,t}(M^u)$$  \hspace{1cm} (45)$$

In this segment, $\frac{\partial E(u^s_i)}{\partial p} < 0$. Additionally, when $p=0$ the utility of a senior agent converges with the ex-ante senior-agent utility. Following Proposition 2, the utility at absolute secrecy ($p=0$) surpasses that at full information. Thus, at least in some fraction on the verge of this segment, denoted by $p^*$ (where $\Phi_2 \geq p^* > p \geq 0$), the utility expectancy, $E(u^s_i)$ exceeds the senior agent’s utility at full information. Beyond this fraction, utility increases until it peaks when $p=0$.

**Proposition 6**

In the $(0 < p < p^*)$ segment, both types of agents prefers a secrecy norm over full information ($p=1$).

**Proof**: immediate, following the proof of Proposition 5.

Proposition 6 supply the main result of this paper: it confirms that both senior and junior agents prefer some secrecy over none. In the $0 < p < p^*$ segment, the utility expectancy of all agents is higher than the utility expectancy upon full information when no secrecy norm exists.\(^{35}\) Hence, following the secrecy norm produces surplus utility to all members of the labor market. Though the secrecy norm is not an endogenous parameter in this model, it is clear that this kind of norm may be favored by all players on this segment. Since universal support is crucial in the preservation of the secrecy norm, the existence of such a segment proofs that secrecy norm may evolve and be preserved in the economy.

\(^{35}\) However, a higher utility expectancy for junior agents may be attained under a higher $p$ when the RS strategy is implemented.
Additionally, in the segment \(0<p<p^*\), the two types of agents exhibit different attitudes toward the secrecy level. Although all agents favor the general notion of a secrecy norm, they disagree about its desired intensity. While the seniors’ utility expectancy rises as the norm gathers strength, that of the juniors decreases. This implies that juniors would rather have a somewhat weaker norm and that seniors prefer stricter enforcement of norm-oriented behavior. Similarly, a mixed attitude toward secrecy and secrecy-norm conflict between employers and employees are widely demonstrated in real life. If a norm is indeed subjected to social negotiation between groups, it is possible that with the help of value transfers from one group to the other, the long-term secrecy-norm equilibrium would be formed across a broader segment of \(p\).

Finally, the junior agent’s actual level of ability plays an important role in the determination of wages and strategies, especially the shift away from separation and toward pooling. Still, the results are robust to numerous levels of junior-agent abilities. The effect of varied abilities is that a higher level of junior-agent ability increases total production and, therefore, increases both the junior and senior agents’ outcomes since there is more value to share.

Figure 2: utilities of Junior (bl.) and Senior (gr.) agents under various secrecy levels
1.4.6 Determining the Secrecy Norm

Sociologists, philosophers, and economists are somewhat at odds about the definition and the evolutionary process of social norms. According to Elster (1989), norms are commitment devices that a society adopts to ensure common goals and objectives. Akerlof (1980) pointed out that a large share of social norms is not fully followed. Akerlof suggested that a code of behavior's strength is based on the fraction of the population that honors the code. Thus, partial practice of a norm is feasible and common. In that sense we may consider a statistical approach in which the norm is followed with a probability lower than 1.

The main difference between a norm and some other endogenous policy parameter is the support of the norm: Society enjoins people from violating its norms by invoking formal and non-formal sanctions, e.g., by making violators feel embarrassed, anxious, guilty, or ashamed (Elster, 1989). Thus, when a person breaks a norm, he or she is expected to pay a high price in terms of utility. In this paper, compliance with wage-secrecy norms means that both firms and employees believe that the equilibrium level of pay secrecy is also the optimum level. In this case, neither side evinces any willingness to deviate from the equilibrium norm level, either because the norm level is optimal or because deviation is too costly. The norm may change in the long term only if enough social pressure toward changing the level of secrecy is generated. If such a scenario, more and more agents will be willing to pay the cost of deviance until the entire norm changes.

Thus far it has been assumed that the secrecy norm is exogenously determined and handed to players as a given. However, norms are usually subject to continuous social struggle and are determined endogenously. Hence, a shift in norm is costly, usually slow, and in need of broad social consent (Frank, 1985). Circumventing a norm is costly in terms of status, external influence, and sometimes (when the sanctions are formal) in money. All these costs may be translated into a decrease in utility, of course. Thus, to

36 “High” in relative terms, i.e., compared with the actual cost of the action. For example, when a person throws a can onto a park lawn, the formal and non-formal punishment is considered to inflict greater disutility than the effort of putting the can in the trash.

37 For example, when an employee wishes to lower the veil of secrecy by directly asking about a co-worker’s wage, s/he may face formal (a fine, discharge) and non-formal (negative status attainment and
violate the norm, the expected utility surplus should exceed the disutility caused by the violation.

Along the path of different levels of secrecy, the two types of agents exhibit the following attitudes toward wage-secrecy norm:

When $1 \geq p \geq \Phi_1$, both types of agents are indifferent to the level of the secrecy norm.

When $\Phi_1 > p \geq \Phi_2$, senior agents prefer a higher $p$ (less secrecy) and junior agents favor a lower $p$ (more secrecy). Since aggregate production is constant, the aggregate utility expectancy is also constant and the transfer of value from juniors to seniors may make both indifferent about the secrecy norm.

When $\Phi_2 > p \geq 0$, senior agents favor a lower $p$ (more secrecy) and junior agents prefer a higher $p$ (less secrecy). Note that when $p^* > p \geq 0$, the aggregate utility expectancy is higher than the aggregate utility expectancy at secrecy levels lower than $p^*$ (i.e. $1 > p > p^*$).

To examine possible shifts of the norm in this model, the transition costs have to be modeled. Let us consider the cost of changing the secrecy norm (denoted by $C$) an upward monotonic function of the combination of the norm strength (the level of secrecy) and the magnitude of the change:

$$C (\Delta p) = f ((1 - p), \Delta p)$$

(46)

Thus, the stronger wage secrecy is, the harder it is to change the norm. Moreover, the larger the deviation, the costlier the norm change becomes. To shift the norm, then, the agents must expect the new level of the norm to generate surplus utility; only then would they agree to bear the transition costs. Sometimes, however, it is possible to attain social consent even where only one type of agents expects a positive effect.

Consider a shift mechanism based on a median voter from both groups—juniors and seniors (i.e. firms). The relative power of influence of junior agents is denoted by $\psi_j$ (when $\psi_j + \psi_s = 1$). Each group maximizes its expected utility expectancy and chooses its

harmful peer reaction: “the employee is nosy / has bad manners”) sanctions. Alternatively, when an agent wishes to reinforce secrecy, s/he may be considered arrogant, snobbish, or even dishonest.

38 It stands to reason that senior employees have more power than junior workers in shaping the norm in society.
preferred level of secrecy accordingly. The next period level of wage secrecy is determined by the groups’ relative power and shift that each group desires. Clearly, when a value transfer between groups is possible, a shift is feasible if the total expected utility surplus exceeds the total transition costs.

As described above, the optimal level of wage-secrecy norm for junior agents is achieved when $p=\Phi_2$ and that for senior agents is achieved when $p=0$. Thus, the actual secrecy level in the long run depends mainly on $C(p)$, the relative ability to influence ($\psi'$), and the preliminary secrecy-norm level. Therefore, any steady state within the \{${p=0, I\geq p > \Phi_1}$\} range is feasible.

Finally, pursuant to Propositions 5–6, the steady state would probably be characterized by a secrecy level ($p$) that satisfies $1>p>p^*$. Since there are various ways to model norms and, especially, shifts in norms, it is somewhat problematic to identify a specific path toward a steady state within the $1>p>p^*$ segment without incurring a considerable loss of generality. However, considering the positive utility surplus that is expected for both type of agents in this segment and the possibility of making minor norm shifts in each period, one would expect the norm eventually to converge to these levels.

1.5. Concluding Remarks

The results of this model point to several additional salient conclusions:

First, all members of society may embrace secrecy under some circumstances. By imposing a salary taboo, society may protect itself from potential disharmony and allow for better cooperation and satisfaction. On the one hand, wage ambiguity relieves underpaid employees of inferiority feelings that may lead to anger, rage, and destructive actions. On the other hand, it allows firms to increase the remuneration of executives, owners, or any group of employees whom it selects. The support of wage secrecy by both sides is the motive force behind the formation of what we have called, alternately, the wage-secrecy norm or the salary taboo.

Second, a strong secrecy norm increases income inequality at the macro level. Thus, the outcome of wage-secrecy norm may be considered negative on grounds of equity.
Interestingly, insiders (i.e., juniors and seniors) and outsiders (non-working members of society, officials) may experience the outcomes differently.

Third, the secrecy norm does not necessarily imply that the employee are oblivious to co-workers’ wages. When the norm is relatively weak, the firm eliminates any ambiguity by signaling its productivity level. This, however, does not mean that the norm does not exist; it may still be considered impolite to ask or tell about pay.

Fourth, the firm’s decision about whether to exploit the secrecy norm and use a pooling strategy depends not only on the strength of the secrecy norm but also on the information set of the previous period (actual observations during time $t-1$). Thus, one level of secrecy norm may produce different behaviors by firms in different periods and industries. Accordingly, one economy may experience different patterns of wage disclosure by firms and still share a common wage-secrecy norm.

Finally, the specific abilities of employees affect total product and, in turn, the utility surplus achieved by secrecy. For this reason, abler employees are expected to exert stronger support in favor of a shift toward the optimal level of secrecy norm—whether this means an increase or a decrease in secrecy.

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39 Within the framework of the model, $l \geq p \geq \Phi_2$ when a separation strategy is applied.
1.A.1. Proof of Proposition 1

The wage expectancy of a junior agent under full information is:
\[
E_{p=1}(w_{i,j}) = 0.5w_{i,j}^f (M^a) + 0.5w_{i,j}^d (M^d) = 0.5 \left( \frac{a_{i,j} \alpha}{a_{i,j}^f (1+\alpha)} \right) (a_{i,j}^f + 1)M^a + \frac{0.5(a_{i,j}^f)^2}{a_{i,j}^f (1+\alpha)} M^d + 0.5a_{i,j}^f M^d
\] (A1)

The wage expectancy of a junior agent under absolute secrecy is:
\[
E_{p=0}(w_{i,j}) = w_{i,j}^f = 0.5w_{i,j}^f (M^a) + 0.5w_{i,j}^d (M^d) = 0.5 \left( \frac{a_{i,j} \alpha}{a_{i,j}^f (1+0.5\alpha) + 0.5\alpha} \right) (1+a_{i,j}^f)M^a + \frac{0.5(a_{i,j}^f)^2}{a_{i,j}^f (1+0.5\alpha) + 0.5\alpha} M^d
\] (A2)

Denote \( d = M^a - M^d \). Then the full information term may be written as:
\[
\Rightarrow \left[ \frac{0.5a_{i,j}^f \alpha(a_{i,j}^f + 1)}{a_{i,j}^f (1+\alpha) + \alpha} + \frac{0.5(a_{i,j}^f)^2}{a_{i,j}^f (1+\alpha) + \alpha} + 0.5a_{i,j}^f \right] M^d + \frac{0.5a_{i,j}^f \alpha(a_{i,j}^f + 1)}{a_{i,j}^f (1+\alpha) + \alpha} \right] d = \left[ \right. \right]
\[
\Rightarrow \left[ \frac{0.5a_{i,j}^f \alpha(a_{i,j}^f + 1) + 0.5(a_{i,j}^f)^2 + 0.5a_{i,j}^f (a_{i,j}^f + \alpha) a_{i,j}^f}{a_{i,j}^f (1+\alpha) + \alpha} \right] M^d + \frac{0.5a_{i,j}^f \alpha(a_{i,j}^f + 1)}{a_{i,j}^f (1+\alpha) + \alpha} \right] d = \left[ \right. \right]
\[
\Rightarrow \left[ \frac{0.5a_{i,j}^f (2a_{i,j}^f (1+\alpha) + 2\alpha)}{a_{i,j}^f (1+\alpha) + \alpha} \right] M^d + \frac{0.5a_{i,j}^f \alpha(a_{i,j}^f + 1)}{a_{i,j}^f + a_{i,j}^f \alpha + \alpha} \right] d = \left[ \right. \right]
\[
\Rightarrow (a_{i,j}^f) M^d + \frac{0.5a_{i,j}^f \alpha(a_{i,j}^f + 1)}{a_{i,j}^f + a_{i,j}^f \alpha + \alpha} \right] d
\] (A3)

The parallel absolute secrecy term is:
\[
\left[ \frac{0.5a_{i,j}'\alpha(1 + a_{i,j}')}{a_{i,j}'(1 + 0.5\alpha) + 0.5\alpha} \right] + \left[ \frac{(a_{i,j}')^2}{a_{i,j}'(1 + 0.5\alpha) + 0.5\alpha} \right] M^d + \left[ \frac{0.25a_{i,j}'\alpha(a_{i,j}' + 1)}{a_{i,j}'(1 + 0.5\alpha) + 0.5\alpha} \right] d = \\
\Rightarrow \left[ \frac{0.5a_{i,j}'\alpha(1 + a_{i,j}') + (a_{i,j}')^2}{a_{i,j}'(1 + 0.5\alpha) + 0.5\alpha} \right] M^d + \left[ \frac{0.5a_{i,j}'\alpha(a_{i,j}' + 1)}{a_{i,j}'(2 + \alpha) + \alpha} \right] d = \\
\Rightarrow \left[ \frac{a_{i,j}'(a_{i,j}'(1 + 0.5\alpha) + 0.5\alpha)}{a_{i,j}'(1 + 0.5\alpha) + 0.5\alpha} \right] M^d + \left[ \frac{0.5a_{i,j}'\alpha(a_{i,j}' + 1)}{2a_{i,j}' + a_{i,j}'\alpha + \alpha} \right] d = \\
\Rightarrow (a_{i,j}')M^d + \left( \frac{0.5a_{i,j}'\alpha(a_{i,j}' + 1)}{2a_{i,j}' + a_{i,j}'\alpha + \alpha} \right) d 
\] 

(A4)

The inequality is therefore:

\[
(a_{i,j}')M^d + \left( \frac{0.5a_{i,j}'\alpha(a_{i,j}' + 1)}{a_{i,j}' + a_{i,j}'\alpha + \alpha} \right) d \geq (a_{i,j}')M^d + \left( \frac{0.5a_{i,j}'\alpha(a_{i,j}' + 1)}{2a_{i,j}' + a_{i,j}'\alpha + \alpha} \right) d \\
\Rightarrow \frac{1}{a_{i,j}' + a_{i,j}'\alpha + \alpha} > \frac{1}{2a_{i,j}' + a_{i,j}'\alpha + \alpha} 
\] 

(A5)

Note that since the senior agent gets the residual wage, if the wage expectancy of a junior agent is lower under secrecy, than the wage expectancy of a senior agent must be higher under secrecy.
1.A.2 Proof of the derivative of Proposition 3

\[
\frac{\partial W_i}{\partial q_{i,j}} = \left( a_{i,j}^2 \alpha + a_{i,j} q_{i,j} \alpha + a_{i,j} q_{i,j} \alpha - a_{i,j}^2 \alpha^2 q_{i,j} - a_{i,j} \alpha^2 q_{i,j} \right) \left( 1 + a_{i,j} \right) \left( q_{i,j} M^n + \left( 1 - q_{i,j} \right) M^d \right) + \\
(M^n - M^d) \left( 1 + a_{i,j} \right) \left( \frac{q_{i,j} a_{i,j} \alpha}{a_{i,j} \left( 1 + q_{i,j} \alpha \right) + q_{i,j} \alpha} \right) - \\
\left( \frac{(a_{i,j}^3 \alpha + (a_{i,j}^2 \alpha)^2}{a_{i,j} \left( 1 + q_{i,j} \alpha \right) + q_{i,j} \alpha} \right) M^d = \\
\Rightarrow \left( \frac{a_{i,j} \alpha}{a_{i,j} \left( 1 + q_{i,j} \alpha \right) + q_{i,j} \alpha} \right) \left( 1 + a_{i,j} \right) \left( q_{i,j} (M^n - M^d) + M^d \right) + (M^n - M^d) \left( \frac{q_{i,j} a_{i,j} \alpha (1 + a_{i,j})}{a_{i,j} \left( 1 + q_{i,j} \alpha \right) + q_{i,j} \alpha} \right) - \\
\left( \frac{(a_{i,j}^2 \alpha (a_{i,j}^1 + 1)}{a_{i,j} \left( 1 + q_{i,j} \alpha \right) + q_{i,j} \alpha} \right) M^d = \\
\Rightarrow (M^n - M^d) \left( \frac{a_{i,j} \alpha (1 + a_{i,j}) q_{i,j}}{a_{i,j} \left( 1 + q_{i,j} \alpha \right) + q_{i,j} \alpha} \right) + \frac{q_{i,j} a_{i,j} \alpha (1 + a_{i,j})}{a_{i,j} \left( 1 + q_{i,j} \alpha \right) + q_{i,j} \alpha} > 0 
\]

(A6)
References


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Chapter 2

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

2.1 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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1 This chapter is a joint work with Prof. Jean-Marc Robin, Paris School of Economics; Université Paris I – Pantheon Sorbonne; And: University college London.
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 – is the result of both active and passive on-the-job search (OJS). We use the notion of active and passive 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).

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’

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2 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.

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

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4 Around 50% of job quitting among young employees traces to direct switching to a new workplace (Parsons, 1991).
all necessary information. We assume that if secrecy is not in the workers’ best interest (at least \textit{ex ante}), firms cannot persistently keep information secret (unless some compensatory transfers are available).\textsuperscript{5} However, this study focuses mainly on secrecy in respect to wage changes, which, we believe, are even more common and less controversial.

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, they considered it rude and inappropriate to be asked about their wages.\textsuperscript{6} 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.\textsuperscript{7}

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.

\textsuperscript{5} 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.

\textsuperscript{6} 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.

\textsuperscript{7} To the best of my knowledge, there are no available data on differences in secrecy levels among countries.
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.

The rest of this chapter 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.

### 2.2 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. ⁸

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. ⁹

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⁸ 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.

⁹ 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.
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 $A-l>T$, meaning that it is profitable to move a “low-productivity worker” into a high-productivity position if possible.

Job destruction is generated by an exogenous stochastic process. $\theta_{i,t}$ denotes the job-destruction probability at firm $i$ in period $t$. 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).

### 2.2.1 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 $\lambda$ ($0<\lambda<l$) 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. The minimum wage is upper-bounded by $l-T$.

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10 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.

11 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.
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).

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.

2.2.2 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 (\( 0 < m^k < 1 \)).

2.2.3 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-

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

2.2.4 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.\(^{13}\) 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.

\(^{13}\) 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.
2.2.4.1 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 chapter 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 incentive to deceive and underestimate productivity and matching probability) unless workers can verify it.

2.2.4.2 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.\textsuperscript{14}

\textbf{2.2.5 Scheduling}

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

\textit{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).

\textit{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 (\( 1/0 \)) 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 \( \lambda \)). 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.

\textbf{2.3. Partial Market Equilibrium}

We first analyze the system within a partial equilibrium framework by taking \( \lambda \) 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.

\textsuperscript{14} 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.
2.3.1 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 \((w^{l}_{t=1}, w^{h}_{t=1}, w^{l}_{t=2}, w^{h}_{t=2})\) 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.

2.3.2 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 \(\{w^{k}_{t=2} = b, m^{k} = M^{k}(b)\}\)
  
  ii. High wage, full matching, no search \(\{w^{k}_{t=2} = \bar{w}^{k}, m^{k} = 1\}\)
  
  iii. Minimal wage, full matching, search \(\{w^{k}_{t=2} = b, m^{k} = 1\}\)

Where:

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

And:

\(\bar{w}^{k}(b,c,T,\lambda)\) 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, \( A < \tilde{A} = 3 - b \), workers with high-productivity jobs are more likely to quit.\(^{15}\)
- Without search, workers in high- and low-productivity jobs have the same expected wage.\(^{16}\)

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.

### 2.3.2.1 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 \( I - T \) at 0.5 probability depending on the level of productivity at the poaching firm.

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):

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

\(^{15}\) Proof in Appendix 5.

\(^{16}\) Proof in Appendix 5.
Likewise, the expected utility with search is the expected wage, with or without matching, less the search cost:

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

(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 \((NS\geq S)\), we get:

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

(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 \(I\). We use \(\bar{w}^h\) to denote the wage level that quashes all searching irrespective of the matching policy \((M^h=1)\). Simple algebra yields: \(\bar{w}^h = \left( \frac{A+1}{2} - T \right) - \frac{c}{(1-\lambda)}.\) Clearly, for any \(w_{t=2}^h \geq \bar{w}_{t=2}^h\) 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:

\[
\bar{w}_{t=2}^h = \max \left[ \left( \frac{A+1}{2} - T \right) - \frac{c}{(1-\lambda)}, b \right]
\]

(4)
Note that when $\bar{w}_{t=2} > 1 - T$, 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.\textsuperscript{17}

\subsection*{2.3.2.2 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:

$$E[(\pi^h_{t=2} | S, m = 1)] = E[(1 - \theta_i) \left( T + (A - 1 + T) \right)] = \left( 1 - \frac{b}{2} \right) \left( T + \frac{A-1}{2} \right)$$ \hspace{1cm} (5)

Naturally, when workers search, the value of $\bar{w}_{t=2}$ 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 $w^h_{t=2} = \bar{w}^h_{t=2}$ and no one searches, with the limitation of $\bar{w}^h_{t=2} \leq 1 - T$: \textsuperscript{18}

$$E[(\pi^h_{t=2} | NS, \bar{w}^h_{t=2} \leq 1 - T)] = E[(1 - \theta_i) \left( (1 - \lambda) (A - \bar{w}^h) + \frac{\lambda}{2} (A - 1 + 2T) \right)]$$ \hspace{1cm} (6)

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

$$E[(\pi^h_{t=2} | NS, \bar{w}^h_{t=2} \leq 1 - T)] = \left( 1 - \frac{b}{2} \right) \left[ T + \frac{A-1}{2} \right] + c$$ \hspace{1cm} (7)

Comparing (5) and (7) we can see that for $c > 0$, we get: $E[(\pi^h_{t=2} | NS, \bar{w}^h_{t=2} \leq 1 - T)] > E[(\pi^h_{t=2} | S)]$. Note that when $\left( \frac{A+1}{2} - T \right) - \frac{c}{(1-\lambda)} < b$ the foregoing result does not hold.

\textsuperscript{17} Consequently, the firm’s profit function also changes, of course.

\textsuperscript{18} 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.
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.

When \(\bar{\omega}_{t=2}^h > 1 - T\), it implies that \(A > 1 + \frac{2c}{1-\lambda}\) and the profit function becomes:

\[
E\left[\left(\pi_{t=2}^h | NS, \bar{\omega}_{t=2}^h > 1 - T\right)\right] = E\left[\left(1 - \theta_j\right)\left((1 - \lambda)(A - \bar{\omega}^h) + \frac{A}{2}(A - \bar{\omega}^h + T)\right)\right]
\] (8)

Again, placing \(\bar{\omega}_{t=2}^h\) into the above equation and after some algebra we get:

\[
E\left[\left(\pi_{t=2}^h | NS, \bar{\omega}_{t=2}^h > 1 - T\right)\right] = \left(1 - \frac{b}{2}\right)\left[\left(1 - \frac{A}{2}\right)\left(\frac{c}{1-\lambda} + \frac{A-1}{2}\right) + T\right]
\] (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 \(\lambda\) is high enough or low enough, this condition is never satisfied. However, a segment of \(\lambda\) 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 \(\lambda\) such that it is better to allow search and fully match than to offer low wages with only partial matching.\(^{19}\) In sum, allowing workers to search is a feasible equilibrium whenever \(\bar{\omega}_{t=2}^h > 1 - T\), 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 \(\{\omega_{t=2}^h, M^h(\omega_{t=2}^h)\}\) where \(\omega_{t=2}^h \in [b, \bar{\omega}_{t=2}^h]\) and \(M^h(\omega_{t=2}^h)\) 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 \(\bar{\omega}_{t=2}^h\). This happens because the firm’s profit

\(^{19}\)The intuition is that when \(\lambda\) 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.
function in this segment is either monotonic or has a single minimum point inside the segment.  

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 \((\bar{w}^h, 1)\). Clearly, if \(\bar{w}^h \leq b\) the firm must pay \(b\) and match all outside offers. The more interesting cases involves \(\bar{w}^h > b\). Given \(w^h_{t=2} = b\) the compatible no-search matching policy is \(M^h(b) = \text{Min} \left[ \frac{c}{(1-\lambda)(\frac{A+1}{2} - T - b)}, 1 \right]\). When \(\bar{w}^h > b\) it also implies that the minimum is not binding and we may plug \(M^h(b) = \frac{c}{(1-\lambda)(\frac{A+1}{2} - T - b)}\) directly into the expected per-worker profit:\(^{21}\)

\[
E\left( \pi^h_{t=2} | NS, b, M^h(b) \right) = E\left[ (1 - \theta_1)(1 - \lambda)(A - b) + \frac{\lambda c(\frac{A+1}{2} + T)}{(1-\lambda)(\frac{A+1}{2} - T - b)} \right]
\]  

(10)

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

- For \(\bar{w}^h_{t=2} \leq 1 - T\):

\[
(1 - \lambda)(A - b) + \frac{\lambda c(\frac{A+1}{2} + T)}{(1-\lambda)(\frac{A+1}{2} - T - b)} > \left( T + \frac{A-1}{2} \right) + c
\]

(11)

- For \(\bar{w}^h_{t=2} > 1 - T\):

\[
(1 - \lambda)(A - b) + \frac{\lambda c(\frac{A+1}{2} + T)}{(1-\lambda)(\frac{A+1}{2} - T - b)} > \left( 1 - \frac{A}{2} \right) \left( \frac{c}{1-\lambda} + \frac{A-1}{2} \right) + T
\]

(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:

---

\(^{20}\) For a detailed proof, see Appendix 1.

\(^{21}\) Proof: when \(b < \bar{w}^h = \frac{A+1}{2} - T - \frac{c}{(1-\lambda)}\) it implies \(\frac{c}{(1-\lambda)(\frac{A+1}{2} - T - b)} < \left( \frac{c}{1-\lambda} - \frac{c}{(1-\lambda)(\frac{A+1}{2} - T - b)} \right) = 1\).
I. There is always a segment of \( \lambda \in [0, \lambda_1(A)] \) at which a partial matching policy is optimal. The size of \( \lambda_1 \) is dependent on the size of \( A \), which determines the relevant profit function under full matching between the two possible values of \( \lambda_1 \).

II. For \( 1 \geq \lambda \geq \lambda^h = 1 - \frac{c}{\frac{A+1}{2} - T - b} \), 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 \( \lambda \) which full matching is strictly optimal.

IV. If a value of \( \lambda \) for which full matching is optimal exists, for any higher \( \lambda \), full matching weakly dominates partial matching.\(^{22}\)

2.3.2.3 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, much 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, \( M^l \):

\[
M^l = \min \left[ \frac{c}{(1-\lambda)(1-\frac{1}{2}w_{t=2})}, 1 \right]
\]

(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

\(^{22}\) Proof: see Appendix 2.
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 $\lambda$.

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

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

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.\(^\text{23}\) A computed illustration is given in Figure 2.

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.\(^\text{24}\)

\(^{23}\) Note that this is dependent of the condition that $A > l + t$, which implies that the difference in productivity is greater than the adjustment cost.

\(^{24}\) 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.
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 \( M^i(w^i_{t=2}) \). Last, we calculate the expected profit on strategy \( (b, M^i(b)) \) and compare it to strategy \((\bar{w}^i, 1)\) and provide the characteristics of the firms’ total behavior.

Much as in the high-productivity case, it is almost never optimal to allow workers to search. For \( \bar{w}^i < 1 - \frac{T}{2} \), allowing search is an inferior strategy. When \( \bar{w}^i > 1 - \frac{T}{2} \), allowing search may be optimal at an internal segment of \( \lambda \) where the search cost \( c \) is very low.\(^{25}\) Furthermore, when a firm chooses a no-search matching policy of \( M^i \), the optimal wage level is the lowest possible and equals \( b \).\(^{26}\)

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

\[
E\left[\pi^i_{t=2} | NS, b, M^i(b)\right] = E[ (1 - \theta)(1 - \lambda)(1 - b) + \frac{\lambda \sigma^2(T)}{(1-\lambda)(1-\frac{T}{2}-b)} ]
\]

The expected profit under high wage and full matching is dependent on the value of \( \bar{w}^i \) in respect to \( I-T \). Hence, the profit function contains an internal minimum condition:

\(^{25}\) Proof: see Appendix 3.
\(^{26}\) Proof: see Appendix 4.
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:

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

II. For any $1 \geq \lambda \geq \tilde{\lambda}_1 = 1 - \frac{c}{1-\frac{a}{b}}$, all potential matching policies merge. Expected profits as well as matching behaviors and wages are equal.

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

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

Proof: see Appendix 2a.

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

28 Cleaning is an example: we are all better off 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
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).
- 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.

**2.3.3.1 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).

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.
Denote \((s^h_t, s^l_t)\) as the share of searching workers 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) at Firm \(i\) in Period \(t\) in each unit, denoted by \(q^k_{i,t} (k = h, l)\), is:

\[
q^h_{i,t} = \theta_{i,t} + (1 - \theta_{i,t})[(\lambda + (1 - \lambda)s^h_t)(1 - m^h)]
\]

\[
q^l_{i,t} = \theta_{i,t} + (1 - \theta_{i,t})[(\lambda + (1 - \lambda)s^l_t)(1 - m^l)]
\]

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

\[
Q^h = (\lambda + (1 - \lambda)s^h_t)(1 - m^h); \ Q^l = (\lambda + (1 - \lambda)s^l_t)(1 - \frac{m^l}{2})
\]

and find that given \(s^k_t\) and \(m^k\):

\[
q^h_{i,t} \sim U[Q^h, (1 - D)Q^h + D]
\]

\[
q^l_{i,t} \sim U[Q^l, (1 - D)Q^l + D]
\]

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 \(\hat{\rho}^h\) as the probability that a worker assigns to her working in a high-productivity unit on the basis of observation \(\hat{q}_{i,t}\).

\[
\hat{\rho}^h = prob [\hat{q}_{i,t} \in q^h_{i,t}]
\]

Due to the nature of the uniform distribution, \(\hat{\rho}^h\) 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 \(q^h_{i,t}\) and \(q^l_{i,t}\) are feasible:

\[
p^h = \frac{1 - q^l}{2 - q^h - q^l}
\]

\(^{29}\) From here on, all calculations in the model are made on the basis of such ratios.
Note that whenever $Q^h < Q^l$, high-productivity workers do not assign $\hat{p}^h = 0$ and low-productivity workers do not hold $\hat{p}^h = 1$.

2.3.3.2 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:

$$E[(u_{t=2}\mid S, p^h)] > E[(u_{t=2}\mid NS, p^h)]$$  \hspace{1cm} (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:

$$E[(u_{t=2}\mid S, p^h)] = E\left[(1 - \theta_i) \left[ p^h \left( m^h_s \left( \frac{A+1}{2} - T \right) + (1 - m^h_s)w_{t=2} \right) + \left(1 - p^h\right) \left( m^l_s \left( \frac{1 - T}{2} \right) + (1 - m^l_s)w_{t=2} \right) - c \right] + \theta_i b \right]$$ \hspace{1cm} (26)

The expected utility without search is given by:

$$E[(u_{t=2}\mid NS, p^h)] = E\left[(1 - \theta_i) \left\{ p^h \left( (1 - \lambda)w_{t=2} + \lambda m^h_s \left( \frac{A+1}{2} - T \right) \right) + (1 - p^h) \left( (1 - \lambda)w_{t=2} + \lambda m^l_s \left( \frac{1 - T}{2} \right) \right) - c \right\] + \theta_i b \right]$$ \hspace{1cm} (27)

Where $m^k_s$ is the matching policy toward agents with $k$ productivity under secrecy.

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

$$p^h m^h_s \left( \frac{A+1}{2} - T - w_{t=2} \right) + (1 - p^h) m^l_s \left( 1 - \frac{T}{2} - w_{t=2} \right) \geq \frac{c}{1 - \lambda}$$ \hspace{1cm} (28)

For any $p^h$, when we place $m^h_s = M^h$, $m^l_s = M^l$, 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 \( m^h_s = a^h M^h; m^l_s = a^l M^l \), for any non-negative \( a^h \) and \( a^l \) we may rewrite Inequality (28) and draw the frontier of non-search matching possibilities given \( w = b \):

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

(29)

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

\[
p^h a^h + (1 - p^h) a^l = 1
\]  

(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 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 \( m^h_s = 1 \) and only then do firms start matching low-productivity workers. Such behavior is represented by the following equations:

\[
\begin{align*}
\frac{1}{p^h} M^h \leq 1 & \quad \rightarrow \quad a^h = \frac{1}{p^h}; \quad m^h_s = \frac{1}{p^h} M^h; \quad a^l = 0; \quad m^l_s = 0 \\
\frac{1}{p^h} M^h > 1 & \quad \rightarrow \quad a^h = \frac{1}{M^h}; \quad m^h_s = 1; \quad a^l = \frac{1 - \frac{p^h}{M^h}}{1 - p^h}; \quad m^l_s = \frac{1 - \frac{p^h}{M^h}}{1 - p^h} M^l
\end{align*}
\]  

(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, $m_i^h = 1$ and $m_i > 0$. 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 $m_s^l < M^i$.

2.3.3.3 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 $w^h$. 

Chart 1: The frontier of No-Search matching strategies
(For a given $p^h$, $M^l$, $M^h$)
Much as in the openness case, firms need to choose between paying the minimum wage ($b$) 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 $\bar{w}^s$) is unique because both high- and low-productivity workers earn the same wage (whereas in the full-information case, $\bar{w}^h > \bar{w}^l$). Still, workers who are sure that they belong to a high-productivity unit will 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 $\{(\bar{w}^h, I), (\bar{w}^l, I)\}$. Thus, paying a high wage under secrecy may never be secrecy equilibrium.

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 $M^l(b)$ outside offers and workers never search (because they are on their

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30 See proof in Appendix 6.
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 $a^h$. 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: $v = \frac{A-1}{2} = 2 + \frac{A-1}{T}$. Under secrecy, a firm may choose any combination of $a^h$ and $a^l$ that satisfies the no-search condition for workers who have the perception of $p^h = p^h$ (Equation 30). However, as $p^h$ is upper-bounded by 0.5, we find that a maximal discrimination policy (setting $a^l$ to zero) is optimal, in the short run, when $v a^h (p^h) M^h > a^l (p^h) M^l$. This last inequality yields the condition $A > 1 - \frac{T(1-b)}{(1-b)}$, which is always satisfied. Hence, under secrecy, all matching policies maximize $a^h$ given the no-search frontier. Having solved the worker problem above, we may rewrite Equation (31) and present the matching coefficients:

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

(32)

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

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31 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 $p^h$.

32 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.
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, we can work out the volume of searching (in probability terms). This portion, $s^h_t$, is a positive function of the distance between $Q^h$ and $Q^l$:

$$
\begin{align*}
Q^h < Q^l & \rightarrow \quad s^h_{t,t} = \frac{Q^l - Q^h}{D(1-Q^h)} \\
Q^h \geq Q^l & \rightarrow \quad s^h_{t,t} = \frac{(1-D)(Q^h - Q^l)}{D(1-Q^h)}
\end{align*}
$$

(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 $q^h > 1$ search will occur and begin at a sizable extent.

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: $s^h_{t,t} = \frac{Q^l - Q^h}{D(1-Q^h)}$. 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 $\frac{1}{\bar{p}^h}M^h \leq 1$, in which only high-productivity workers are matched, and the case of $\frac{1}{\bar{p}^h}M^h > 1$, 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

---

33 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 $q^h$ on the basis of a threshold level of $\hat{p}^h$: 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.
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.

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

When \( M^h \) is relatively small, only high-productivity workers are matched. In this case, 
\[ m^h_s = \frac{1}{p^h} M^h \]
and low-productivity workers are never matched. Therefore, \( m^h_l = 0 \), yielding a constant \( Q^l = \lambda \). We then insert \( p^h \) into the matching equation to get:
\[
( m^h_s | p^h \geq M^h ) = \frac{2-s^h}{(1-(\frac{\lambda}{1-s^h})M^h)} M^h
\]
and the extent of searching is:
\[
s^h = \frac{Q^l - Q^h}{D(1-Q^h)} = \frac{\lambda m^h_s - (1-\lambda)(1-m^h_s) s^h}{D(1-\lambda(1-m^h_s)-(1-\lambda)(1-m^h_s)s^h)}
\]
To find \( s^h \) in the steady state we solve the quadratic equation and then plug the result into the \( m^h_s \) equation to obtain the value of \( m^h_s \).

2.3.3.3.2 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 \( m^h_s = 1 \). 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, \( Q^l \) is no longer constant and equal: \( Q^l = \lambda(1 - \frac{m^l_s}{2}) \). Therefore, we may derive the search function:
\[
s^h = \frac{\lambda}{D} (1 - \frac{m^l_s}{2})
\]
plugging \( Q^l \) into \( p^h \), we obtain:
\[ p^h = \frac{1 - \lambda (1 - \frac{m^l}{z})}{2 - \lambda (1 - \frac{m^l}{z})} \]  

(37)

And by using the workers’ indifference utility equation, we may derive \( m^l_s \):

\[ (m^l_s | p^h < M^h) = \frac{1 - p^h}{M^h (1 - p^h)} M^l \]  

(38)

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

\[ m^l_s = \frac{2 - \lambda - \frac{1 - \lambda}{M^h}}{1 + M^l (\frac{1}{M^h} - 1)} M^l \]  

(39)

and for \( M^l = 1, M^h < 1 \):

\[ m^l_s = 2 (1 - \frac{1}{M^h (2 - \lambda) + \lambda}) \]  

(40)

**2.3.3.4 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 \( m^l_s < M^l \). 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 \( Q^h, s < Q^h, f \). The difference in quitting between the full information case and the secrecy case for \( M^h < 1 \) is:

\[ Q^{h, f} - Q^{h, s} = \lambda M^h (a^h - 1) - (1 - \lambda) s^{h} (1 - a^h M^h) \]  

(41)

As we see, \( Q^{h, f} > Q^{h, s} \) 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 \( s^{h} > 0 \)) occurs only when secrecy is optimal for the firm, i.e., \( E[(\pi^{s}_{t=2} | NS, b)] > E[(\pi^{h}_{t=2} | NS, b)] \).
Where this condition is met, Equation (41) is always positive. 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:

\[ Q^s = \frac{q^{h} + q^{l}}{2} = \frac{1}{2} \left[ \left( \lambda + (1 - \lambda)s_{l}^{h} \right)(1 - m_{s}^{h}) + \lambda(1 - \frac{m_{s}^{l}}{2}) \right] \]  

(42)

To simplify this, we may use the distinction between the segment on which \( m_{s}^{h} < 1 \) and that on which \( m_{s}^{h} = 1 \) and obtain:

\[ Q^s( m_{s}^{h} < 1, m_{s}^{l} = 0) = \frac{1}{2} \left[ \left( \lambda + (1 - \lambda)s_{l}^{h} \right)(1 - a^{h}M^{h}) + \lambda \right] \]  

(43)

\[ Q^s( m_{s}^{h} = 1, m_{s}^{l} > 0) = \frac{1}{2} \left[ \lambda(1 - \frac{m_{s}^{l}}{2}) \right] \]  

(44)

### 2.3.4 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.

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34 See proof in Appendix 7.
2.3.4.1 Workers’ Support

We study workers’ support for secrecy on the basis of \textit{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, $\lambda$). 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.

2.3.4.1.1 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.

\textbf{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 \textit{ex ante} expected wages; all workers favor secrecy \textit{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:

\[
E[(u^{h}_{t=2}|NS, b, M^{h})] = E[(u^{l}_{t=2}|NS, b, M^{l})] = b + \left(1 - \frac{\beta}{2}\right) \frac{\lambda c}{1-\lambda} \tag{45}
\]

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

\[
E[(u^{h}_{t=2}|Se)] = \left(1 - \frac{\beta}{2}\right) \left[\frac{(1 - \lambda)(1 - s^{h})b - (1 - \lambda)s^{h}c + \left((1 - \lambda)s^{h} + \lambda\right) \left(\frac{a^{h}M^{h}(\lambda + 1 - 2\beta)}{2} + (1 - a^{h}b)\right)}{(1 - \lambda)s^{h} + \lambda}\right] + \frac{\beta}{2} b \tag{46}
\]

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:

\[
E[(u^{h}_{t=2}|Se)] = b + \left(1 - \frac{\beta}{2}\right) c \left[\frac{\lambda a^{h}}{1-\lambda} + s^{h}(a^{h} - 1)\right] \tag{47}
\]

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:

\[
E[(u^{l}_{t=2}|Se)] = b + \left(1 - \frac{\beta}{2}\right) a^{l} \frac{\lambda c}{1-\lambda} \tag{48}
\]

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):

\[
E[(u^{l}_{t=2}|Se, NS, b, m^{h}, m^{l})] = b + \left(1 - \frac{\beta}{2}\right) c \left[\frac{\lambda}{1-\lambda} \left(\frac{a^{l} + a^{h}}{2}\right) + \frac{s^{h}}{2}(a^{h} - 1)\right] \tag{49}
\]
The equivalent expected utility under full information is:

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

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

$$\frac{\lambda}{1-\lambda} \frac{(a^l+a^h)}{2} + \frac{s^h}{2} (a^h - 1) > \frac{\lambda}{1-\lambda}$$  \hspace{1cm} (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 $\frac{1}{p^h} M^h \leq 1$, $a^h = \frac{1}{p^h}$ as $p^h$ is upper-bounded by $\frac{1}{2}$ (see Equation 24), $a^h$ itself is always greater than 2. When $\frac{1}{p^h} M^h > 1$, $a^h = \frac{1}{M^h}$ and $a^l = \frac{1-p^h}{1-p^h}$ We may rewrite the condition as $\frac{1}{M^h} + \frac{1-p^h}{1-p^h} > 2$. 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, $\frac{z^h}{2}$, 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:

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

2.3.4.1.1 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 $\lambda < \tilde{\lambda}^h$). In both cases, this is the result of the high matching probability ($=l$) 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.
2.3.4.2 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 (2.3.2.2 and 2.3.2.4), we saw that under a full-information regime, partial matching is always optimal when $\lambda$ is small. Paying a high wage could be optimal for a higher $\lambda$ 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 $\lambda$ where discriminatory matching under secrecy is more profitable than partial matching under full information always exists if the costs of searching are low enough $c < \bar{c}$.

**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 $\lambda$. Third, we describe the segment of $\lambda$ for which we may extend the optimality of secrecy.

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

$$E[(n_{t=2}^{h,*}|NS, b)] = E(1 - \theta_{1,t}) \left[ (1 - \lambda)(1 - s_{i,t}^h)(A - b) + (\lambda + (1 - \lambda)s_{i,t}^h)m^h \left( \frac{\lambda-1}{2} + \frac{1}{2} \right) \right]$$ \hspace{1cm} (53)

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

$$E[(n_{t=2}^{l,*}|NS, b)] = E(1 - \theta_{1,t}) \left[ (1 - \lambda)(1 - s_{i,t}^l)(1 - b) + (\lambda + (1 - \lambda)s_{i,t}^l)m^l \left( \frac{1}{2} \right) \right]$$ \hspace{1cm} (54)
Finally, the combined profit per worker (given $s_{it}^h = 0$, as low-productivity workers never search in equilibrium) is:

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

(55)

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

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

(56)

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

$$\Delta_{s,fi} = \frac{1}{2} \left( 1 - \frac{b}{2} \right) \left[ \lambda M^h (a^h - 1) \left( \frac{A-1}{2} + T \right) - \lambda M^i (1 - a^i) \left( \frac{A-1}{2} + T \right) - s_{it}^h (1 - \lambda) \left[ \frac{A+1}{2} - T - b \right] \right]$$

(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 $\lambda$ 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 $\lambda$ verges on $\bar{\lambda}^h$ (note that at $\bar{\lambda}^h > \bar{\lambda}^i$), the secrecy behavior converges with the full-information behaviors as both discriminatory-matching coefficients ($a^h$ and $a^i$) 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 \( \lambda \) as a function of all other parameters of the model:
\[
\lambda(m^h = 1) = \lambda_{m^h=1} = 1 - \frac{c+\sqrt{c^2+4c\left(\frac{A+1}{2} - T - b\right)}}{2\left(\frac{A+1}{2} - T - b\right)}
\] (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:
\[
E[(\pi_{i,t}^s|NS, b)] = \frac{1}{2}(1 - \frac{D}{D}) \left[ (1 - \lambda)(A + 1 - 2b) + \lambda \left(\frac{A-1}{2} + T\right) \right] - \frac{\lambda}{D} \left[ (1 - \lambda) \left(\frac{A+1}{2} - T - b\right) \right]
\] (59)

The difference in the expected profit between secrecy and full information becomes:
\[
\Delta_{s,f,i}(m^h = 1) = \frac{1}{2}(1 - \frac{D}{D}) \left[ \lambda(1 - M^h) \left(\frac{A-1}{2} + T\right) - \lambda T \right] - \frac{\lambda}{D} \left[ (1 - \lambda) \left(\frac{A+1}{2} - T - b\right) \right]
\] (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:
\[
\Delta_{s,f,i}(m^h = 1) = \frac{\lambda}{2}(1 - \frac{D}{D}) \left[ \frac{A-1}{2} + \frac{T}{2-\lambda} - \frac{c}{1-\lambda} \left(\frac{T}{2-2b} + \frac{2-\lambda}{D}\right) \right]
\] (61)

Clearly, the \(\Delta_{s,f,i}(m^h = 1)\) is positive i.f.f
\[
\frac{A-1}{2} + \frac{T}{2-\lambda} > c \left(\frac{T}{2-2b} + \frac{2-\lambda}{D}\right)
\]
which result in the following condition for the value of \(c\):
\[
c < \frac{\frac{1-\lambda}{2-2b} + \frac{2-\lambda}{D}}{\left(\frac{T}{2-2b} + \frac{2-\lambda}{D}\right)} = \tilde{c}
\] (62)

This condition reflects several additional important features of the model:

First, \(\tilde{c}\) 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 $c \in [0, \bar{c}]$ for which secrecy is preferable to partial matching in the inner segment around $\lambda_{m^b=1}$.

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

$$\bar{c}^* = \frac{\frac{A+1}{2} - T - b}{2+\sqrt{5}} \left( -2 - \frac{DT}{2-T-2b} + \sqrt{\frac{DT}{2-T-2b}} + \frac{2D(1+\sqrt{5})(\frac{A-1}{2}+T)}{(\frac{A+1}{2} - T - b)} \right)$$ (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 $\lambda > \lambda_{m^b=1}$ (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 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 $\lambda$ than the segment in which it is also favored by workers. Hence, if secrecy

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35 For full details, see Appendix 9.
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.

2.3.5 Partial Equilibrium Conclusions

Denote $\lambda_1$ as the value that satisfies $E[(\pi_{t=2}^{fi}|NS,b)] = E[(\pi_{t=2}^{fi}|NS,\bar{w}^h,\bar{w}^l)]$, then the partial-equilibrium behavior along the path of the increasing $\lambda$ is summarized by the following proposition:

**Proposition 6:**

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

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 $\lambda_1 = \bar{\lambda}^h$, 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 $\lambda$ in which secrecy is optimal over other matching behaviors $[\bar{\lambda}_s, \bar{\lambda}_s^h]$, where $\bar{\lambda}_s > 0$ 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 $\lambda$. Workers favor the norm only when profits are greater under partial
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)

Parameters Value:
A=2; T=0.2;
c=0.1; b=0.6;
D=0.99
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).

### 2.4. 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.\textsuperscript{36} 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:

\begin{equation}
    h = V(\lambda)
\end{equation}

Where:

\begin{equation}
    V(\lambda) = \frac{1}{2} E \left[ (1 - m^h) \left( \frac{A+1}{2} - T - w^h \right) + (1 - m^l) \left( \frac{A+1}{2} - T - w^l \right) + m^l \left( \frac{A-1-T}{2} \right) \right]
\end{equation}

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).

2.4.1 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

\textsuperscript{36} 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).
expected value of approaching high- and low-productivity workers separately is also presented.)

\[
\begin{align*}
V_{pm}^l (\lambda \leq \bar{\lambda}^l) &= \frac{A+1}{2} - T - b - \frac{c}{1-\lambda}; V_{pm}^l (\lambda > \bar{\lambda}^l) = \frac{A-1-T}{2} \\
V_{pm}^h (\lambda \leq \bar{\lambda}^h) &= \frac{A+1}{2} - T - b - \frac{c}{1-\lambda}; V_{pm}^h (\lambda > \bar{\lambda}^h) = 0 \\
V_{pm} (\lambda \leq \bar{\lambda}^l) &= \frac{A+1}{2} - T - b - \frac{c}{1-\lambda}; V_{pm} (\bar{\lambda}^l < \lambda \leq \bar{\lambda}^h) = \frac{A}{2} - \frac{3T}{4} - \frac{b}{2} - \frac{c}{2(1-\lambda)} \\
V_{fm} &= \frac{A-1-T}{4}; V_{lm}^l = \frac{A-1-T}{2}; V_{fm}^h = 0
\end{align*}
\] (66)

\[
\begin{align*}
V_{md} (\lambda \leq \lambda_{m=1}^h) &= \frac{A+1}{2} - T - b - \frac{a^h c}{2(1-\bar{\lambda})} \\
V_{md} (\lambda_{m=1}^h < \lambda \leq \bar{\lambda}^l) &= \frac{1}{2} \left( \frac{A+1}{2} - T - b - \frac{a^h c}{1-\lambda} \right) \\
V_{md} (\bar{\lambda}^l < \lambda \leq \bar{\lambda}^h) &= \frac{1}{2} \left( \frac{A+1}{2} - T - b - 2 \left( 1 - \frac{1}{M^h(2-\lambda)+\lambda} \right) \left( 1 - \frac{T}{2} - b \right) \right)
\end{align*}
\] (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. Switching from and to full matching also involves discontinuity in the value function (unless it occurs exactly at $\bar{\lambda}^h$).

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

91
2.4.2 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.

2.4.3 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 \( h_0 \geq h > h_3 \), employer competition is low, incumbent employers partly match and pay the minimum wage, workers do not search, and wage information is open.

- If \( h_3 \geq h > h_2 \), 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 \( h_3 \geq h > h \), employer competition is high, marginal incumbent employers fully match and pay either \( w = \bar{w} \) 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 \( h \geq h \), 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 \( w = \bar{w} \) 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:

\[
h_0 = V_{PM}(\lambda = 0); h_1 = V_{PM}(\tilde{\lambda}_2); h_2 = V_{MD}(\tilde{\lambda}_3); h_3 = \text{Min}[V_{PM}(\lambda_1), V_{MD}(\tilde{\lambda}_5)];
\]

\( \underline{h} = V_{FM}. \)

**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 \( h_1 \geq h > \underline{h} \)).
we consider it a secrecy equilibrium and when \( h_3 \geq h > h_1 \) 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 \( h_1 \geq h \), outside firms profit from poaching even under full matching; in this case, employer competition becomes intensive, \( \lambda \) 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 above illustrates the various poaching value functions.
2.5. 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 2.3.3.3.2, 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 $\hat{p}^h = 0.5$:

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

(69)

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:

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

(70)

while the corresponding profit under full information is:

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

(71)

and the difference is:

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

(72)

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:

\[
E[(u(b)_{t=2}^{T, NS}|NS, b)] - E[(u(b)_{t=2}^{T, fi}|NS, b)] = \left(1 - \frac{D}{2}\right) \lambda \left(\frac{M^h - 2M^h}{2M^h + M^f}\right) \left[M^h \left(\frac{\lambda^{1+\frac{1}{2}}}{\lambda^{1+\frac{3}{2}} - T}\right) - M^f \left(1 - \frac{T}{2}\right)\right]
\]

\[
= \left(1 - \frac{D}{2}\right) \lambda \left(\frac{M^h - 2M^h}{2M^h + M^f}\right) \left[c \frac{(\lambda^{1+\frac{1}{2}} - T)(1 - \frac{T}{2}) - (1 - \frac{T}{2})^2}{\lambda^{1+\frac{3}{2}} - T - b}\right] < 0
\]

(73)

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.

2.5.1 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 performed 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 (2004), 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 ($c, T, \text{and} h$) 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.
2.A Appendix:

2.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 \( m^h = M^h \):

\[
\max_{w_{t=2}^h} E\left[\left(\pi_{t=2}^h|NS, m^h = M^h\right)\right] = E\left[(1 - \theta_l)(1 - \lambda)(A - w_{t=2}^h) + \frac{\lambda c(A-1 + \theta)}{(1-\lambda)(A-1 + \theta)}\right] \tag{A1}
\]

subject to: \( \bar{w}^h \geq w_{t=2}^h \geq b \)

And we get the FOC:

\[
\left(1 - \frac{\theta}{2}\right) \left[-(1 - \lambda) + \frac{\lambda c(A-1 + \theta)}{(1-\lambda)(A-1 + \theta)}\right] = 0 \tag{A2}
\]

This yields:

\[
w_{t=2}^h = \frac{A+1}{2} - T - \frac{\lambda c(A-1 + \theta)}{(1-\lambda)^2} = \varphi^h \tag{A3}
\]

But from the second derivation we can see that this is a minimum.\(^{38}\) Hence, when \( \bar{w}^h > \varphi^h \), the expected profit is decreasing in the segment \( [b, \varphi^h] \) and increasing in the segment \( [\varphi^h, \bar{w}^h] \) so the only two potential wages are \( b \) and \( \bar{w}^h \). When \( \bar{w}^h \leq \varphi^h \), it means that \( \bar{w}^h \) may not be the optimal policy as it is inside the decrease profit segment. In this case firms will always prefer paying \( b \). \( \blacksquare \)

More technically this implies that in order to consider the strategy of paying \( \bar{w}^h \) we demand that:

\[
\left(\frac{A+1}{2} - T\right) - \frac{c}{(1-\lambda)} > \frac{A+1}{2} - T - \frac{\lambda c(A-1 + \theta)}{(1-\lambda)^2} \quad \text{Or:} \quad c < \lambda \left(\frac{A-1}{2} + T\right). \tag{A3}
\]

\(^{38}\) note that the other solution \( w_{t=2}^h = \frac{A+1}{2} - T + \frac{\lambda c(A-1 + \theta)}{(1-\lambda)^2} \) is larger than \( \bar{w}^h \).
\[ \lambda^h = 1 - \frac{c}{\frac{A-1}{2}T - b}, \] we get: \[ c < \frac{A^{-1} + T}{\frac{A^{-1}}{2} - T - b} \] which is a sufficient condition for FM to be an optimal policy in a segment of \( \lambda^h > \lambda > 0 \).

2.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. \( \blacksquare \)

II. Proof: placing \( \lambda^h \) into equation (4) we get that \( \bar{w}^{h}_{\lambda^h} = b \). 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 \( \bar{w}^{h}_{\lambda^h} \), and from that point \( \bar{w}^{h}_{\lambda^h} \) stays at \( b \) for any \( 1 \geq \lambda \geq \lambda^h \). In this segment firms always play \( \{ w^{h}_{\lambda^h} = b, m^{h} = 1 \} \). \( \blacksquare \)

III. Proof: see as part of Appendix 1.

IV. We start with the profit function of full matching when \( \bar{w}^{h}_{\lambda^h} \leq 1 - T \). This is a constant function in respect to \( \lambda \). The profit function under partial matching is a quadratic function in \( \lambda \) 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 \( \lambda \), it means that for any \( \lambda \) in between, full matching is also superior. Otherwise, we get that partial matching is always optimal.

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

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

Below are the proofs for statements i-iv:

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

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

III. Following the notation in appendix 4, note that when $\bar{w}^l \leq \varphi^l$, it means that $\bar{w}^h$ 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.

2.A.3: when search is optimal

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

$$E\left[\left(\pi_{t=2}\right|S, m^l = 1\right] = E\left[(1 - \theta_i) \frac{T}{2}\right]$$ (A4)

When the firm pays non-search high wage where $\bar{w}^l \leq 1 - T$ and matches all outside offers the profit function is given by: $^{39}$

$$E\left[\left(\pi_{t=2}\right|NS, w^l_{t=2} = \bar{w}^l \leq 1 - T\right] = E\left[(1 - \theta_i) \left(1 - \lambda\right) \left(1 - \bar{w}^l\right) + \lambda \frac{T}{2}\right]$$ (A5)

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

$$E\left[\left(\pi_{t=2}\right|NS, w^l_{t=2} = \bar{w}^l\right] = E\left[(1 - \theta_i) \left(\frac{T}{2} + c\right)\right]$$ (A6)

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

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

$^{39}$ Assuming $\left(1 - \frac{T}{2}\right) - \frac{c}{1 - \lambda} > b$. However, the above statement is true even when $\bar{w}^l = b$. 

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\[ E[(\pi_{t=2}^l | NS, w_{t=2}^l = \bar{w}^l > 1 - T)] = E[(1 - \theta_i)(1 - \bar{w}^l) + \lambda \frac{(1-\bar{w}^l)}{2}] \quad (A7) \]

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

\[ E[(\pi_{t=2}^l | S, m^l = 1)] > E[(\pi_{t=2}^l | NS, b, m^l = M^l)] \quad (A8) \]

This gives:

\[ \frac{T}{2} > (1 - \lambda)(1 - b) + \lambda M^l \frac{T}{2} > (1 - \lambda)T \quad (A9) \]

Which might be considered only for \( \lambda > 0.5 \).

2.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 \( w_{t=2}^l \):

\[
\max_{w_{t=2}^l} E[(\pi_{t=2}^l | NS, m^l = M^l)] = E[(1 - \theta_i)(1 - \lambda)(1 - w_{t=2}^l) + \frac{\lambda c(T)}{1 - \lambda}(\frac{T}{2} - w_{t=2}^l)^2] \\
\text{subject to:} \quad \bar{w}^l \geq w_{t=2}^l \geq b \\
\text{And we get the FOC:} \quad (1 - \frac{\lambda}{2}) \left[-(1 - \lambda) + \frac{\lambda c(T)}{1 - \lambda}(\frac{T}{2} - w_{t=2}^l)^2 \right] = 0 \quad (A11) \]

After some algebra: \( w_{t=2}^l = 1 - \frac{T}{2} - \frac{\lambda c(T)}{(1 - \lambda)^2} = \phi^l \)

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

Again, for even considering \( \bar{w}^l \) it needs to fulfill the following condition:
\[ (1 - \frac{T}{2}) - \frac{c}{1-\lambda} > 1 - \frac{T}{2} - \frac{\lambda c (T)}{(1-\lambda)^2} \]  \hspace{1cm} (A12)

Or:

\[ c < \frac{\lambda T}{2} \]  \hspace{1cm} (A13)

Comparing this with the condition of a high-productivity job \((c < \lambda \left( \frac{A-1}{2} + T \right))\), we can see that paying \(\bar{w}\) 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 \((\bar{w}^h, 1)\) for high productivity workers.

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

Under partial matching: the expected quitting probability of high productive worker is:

\[ q^{h,\text{pm}} = \frac{D}{2} + \left(1 - \frac{D}{2}\right) \lambda (1 - M^h(b)) \]

equivalent quitting probability for low productive workers is:

\[ q^{l,\text{pm}} = \frac{D}{2} + \left(1 - \frac{D}{2}\right) \lambda (1 - M^l(b)) \]

Comparing the two, we get that higher productivity workers quit more than low productivity workers only if:

\[ 2 \left(1 - \frac{T}{2} - b\right) > \left(\frac{A+1}{2} - T - b\right) \]  \hspace{1cm} (A14)

After some arrangement we get that the upper inequality is satisfy for any \(A < \tilde{A} = 3 - b\). 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:
The expected wage for low productive worker is:

\[
E[(u_{t=2}^{h} | NS, b, m^{h})] = E \left[ (1 - \theta_i ) \left[ (1 - \lambda )b + \lambda \left( \frac{m^{h} (\frac{A-T}{2} + \frac{1-T}{2})}{1 - m^{h}b} \right) \right] + \theta_i b \right] \quad (A15)
\]

The expected wage for low productive worker is:

\[
E[(u_{t=2}^{l} | NS, b, m^{l})] = E \left[ (1 - \theta_i ) \left[ (1 - \lambda )b + \lambda \left( \frac{m^{l} (\frac{1}{2} + \frac{1-T}{2})}{1 - m^{l}b} \right) \right] + \theta_i b \right] \quad (A16)
\]

Comparing the two we can see that \( E[(u_{t=2}^{h} | NS, b, m^{h})] = E[(u_{t=2}^{l} | NS, b, m^{l})] \) only if:

\[
m^{h} \left( \frac{A+1}{2} - T - b \right) = m^{l} \left( 1 - \frac{T}{2} - b \right) \quad (A17)
\]

But after placing the matching behaviors we see that both sides are always equal. \( \blacksquare \)

**2.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 \( m=1 \):

\[
E[(u_{t=2}^{s} | S, p^{h}, m = 1)] = E \left[ (1 - \theta_i ) \left[ p^{h} \left( \frac{A+1}{2} - T \right) + (1 - p^{h}) \left( 1 - \frac{T}{2} - c \right) \right] + \theta_i b \right] \quad (A18)
\]

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

\[
(1 - p^{h}) \left( (1 - \lambda ) \bar{w}^{s} + \lambda \left( 1 - \frac{T}{2} \right) \right) + \theta_i b \right] \quad (A19)
\]

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

\[
\bar{w}^{s} = p^{h} \left( \frac{A+1}{2} - T \right) + (1 - p^{h}) \left( 1 - \frac{T}{2} - c \right) = p^{h} \bar{w}^{h} + (1 - p^{h}) \bar{w}^{l} \quad (A20)
\]

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

\[
\bar{w}^{s} = \frac{1}{2} \left( \bar{w}^{h} + \bar{w}^{l} \right) - \frac{\lambda}{4(4-\lambda)} (A - 1 - T) \quad (A21)
\]

The firm expected profit per worker is:
\[
E[(\pi_{t=2}^{S}|NS, \bar{w}^{S})] = E(1-\theta_{1,t})^{\frac{1}{2}} \left[ \frac{(1-\lambda)(1-s^h)(A-\bar{w}^S)}{2} + \left( \lambda + (1-\lambda)s^h \right) \left( \frac{A-1}{2} + T \right) + \frac{(1-\lambda)(1-\bar{w}^S) + \lambda T}{2} \right] \quad (A22)
\]

After some assignments and arrangement we get:
\[
E(1-\theta_{1,t})^{\frac{1}{2}} \left[ \frac{(1-\lambda)(A + 1 - \bar{w}^h - \bar{w}^i)}{2} + \left( \lambda - \frac{\lambda}{2(4-\lambda)} (A - 1 - T) \right) + \frac{(1-\lambda) + \lambda (A-1)}{2} - \frac{\lambda}{2D} (c + 1-\lambda) (A - 1 - T) \right] \quad (A23)
\]

Assigning $\bar{w}^h$ and $\bar{w}^i$ we get:
\[
E(1-\theta_{1,t})^{\frac{1}{2}} \left[ \frac{A-1}{2} + \frac{3T}{2} + 2c + \frac{\lambda (1-\lambda)}{2(4-\lambda)} (A - 1 - T) \left( 1 - \frac{1}{D} - \frac{c\lambda}{2D} \right) \right] \quad (A24)
\]

When we compare it to the expected profit under high wage with full information we get:
\[
E\left[ (\pi_{t=2}^{FI}|NS, \{\bar{w}^h, \bar{w}^i\}, m = 1) \right] = E\left[ (1-\theta_{1})^{\frac{1}{2}} \left[ \frac{A-1}{2} + \frac{3T}{2} + 2c \right] \right] \quad (A25)
\]

We see that:
\[
E\left[ (\pi_{t=2}^{FI}|NS, \{\bar{w}^h, \bar{w}^i\}) \right] - E\left[ (\pi_{t=2}^{S}|NS, \bar{w}^S) \right] =
E\left[ (1-\theta_{1})^{\frac{1}{2}} \left[ \frac{\lambda (1-\lambda)}{2(4-\lambda)} (A - 1 - T) \left( \frac{1-D}{D} \right) + \frac{c\lambda}{2D} \right] \right] \quad (A26)
\]

Which is always positive as $D \leq 1$ and $A \geq 1+T$. ■

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

When $\left[ (\pi_{t=2}^{h,S}|NS, b) \right] > E\left[ (\pi_{t=2}^{h,FI}|NS, b) \right]$ it implies that:
\[
(1-\lambda)(1-s^h_{i,t})(A - b) + (\lambda + (1-\lambda)s^h_{i,t})m^h \left( \frac{A-1+2T}{2} \right) > (1-\lambda)(A - b) + \lambda M^h \left( \frac{A-1+2T}{2} \right) \quad (A27)
\]

We can rearrange it into:
\[
\lambda M^h \left( \frac{A-1+2T}{2} \right) (a^h - 1) - (1-\lambda)s^h_{i,t} \left( A - b + a^h M^h \frac{A-1+2T}{2} \right) > 0 \quad (A28)
\]

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

\[
\lambda M^h \left( \frac{A - 1 + 2T}{2} \right) (a^h - 1) - (1 - \lambda) s^h_{i,t} (1 + a^h M^h) \frac{A - 1 + 2T}{2} > 0
\]

(A29)

And:

\[
\lambda M^h (a^h - 1) - (1 - \lambda) s^h_{i,t} (1 + a^h M^h) > 0
\]

(A30)

Again, as \( 1 + a^h M^h > 1 - a^h M^h \) we can write:

\[
\lambda M^h (a^h - 1) - (1 - \lambda) s^h_{i,t} (1 - a^h M^h) > 0
\]

(A31)

And hence, equation (41) is positive. ■

2.8A: comparing utilities under MD with FM

When search is promoted by the firm, the expected wage is constant in respect to \( \lambda \), and we get that:

\[
E[(u^h_{t=2} | search)] = \left( 1 - \frac{D}{2} \right) \left( \frac{A+1}{2} - T - c \right) + \frac{D}{2} b
\]

(A32)

and:

\[
E[(u^l_{t=2} | search)] = \left( 1 - \frac{D}{2} \right) \left( 1 - \frac{T}{2} - c \right) + \frac{D}{2} b
\]

(A33)

The result is equal for full matching strategy without search when \( \bar{w}^h \leq 1 - T \) and \( \bar{w}^l \leq 1 - \frac{T}{2} \) respectively:

\[
E[(u^h_{t=2} | \bar{w}^h, NS, \lambda \leq \bar{\lambda}^h)] = \left( 1 - \frac{D}{2} \right) \left( \frac{A+1}{2} - T - c \right) + \frac{D}{2} b
\]

(A34)

and:

\[
E[(u^l_{t=2} | \bar{w}^l, NS, \lambda \leq \bar{\lambda}^l)] = \left( 1 - \frac{D}{2} \right) \left( 1 - \frac{T}{2} - c \right) + \frac{D}{2} b
\]

(A35)

However, when \( \lambda > \bar{\lambda}^k \), not searching produces higher expected earnings as:

\[
E[(u^h_{t=2} | \bar{w}^h, NS, \lambda > \bar{\lambda}^h)] = b + \left( 1 - \frac{D}{2} \right) \lambda \left( \frac{A+1}{2} - T \right) > E[(u^h_{t=2} | \bar{w}^h, NS, \lambda \leq \bar{\lambda}^h)]
\]

(A36)

and:

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\[ E[(u^i_t = 2 | \bar{w}^i, NS, \lambda > \bar{\lambda}^i)] = b + \left( 1 - \frac{D}{2} \right) \lambda \left( 1 - \frac{T}{2} \right) > E[(u^i_t = 2 | \bar{w}^i, NS, \lambda \leq \bar{\lambda}^i)] \quad (A37) \]

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

2.A 9: More detailed way to reach condition 62

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

\[
\frac{1+\sqrt{5}}{2} \left( \frac{A+1}{2} - T \right) \frac{1}{1 + \frac{1+\sqrt{5}}{2} \left( \frac{c}{A+1-T-b} \right)} = \tilde{c}^* \quad \text{(A38)}
\]

And after some algebra:

\[
\frac{1+\sqrt{5}}{2} \frac{1}{1 + \frac{1+\sqrt{5}}{2} \left( \frac{c}{A+1-T-b} \right)} \left( \frac{A-1}{2} + T \right) = \frac{T}{2-T-2b} + \frac{1+\sqrt{5}}{2} \frac{\tilde{c}^*}{D} \quad \text{(A39)}
\]

And even more:

\[
(1 + \sqrt{5}) \left( \frac{A-1}{2} + T \right) = 2 \left( \frac{A+1}{2} - T - b \right) + (1 + \sqrt{5}) \tilde{c}^* \left( \frac{T}{2-T-2b} + \frac{1}{D} + \frac{1+\sqrt{5}}{2D} \frac{\tilde{c}^*}{D} \right) \quad \text{(A40)}
\]

Final stage:

\[
(1 + \sqrt{5}) \left( \frac{A-1}{2} + T \right) = 2 \left( \frac{A+1}{2} - T - b \right) \left( \frac{T}{2-T-2b} + \frac{1}{D} \right) + (1 + \sqrt{5}) \tilde{c}^* \left( \frac{T}{2-T-2b} + \frac{1}{D} \right) + \frac{(1+\sqrt{5})\tilde{c}^*}{2D} \frac{1}{2D} \left( \frac{A+1}{2} - T - b \right) + \frac{(1+\sqrt{5})^2\tilde{c}^*}{2D} \frac{1}{2D} \left( \frac{A+1}{2} - T - b \right) \quad \text{(A41)}
\]
And we can write the quadratic equation:

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

(A42)

Or:

\[
\frac{(1+\sqrt{5})^2}{2\left(\frac{A+1}{2} - T - b\right)^2}\bar{c}^* + \left(1 + \sqrt{5}\right)\left(\frac{DT}{2-T-2b} + 2\right)\bar{c}^* - \left(1 + \sqrt{5}\right)\left(\frac{A-1}{2} + T\right) = 0
\]

(A43)

We solve the quadratic equation to get:

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

(A44)

Or with simplification:

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

(A45)

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

For shortness we assign:

\[
a = 1 + \sqrt{5}; \quad x = \frac{T}{2-T-2b}; \quad y = 2\left(1 + \sqrt{5}\right)\left(\frac{A-1}{2} + T\right); \quad z = \left(\frac{A+1}{2} - T - b\right)
\]

(A46)

Note that x, y and z are all positive.

And we can derive \(\frac{\partial x^*}{\partial D}\) and we get that \(\frac{\partial x^*}{\partial D} > 0\) i.f.f:

\[
\frac{\partial}{\partial D} \left(-Dx + \sqrt{(Dx)^2 + Dy^2} \right) > 0
\]

(A47)

or after we do the derivation:
\[ -x + \frac{2x^2D + \frac{Y}{Z}}{2\sqrt{(Dx)^2 + \frac{DY}{Z}}} > 0 \]  

(A48)

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

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

(A49)

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


Chapter 3

Show Me the Money: Status, Cultural Capital, and Conspicuous Consumption

3.1 Introduction

Conspicuous consumption is not only about jewelry and sports cars. Holding the right book, possessing the right painting, or even wearing a fashionable T-shirt are also acts of signaling and status-seeking. But while almost anyone who is rich enough can buy a pretentious BMW as a signal of wealth, only some people can identify the “right” book, work of art, or even T-shirt. We present a general model of conspicuous consumption in which two partly visible goods signal the presence of dual unobserved attributes (wealth and wisdom). In addition to a classic Veblen good, a more sophisticated conspicuous-consumption good is introduced and modeled on the basis of Bourdieu’s (1979) conceptualization of cultural capital. Agents’ ability to use this sophisticated good is mediated by their level of wisdom: smart agents can choose and send a better signal and, just as important, are better able to interpret such signals. Other agents lack the ability to differentiate between high and low signals and, therefore, cannot use the sophisticated good properly.

The outcome of our discrete signaling game is a set of buying decisions for each social group that allows us to derive the status level of all individuals in society and to map the potential linkage between various initial characteristics of the market and the status distribution of the society. The analysis pertains mainly to two possible extreme equilibria: elite equilibrium (smart agents buy the conspicuous-consumption good) and nouveau riche equilibrium (rich agents buy the conspicuous-consumption good). In both equilibria, a select group uses the signal to distinguish itself from others, thereby allowing a social upper class to take shape. Our study provides existence and uniqueness conditions for such equilibria and outlines their main features. While only a nouveau riche equilibrium can be supported under the typical conspicuous-consumption product setting, the introduction of the cultural conspicuous-consumption product allows both
equilibria, the elite and the nouveau riche, to exist. Our results suggest that low income inequality and high relative importance of intellectualism are associated with an elite equilibrium while high income inequality and relative importance of materialism lead to a nouveau riche equilibrium. We also show how the cultural product permits a higher level of separability between types and examine the (mostly positive) effect of the visibility of products on their equilibrium prices.

3.1.1 Social Status from an Economic Perspective

Human beings care about their standing in society and about what others think of them. One of the major reasons for this is the social-status consideration. The economic literature reckons social status as a social reward that affects the incentive structure that individuals face. (For a review, see Weiss and Fershtman, 1998.) Unlike other classical economic rewards, the value of status depends on the consensual-allocation rule that determines who is eligible for inclusion in upper status groups. Fershtman (2008) concludes: “Social status may thus be viewed as the ranking of individuals, or groups of individuals, in society. This ranking may be based on personal attributes, actions, occupations or group affiliations. Yet, by definition, if someone climbs up in rank, someone else climbs down” (p. 2). When people seek status, their aim is to convince others that they possess certain attributes. Due to various physical and institutional constraints (including the wage-secrecy norm, the main focus of the two previous chapters), individual attributes are rarely directly observed. For this reason, people play a large-scale signaling game in which others constantly observe and interpret behaviors and use the collected information to form and update their beliefs about someone’s appropriate rank.

Thorstein Veblen, who coined the term “conspicuous consumption” in his 1899 book The Theory of the Leisure Class, claimed that people consume highly visible and extravagant goods in order to prove their wealth and gain prestige.¹ The term “Veblen effect” refers to

¹ Potentially, conspicuous consumption is not necessarily meant for the acquisition of status only. It may also serve as a specific signaling tool for other social interactions. For example, it may function as a costly signal of desirable mate qualities. (For a recent example, see Griskevicious et al., 2007). Alternatively, certain forms of conspicuous consumption may be rationalized as advertising signal: professionals may use excessive consumption to signal their quality and strength to potential customers.
the case in which demand increases with price and people prefer to buy a higher priced conspicuous-consumption good in order to send a better signal.

### 3.1.2 Modeling of Conspicuous Consumption

The concept of conspicuous consumption is discussed in several modern economic texts, from Leibenstein’s seminal paper (1950) and continuing with Frank (1985) and Ng (1987). The first line of studies assumed directly that prices increase utility. More recently, Ireland (1994), Fershtman and Weiss (1998), and Bagwell and Bernheim (1996) presented models that define utility in terms of consumption and status rather than consumption and prices. Bagwell and Bernheim stated, “Prices that one pays for goods may affect status in equilibrium; this relation should be derived not assumed” (p. 350).

Our study follows the same modeling strategy, basing utility on regular consumption and status; the quantity and prices of conspicuous-consumption goods do not enter into it directly.

When relative wealth is the only factor that determines social status, a classical conspicuous-consumption good may serve as the best signal. It easily (but expensively) separates people on the basis of their income level and their ability to spend money on a visible good that signals their wealth. Provided that the agent’s utility function satisfies the single-crossing property, a continuous conspicuous-consumption product may fully differentiate among agents on the basis of their income level. But what if it is not only wealth that determines social status? Can a signaling system based on a traditional conspicuous-consumption good yield a separating equilibrium? We will show that the answer is no.

The two main contributions of our model to the conspicuous-consumption literature are the dual attributes that determine status and the introduction of a cultural signaling good

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2 Braun and Wicklund (1989) provide interesting anecdotal psychological support for this notion; Creedy and Slottje (1991) furnish empirical evidence.

3 Bagwell and Bernheim show that the Veblen effect cannot ordinarily arise when a preference satisfies the commonly assumed “single-crossing property” (in which case, larger quantities may provide optimal signaling). They do, however, provide conditions under which the Veblen effect does appear as the result of a signaling system.

4 This result derives immediately from the classical Spence (1973) signaling model; in the context of conspicuous consumption, see Bagwell and Bernheim (1996), and Ireland (1994).
First, our model establishes agents’ status on the basis of their perceived levels of wisdom and wealth. The relative importance of these attributes is parameterized so that the model allows heterogeneity in respect of society’s values.\textsuperscript{5} Since we also have two signaling devices, the signaling game is two-dimensional in both signals and information. Multidimensional signaling models of these types are more common in the principal-agent literature and, especially, in studies of financial markets in which a firm signals different performance parameters to its shareholders. (For a more general review of multiple signaling, see Sinclair-Desgagne (1994)).

3.1.3 Cultural Signaling

The major contribution of this study is the introduction of cultural conspicuous consumption. Both the social-science literature and the marketing literature acknowledge that consumption should also be interpreted for its symbolic meaning.\textsuperscript{6} Generally speaking, any culture-dependent signaling behavior requires familiarity with a common ground of social knowledge by both the senders and the receivers of the signal. Consider a person who tries to use a sophisticated Latin idiom to signal h/her (high) ability. Clearly, without the relevant knowledge of Latin (which itself is part of the cultural capital that is associated with certain social classes), the signal may be neither transmitted properly nor recognized.\textsuperscript{7} Similarly, the cultural-conspicuous consumption good in our model may be used properly or improperly depending on the buyer’s attributes. Smart people can use their cultural capital to buy the “good” quality product; others who lack the necessary knowledge may pick the “bad” one. Recognition of the product is also based on people’s attributes: smart people can differentiate between high quality conspicuous-consumption products and bad ones; others cannot.

The two conspicuous-consumption products in our model provide agents with different signaling possibilities. If a sports car is a straightforward classical conspicuous-

\textsuperscript{5} The intuition is that status parameters represent a primitive common hierarchy of values. Obviously, the determination of such a hierarchy may be endogenous; for the time being, however, we leave this for future studies.

\textsuperscript{6} In psychology and sociology, it is expressed within the framework of symbolic interaction by Blumer (1969). For the marketing literature perspective, see Solomon (1983).

\textsuperscript{7} Signaling by language is relatively common social behavior (Rosenberg and Tunney, 2008), though amusingly, we often encounter a person who signals h/herself negatively by misusing an idiom.
consumption product, a book deliberately placed on the dashboard is an example for a cultural conspicuous-consumption product. Assuming that books have no intrinsic value except as signals, book readers (= intellectuals) can easily choose among available books and buy the right ones, those that are sophisticated and trendy. Non-intellectuals cannot choose books properly and may eventually choose randomly. When both books are put on display (with or without a sports car as their mount), a signal is sent. Then, other intellectuals who can easily distinguish between good and bad books will assign the appropriate social status levels to the books’ owners. Non-intellectual agents, in turn, who cannot tell the difference between the latest Booker Prize-winning novel and a piece of corny trash fiction, are limited in their interpretational ability and assign the same status, a somewhat lower one, to the buyers of both books.

One may invoke alternative intuitions toward the structure of the cultural conspicuous-consumption product in the model. Consider the cultural product as a product that one buys in order to be able to speak with others about it. The signaling value of going to the opera, for example, is generated by talking about the opera. Foolish agents may expose their foolishness when they speak about the opera with smart agents. When they speak with other foolish agents, however, the latter cannot tell if the former are truly opera lovers (and, therefore, smart) or not.

Arguably, foolish agents can acquire the needed information or may simply pay someone to buy the cultural product for them. Sometimes (as in buying clothes or choosing a book), this is a plausible course of action but then it increases the relative price of the sophisticated product to foolish agents, resembling in nature our current setting. Alternatively, as in the opera example, nothing less than a complete makeover will do.

Manufacturers, in contrast, can usually manipulate the distinctive features of their products. Usually they do so by marketing and advertising. While Ferrari, for example, is a well known brand even among non-Ferrari buyers; some brands of watches, such as Patek Philippe, are almost unidentifiable for what they are among the uninformed. In both examples, the distinction is the result of a marketing decision: Ferrari is a high-profile company that sponsors public sports events, whereas Patek Philippe marketing is almost secretive and addresses only highly selected segments of the market.
3.1.4 Beliefs and the Assignment of Status

As mentioned above, our model incorporates status into the utility function. Current status models frequently use a closed-form solution for the assignment of status and, therefore, usually derive status directly from the actions of one agent relative to the actions of others.\(^8\) In our study, in contrast, we formally construct a belief function. We do this for three different reasons: first, since the identification of Product B is type-dependent, different agents form beliefs differently, meaning that beliefs are not unanimous. Second, the products are only partly visible; therefore, any particular signal sent may generate several alternative received signals. Again, agents may have different views toward an individual on the basis of their idiosyncratic observations. In a unique series of papers, Heffetz (2004, 2007) was able to measure the visibility of goods and found evidence of the visibility of products on the income elasticity. Although we use a different modeling strategy, our results tend to support Heffetz’s. Third, due to the discrete structure of the model, agents’ actions are affected by out-of-equilibrium beliefs rather than by the marginal effect. This also requires special care of the formation of beliefs.

In sum, our model allows dissimilarities of beliefs among agents: Due to the probabilistic nature of visibility, agents may receive diverse signals from the same signal transmitter. Due to differences in the interpretation of signals, various types may hold disparate views toward the same signal transmitter. As a result, in equilibrium, disparate groups may hold common beliefs about agents that are different from other groups’ beliefs about the same agents.\(^9\) Finally, the individual’s status is a function of the aggregated beliefs of all other agents in the society multiplied by a term of preference for values. Said preference

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\(^8\) For example, for Frank (1985) status is a function of ranking; in Fershtman and Weiss (1998), status is the result of the distance between an agent’s action and the average action; in Ireland (1998), status is derived from a common function of the conspicuous-consumption level.

\(^9\) Adopting an alternative interpretation to our model, we may consider society as constructed by two different social groups that have different values and cultural capital. Assuming that the two social groups are not competing for the same status rank, the diversity of beliefs may serve the best interests of both types. In a similar wider context, Fershtman, Hvide, and Weiss (2005) discuss the role of social status in a multicultural society where every group maintains its own ranking and each ranking may be affected by different characteristics. They show that the gains made from (social) trade in a culturally diverse society can be translated into higher output and wages.
reflects society’s views about the importance (and relative importance) of the attributes, i.e., what society values as a novelty and a reward.

The rest of this chapter is organized as follows: Section 3.2 presents the model; Section 3.3 presents the equilibrium concept; Section 3.4 provides an analysis of two conspicuous-consumption product settings (one product and two products); and Section 3.5 discusses the results and concludes.

### 3.2. The Model

#### 3.2.1 Overview

We present a discrete, static signaling game within a partial-equilibrium framework. In the model, status-oriented agents form a society. Agents are heterogeneous in respect of two main attributes and derive utility from regular consumption and status. Status is the outcome of the public perception regarding one’s attributes and the relative importance of being considered rich (hereinafter: “materialism”) and being considered smart (hereinafter: “intellectualism”). Agents play a signaling game by using two partly visible conspicuous-consumption goods: a typical product (A) and a culturally sophisticated product (B). Product B entails the ability to differentiate: some agents cannot tell “good” and “bad” quality products apart. Visibility, prices, and distinctiveness level are all set exogenously. Each agent’s status is the outcome of the aggregate perceptions of all other agents. Perceptions are based on received signals and the various agents’ ability to differentiate and to satisfy rational expectations.

#### 3.2.2 Agents

The market is populated by four different types of agents that are differentiated by two attributes: wisdom and wealth. The attributes are dichotomies: an agent may be smart or foolish and rich or poor. This structure yields four types: RS (rich and smart); RF (rich and foolish); PS (poor and smart), and PF (poor and foolish). The two levels of wealth are reflected in the income of the different types: Rich agents have higher incomes than poor agents. The two levels of wisdom represent differences in access to cultural capital (Bourdieu, 1979); “smart” agents have the relevant social capital and “foolish” agents do not.
The share of each type in the total population is denoted by $a_i$. We define vector $P$ as the vector of the share of the respective types: $P=(a_1, a_2, a_3, a_4)$. The total number of agents in the society is $N$. In the first stage of the analysis, it is assumed that the share of each type in the total population is equal, i.e., the share of each type is $\frac{1}{4}$ and $P=(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4})$. It is also assumed that all agents belonging to the same type are identical. Hence, the analysis of the model concentrates on four representative agents (one for each type).

### 3.2.3 Products

The market is comprised of two conspicuous-consumption products: A (priced $P_A$) and B (priced $P_B$). Prices are assumed to be set exogenously. “A” products are homogeneous; “B” products have two variants: high quality ($B^+$) and low quality ($B^-$). The ability to identify the quality of a product is a function of the agents’ wisdom attribute: Whenever smart agents (types $RS$ and $PS$) buy $B$, they get $B^+$. Whenever foolish agents (types $RF$ and $PF$) buy $B$, they get $B^+$ at probability $\alpha$ and $B^-$ at probability $(1-\alpha)$. Our study uses the term “distinctiveness” to describe the level of $\alpha$. When the distinctiveness of a product is low, it means that $\alpha$ is high.

Other agents notice the consumption of the various products. Their detection, however, is subject to some uncertainty. The intuition behind this setting is that even when the most conspicuous good is purchased, some agents may not notice it or cannot identify it at all. We use $q_A$ and $q_B$ to denote the probability of visibility, in which any agent identifies the purchase of an A or B product by any other agent. It is assumed that agents are unaware of the actual personal realization of $q_A$ and $q_B$ (i.e., no agent knows what any other specific co-player knows about h/her).

### 3.2.4 Signals

Formally, any agent’s buying action (denoted by $L$) yields a signal (denoted by $s$) that is sent from the buyer to the rest of the population. This buying vector may acquire the form $\{1,1\}$ when both products, A and B, are bought; $\{1,0\}$ if only A is bought; $\{0,1\}$ when only B is bought; and $\{0,0\}$ when no product is bought.

The signals, however, are not necessarily equal to the buying decision. The distinctiveness of the product (via parameter $\alpha$, combined with the type of sender) and
the visibility of the products (via \( q^A \) and \( q^B \)) transform any buying decision \( L \) into a received signal. We use \( s_{i,j} \) to denote the received signal that a specific agent, \( j \), receives from an agent \( i \): \( s_{i,j} = f(L, \alpha, q^A, q^B) \). The vector \( s_{i,j} \) is of size 1x2, representing the consumption of \( \{A, B\} \) where \( A \) is either 0 or \( A \) and \( B \) are 0, \( B^- \) or \( B^+ \).

3.2.5 Beliefs

Agents form beliefs about other agents on the basis of received signals and the known general buying decisions of agents in the society (who buys what). The prior belief about someone’s attributes is based on the distribution of attributes in the society. Whenever an agent sees another person and receives a signal, s/he generates h/her beliefs by estimating to which of the four types the other agent belongs. The result of this Bayesian updating process is a vector of probabilities \( \beta_j(s_{i,j}) = \{\beta_1, \beta_2, \beta_3, \beta_4\} \), where \( \beta_1 \) is the probability assigned by \( j \) of agent \( i \)'s belonging to type RS; \( \beta_2 \) represents RF; \( \beta_3 \) represents PS, and \( \beta_4 \) represents PF. The belief vector is defined for every potential set of signals in the market. Agents know the distinctiveness and visibility parameters and the general consumption behaviors in the society. Thus, the actual transformation from signal to belief is a function of the buying decision of agents in the market and the parameters of the model. Naturally, \( \sum_{k=1}^{4} \beta_k = 1 \).

For example, if in equilibrium only RS agents buy Product B, when an agent receives the signal \( s_{i,j} = \{0, B^+\} \), she develops the belief vector \( \beta_j(s_{i,j}) = \{\beta_1 = 1, \beta_2 = 0, \beta_3 = 0, \beta_4 = 0\} \). When the received signal is \( s_{i,j} = \{0, 0\} \) (and \( q^B \) is set at 1), the receiver cannot determine the sender’s type and, based on the distribution of agents, the belief vector becomes \( \beta_j(s_{i,j}) = \{\beta_1 = 0, \beta_2 = \frac{1}{3}, \beta_3 = \frac{1}{3}, \beta_4 = \frac{1}{3}\} \).

The interpretation of signals, however, is not symmetric in respect to Product B: Smart agents may identify the two levels of B and, therefore, may assign different belief vectors to agents who send a \( B^- \) signal. Foolish agents cannot fully distinguish between “good” and “bad” versions of Product B when they buy it. Similarly, they cannot differentiate between a \( B^+ \) signal and a \( B^- \) signal. As a result, foolish agents interpret a received signal of \( s_{i,j} = \{0, B^+\} \) as they do \( s_{i,j} = \{0, B^-\} \). It is assumed, however, that agents are aware
of their inability to differentiate; this keeps their beliefs consistent within the rational-expectations framework.

Since agents’ abilities and information are identical in all respects other than the identification of B, the final outcome of the belief-generating process is given by two beliefs vectors per each possible sent signal. We use $\beta^S(s_i)$ to denote the belief vector of smart agents (RS and PS) and $\beta^P(s_i)$ to denote the belief vector of foolish agents. Note that when only Product A is purchased or when $\alpha=1$, we obtain $\beta^S(s_i) = \beta^P(s_i)$.

### 3.2.6 Preferences

Risk-neutral agents gain utility from consumption ($c$), and status ($S$):

$$U^k_i = u_c(c^k_i) + u_s(L^k_i)$$  \hspace{1cm} (1)

Where $k$ is the {1..4} index of the agent’s type and $i$ is the specific agent index. As all agents of a given type are identical and act symmetrically, the notation that follows omits agents’ specific indexing.

The two sub-utility functions are additive and separable. The marginal utility of consumption decreases: $(u(c)'>0, u(c)''<0)$. The consumption of the conspicuous product, A or B, promotes no direct consumption utility.$^{10}$

Status is based on other agents’ perception. In the terms of the model, higher status means that other agents assign a higher probability to the observed agent’s being smart and/or rich. Thus, status is actually a function of the belief vectors over the possible signal set that an agent produces. (Note again that the sent and received signals are not necessarily the same.) I modeled a preference function, $m$, for the belief vectors: $m: \beta^T(s_{ij}) \rightarrow R_+$. where $T=\{S,F\}$ as there are two possible belief vectors per signal.

We use the vector $m=(m_1, m_2, m_3, m_4)$ to denote the common vector of preference over the belief vectors, with $m_1$ denoting the utility that an agent gains by being perceived as Type 1 (RS) and so forth for RF, PS, and PF. Multiplication of the belief vector by the

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$^{10}$ Usually even the most conspicuous product has some traditional usability value. If this is the case, the foregoing structure implies that the value of a conspicuous-consumption product is deconstructed into two elements: actual use value and presentation value.
preference function transforms any belief vector into a status level by aggregating the status that is associated with being considered part of types 1–4.

It is assumed that the status attached to each attribute is separable and additive. Therefore, the formation of $m$ is:

$$m = (\gamma + \delta, \gamma, \delta, 0)$$  \hspace{1cm} (2)

Where $\gamma (\gamma \geq 0)$ is the utility gained by being perceived as rich and $\delta (\delta \geq 0)$ is the utility gained by being perceived as smart. When an agent is perceived to be of the first type (RS), she gains $\gamma + \delta$ because she is considered both smart and rich. When an agent is perceived as of the second type (RF), the gain is only $\gamma$ because she is considered only rich, and so forth. Note that when $\gamma = \delta = 0$, it means that agents do not care about status at all.

Since agents themselves do not know what the signal that others received was, the utility of status is based on the expectancy of $m(\beta)$. We use the expectancy because the observation of signals is subject to uncertainty $(q^A, q^B)$ and because for foolish agents the quality of Product B is also uncertain (via $\alpha$).\(^\text{11}\)

Finally, agents assign equal weight to the views of all other agents in the society. Hence, the total status utility is the sum of the four type groups of the multiplication of preference function ($m$) by the expectancy of the belief vector of each group of agents in regard to the specific agent, in view of h/her buying decision ($L$):\(^\text{12}\)

$$u_s(L) = \frac{1}{4} \sum_{k=1}^{4} m E[\beta^k(L)]$$  \hspace{1cm} (3)

\(^{11}\) Note that the current paper doesn’t address the issue of estimating other agents’ perception and the potential problems of misperception and self biased estimation. The model assumes that agents are able to produce rational expectations regarding those perceptions.

\(^{12}\) A possible complexity of the model might be to allow the four types of agents to assign different weights to the belief vectors that the different types elicit. The weights are a measure of the relevancy of others in regard to the utility that one gains from one’s status. For example, agents may care only about what other agents of their own type think of them and may disregard the beliefs of agents of other types. Another possibility is that one attributes greater importance to the beliefs of elite types, such as RS or RF, regardless of one’s own type.
3.2.7 Budget Constraint

Rich agents receive $Y_R$ income; poor agents earn $Y_P$ income. It is given that $Y_R > Y_P$. Agents spend all of their income on non-negative quantities of $C$, $A$, and $B$. Without conceding generality, the price of regular consumption is normalized to 1. Given that the buying decision vector, $L$, is $L = \{A_i, B_i\}$ (where $A_i$ and $B_i$ are the 1/0 quantities of the conspicuous-consumption product that were bought by agent $i$), compliance with the budget constraint means that $Y_i = C_i + p^A A_i + p^B B_i$. Since all agents in the same group are identical, the buying-decision vectors may be reduced to four buying-decision rules, $L_k = \{A_k, B_k\}$, where $k = (1, 2, 3, 4)$.

3.3 Equilibrium

Equilibrium in this model is the case where all agents’ buying decisions are optimal in view of the belief vectors of the players in the market, and where the belief vectors are consistent with the agents’ buying decisions. In equilibrium, on the one hand, each agent is satisfied with h/her purchases and does not wish to buy any further conspicuous-consumption product at market prices. On the other hand, the status attributions of the different groups are consistent with agents’ buying decisions. Note that since the focus of this study is on possible social structures, prices are assumed to be set exogenously and the concept of equilibrium is actually a partial equilibrium since supply-side issues are not addressed.\(^\text{13}\)

3.3.1 Definition of Equilibrium

Equilibrium is the set of four buying-decision vectors, $\{L_{RS}, L_{RF}, L_{PS}, L_{PF}\}$, and two belief vectors for each possible signal $\{\beta^S(s(L_k)), \beta^F(s(L_k))\}$, so that:

1) $L_k$ maximizes the utility of every type $k$, given beliefs $\{\beta^S, \beta^F\}$ and the budget constraint.

2) Belief vectors $\{\beta^S, \beta^F\}$ are consistent with the purchasing decisions of every type and satisfy rational expectations.

\(^{13}\) For a more comprehensive discussion of this issue, see Section 5.
The first condition requires that, in equilibrium, each agent satisfies the best respond condition in respect to the signaling mechanism. Thus, s/he buys Product A or Product B only if the product yields a non-negative return in utility terms (the increase in expected added status occasioned by signaling less the forgone utility of consumption). The second condition implies that the signaling process is correct in the sense that the beliefs are self fulfilling.

3.4. Analysis

The outcomes of the game combine the buying of quantities of products and the statuses associated with them. In this sense, any equilibrium also sketches a general specification of the society. The analysis is arrayed around two extreme special-interest equilibria of this type: an elite equilibrium and a nouveau riche equilibrium.

Definition 1:

- An elite equilibrium is a case where, in equilibrium, all smart agents buy the same conspicuous-consumption product and it alone.
- A nouveau riche equilibrium is a case where, in equilibrium, all rich agents buy the same conspicuous-consumption product and it alone.

In the elite equilibrium, smart agents may be identified as a monolithic group and all non-buyers are also identified (to the power of the visibility of the products) as foolish. In other words, an elite equilibrium generates a society in which wisdom is the main known feature and, therefore, the agents are stratified. In the nouveau riche equilibrium, wealth is the dominant attribute.

3.4.1 Single-Product Analysis: Product A

First, consider a simple setting in which only the classic conspicuous-consumption product, A, exists. The nouveau riche equilibrium occurs when all rich agents (RS and RF) buy A. For each type k, the general symmetric maximization problem of agent i is given by:
\[
\max_{L_{k,i}} \left( E(U^k) \mid \{\beta^S, \beta^F\} \right)
\]

Subject to:
\[
Y_i = C_i + p^A i_A + p^B i_B
\]

Since we are using a discrete framework, the maximization problem in one product transforms into the following inequality condition: agent \(i\) of type \(k\) buys Product A if:
\[
\left( E(U^k_i) \mid L_{k,i} = (1,0), \{\beta^S, \beta^F\} \right) \geq \left( E(U^k_i) \mid L_{k,i} = (0,0), \{\beta^S, \beta^F\} \right)
\]

In other words, agents compare the cost of signaling with the benefit of signaling (the extra status utility that is generated due to their buying the product). Utility maximization means that any agent buys a product only if she gains a positive return to her signaling. Note that while equilibrium behavior is symmetric for all individuals of the same type, the agents’ buying condition is derived from the point of view of the atomistic individual.

This means that an agent considers the current belief vectors exogenous to her decision and does not internalize her effect on beliefs by buying the product. In the discrete model, as opposed to a continuous model, to sustain an equilibrium we must ensure that both buyers and non-buyers are better off by their decision. Consequently, we need at least two (but usually more) incentive-compatibility constraints per equilibrium.

Since Product A allows straightforward signaling and signal recognition, the belief vectors are identical: \(\beta^S(s_i) = \beta^F(s_i)\). For identical buying decisions \((L_{RS} = L_{RF})\), the utility function of RS and RF is the same: \(U^{RS}(C_{RS}, L_{RS}) = U^{RF}(C_{RF}, L_{RF})\). As a result, the elite equilibrium never exists: whenever RS agents signal, RF agents also signal and the equilibrium fails to hold.

Similarly, all poor agents share a utility function and behave identically. Hence, the set of equilibria candidates has four alternatives: two separating equilibria (only rich agents buy A; only poor agents buy A) and two pooling equilibria (all types buy A; no one buys A). The main results of this setting are summarized as follows:

\(\text{Below, I refer to the benefit minus the cost as the return to signaling.}\)
**Proposition 1:**

Assuming that only the classic conspicuous-consumption product (A) is available:

- The nouveau riche equilibrium exists within price segment \( p^R_A < p_A \leq p^*_A \).
- The elite equilibrium does not exist.
- At low \( 0 < p_A \leq p^R_A \) and high prices \( p^*_A < p_A \), the scenario in which no one buys A is an equilibrium.

**Proposition 2:**

- Visibility \( q^A \) has a positive monotonous effect on price limits \( \bar{p}^R_A, \underline{p}^R_A \).
- Partial product visibility breaks the “all buy” pooling equilibrium: such an equilibrium is supported at low prices \( 0 \leq p_A < p^A_{4B} \) i.f.f \( q^A = 1 \) and given a specific out-of-equilibrium belief: that non-buyers are poor and foolish – \( \beta(0,0) = (0,0,0,1) \).

Proofs are provided in Part 1 of the Appendix.

Generally, the outcomes of this simple setting are intuitive and follow the outcome of typical signaling models (Spence, 1973). When only one product is in play, only one piece of information may be transmitted in the signaling game. Hence, rich agents may be signaled out but smart agents may not. Since successful signaling has to be costly enough, the separating equilibrium starts only above a price threshold that is high enough to preclude poor agents from signaling. As a result, demand increases at the point where price exceeds this threshold and the model replicates the Veblen effect (in a degenerate manner).

### 3.4.2 Single-Product Analysis: Product B

The analysis of this setting includes two belief vectors, \( \beta^S \) and \( \beta^E \), indicating that smart and foolish agents interpret signals differently. The utility functions, too, are completely separated because the return to signaling is different among all four types. We show
below that five potential equilibria exist under different parameterizations. We focus on homogeneous signaling equilibria (elite and nouveau riche). In these cases, the initial structure of the society (in terms of inequality and status preferences) shapes the equilibrium outcomes. Our study also provides a more general description of the rest of the results (in non-homogeneous equilibria).

### 3.4.2.1 Non-Homogeneous Equilibria

In this group of equilibria, signaling and non-signaling decisions are shared by agents who differ from one another in both attributes. For any $\alpha<1$, all these equilibria separate smart agents from foolish agents, at least in part. The following proposition provides the main results:

**Proposition 3:**

Assuming that only a cultural conspicuous-consumption product $(B)$ is available:

- Only RS buy $B$ if the price of $B$ satisfies $(p^R_B < p_B \leq \bar{p}^R_B)$.
- RS, RF, and PS buy $B$ if society is intellectual enough $(\delta \geq \frac{Y}{2})$ and if the price satisfies $(p^3_B < p_B \leq \bar{p}^3_B)$
- All agents buy $B$ if $q^B = 1$, given the out-of-equilibrium belief of $\beta(0,0) = (0,0,0,1)$, and if the price of $B$ satisfies $(0 < p_B \leq \bar{p}^A_B)$.

**Definitions and proofs** are provided in Appendix 2.

Proposition 3 evokes two interesting points. First, contrary to the Product A framework, here the strongest type of agent (RS) is able to separate herself by signaling. Interestingly, when RS agents buy Product B exclusively, it is not essential that they spend more money on signaling than in the nouveau riche equilibrium with Product A. Technically, whenever $q^A > \frac{4q^B}{4+q^B}$ we can find a $\gamma$ high enough to satisfy $\bar{p}^R_B < \bar{p}^A_B$ (in which the highest possible equilibrium price of $B$ is lower than the minimum equilibrium price of A). Hence, for top agents, Product B may constitute a better signaling device at a lower

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15 The trivial no-one-buys equilibrium also exists; it resembles the no-buy equilibrium within the Product A framework (see Appendix 1).
cost. Note that the higher distinctiveness level of B may decrease even more the cost of signaling for RS.\textsuperscript{16}

Second, counter intuitively, the effect of $\alpha$ is not necessarily positive in respect to foolish agents’ demand. A higher $\alpha$ enables assimilation with smart agents and increases the wisdom-oriented status utility. When RF agents signal badly, however, they are identified as RF and it becomes clear that they are rich; this increases the wealth-oriented status utility. Consequently, the total effect of $\alpha$ depends on the relative importance of the status attributes.

If society is materialistic enough – ($\gamma > 2\delta$) – the distinctiveness level of Product B will have a positive effect on RF demand or, alternatively, it actually would be better for RF to signal $B^-$. Potentially, since smart agents know how to choose B properly, this means that they can also choose $B^-$ when it yields a higher return.\textsuperscript{17} Smart agents can imitate foolish agents by playing the mixed strategy of choosing $B^+$ with probability $\alpha$ only. By so doing, the equilibrium fails to hold because PF agents also prefer to buy B.

\textbf{3.4.2.2 Homogeneous Equilibria}

The sophisticated conspicuous-consumption product transmits more information than the classic Product A does. Product B allows both rich agents and smart agents to distinguish themselves as a distinct social class. The sustainability of the alternate equilibria depends on the status preference of agents (or society’s values) and on income inequality in the market.

The following proposition articulates the elite equilibrium (all smart agents buy B) and the nouveau riche equilibrium (all rich agents buy B):

\textsuperscript{16} The effect of $\alpha$ on the equilibrium segment is negative: a higher $\alpha$ (lower distinctiveness) increases the value of $p^B_{RS}$, which eventually narrows $[p^B_{RS}, \tilde{p}^B_{RS}]$.

\textsuperscript{17} Otherwise, unless smart agents deliberately signal badly, a different type of “3 buy” equilibrium might evolve: RS, RF and PF would buy B while PS agents do not buy the product. Such an equilibrium may explain intentional antisocial behaviors (especially among youth).
Proposition 4:

- An elite equilibrium exists within the price segment \([p_B^{EL} \leq p_B \leq p_B^{EL}]\) iff:
  
  i. Income inequality is low enough: \(D_F^B(p_B^{EL}) - D_R^B(p_B^{EL}) \leq \frac{q^\alpha(1-\alpha)}{4}(2\delta - \gamma)\)
  
  ii. Society is intellectual enough: \(\delta > \frac{\gamma}{2}\)
  
- Visibility expands both the lower and upper bounds of the price segment.
- Higher distinctiveness (smaller \(\alpha\)) contracts the lower bound of the price segment.

Proposition 5:

- A nouveau riche equilibrium exists within the segment \([p_B^{NR} \leq p_B \leq p_B^{NR}]\) iff:
  
  i. Income inequality is high enough: \(D_F^B(p_B^{NR}) - D_R^B(p_B^{NR}) > \frac{1-\alpha}{2(1+\alpha)}q^B \delta\)
  
  ii. Society is materialistic enough: \(\gamma > \frac{(1-\alpha)(2-q^B)}{4(1+\alpha)}\delta\)
  
- Visibility expands both the lower and the upper bounds of the price segment.
- Higher distinctiveness (smaller \(\alpha\)) expands the lower bound of the price segment and contracts the higher bound of the price segment.

Proofs and analyses are provided in the two subsections that follow.

3.4.2.2.1 Elite Equilibrium

The elite equilibrium is characterized by a maximum status surplus in respect to the wisdom attribute. Under such an equilibrium, smart agents and foolish agents are fully identified (subject to the visibility parameter). Elite equilibrium signaling does not affect the status of wealth because the ratio of smart to poor agents is equal among both buyers and non-buyers of B. The belief vectors are as follows:\(^{18}\) \(\beta^S(0, B^+) = \left(\frac{1}{2}, 0, \frac{1}{2}, 0\right)\);

---

\(^{18}\) Note that the belief \(\beta^S(0, B^-)\) is an out of equilibrium belief since no buying agent actually signals \(B^-\). Since RF agents are the immediate potential group to enter into the buying circle any other realization of this belief is unreasonable.
\( \beta^S(0, B^-) = (0, 1, 0, 0); \quad \beta^F(0, B) = \left( \frac{1}{2}, 0, \frac{1}{2}, 0 \right) \).

\( \beta^S(0, 0) = \beta^F(0, 0) = \left( \frac{1-q^B}{4-2q^B}, \frac{1}{4-2q^B}, \frac{1}{4-2q^B}, \frac{1}{4-2q^B} \right) \).

In equilibrium, society is divided into two groups (based on the expected calculated status of each group): a group of size \( \frac{1}{2} \) that enjoys the higher status and a group of size \( \frac{1}{2} \) that occupies the lower status level.

The derived expected utilities are: \( U^R_S = u_c(Y_R - p_B) + \frac{1}{2-q^B} \delta + \frac{1}{2} \gamma \); And:

\( U^R_F = u_c(Y_R) + \frac{1-q^B}{2-q^B} \delta + \frac{1}{2} \gamma \);

Finally, the incentive compatibility conditions (under the above beliefs) are:

- PS agents buy B: \( U^{PS}(L^{PS} = (0,1)) > U^{PS}(L^{PS} = (0,0)) \)
- RF agents do not buy B: \( U^{RF}(L^{RF} = (0,0)) > U^{RF}(L^{RF} = (0,0)) \)

This yields the following explicit equilibrium conditions:

\[
D^B_R \leq \frac{q^B}{2-q^B} \delta \quad (6)
\]

\[
D^B_R > \left( \frac{q^B}{2-q^B} - \frac{q^B(1-\alpha)}{2} \right) \delta + \frac{q^B(1-\alpha)}{4} \gamma \quad (7)
\]

We use \( p^{EL}_B \) to denote the price that equals the PS agents’ incentive compatibility condition and \( p^{EL}_L \) to denote the price that equals the RF agents’ incentive compatibility condition. We can see that \( \frac{\partial p^{EL}_B}{\partial q^B} > 0; \frac{\partial p^{EL}_B}{\partial q^B} > 0; \frac{\partial p^{EL}_L}{\partial \alpha} > 0 \). For any \( p_B > p^{EL}_B \), RF agents do not prefer to buy B under the specified beliefs. From this price level and above, we may rewrite the above equations (6, 7) jointly to get:

\[
D^B_R (p^{EL}_B) - D^B_R (p^{EL}_L) \leq \frac{q^B(1-\alpha)}{4} (2\delta - \gamma) \quad (8)
\]

The left-hand side of the inequality represents a measure of the initial inequality in society. The difference in the lost consumption utility due to buying conspicuous-consumption product B \( (D^B_R - D^R_B) \) is positive by construction. Also, it is an increase
function of the price and an increase function of initial inequality \((Y_R - Y_p)\). The right-hand side is influenced mainly by the relative value of \(\gamma\) in respect to \(\delta\).

Two extreme necessary conditions may be derived for the above inequality; we address the first as the inequality condition and the second as the values condition:

**Inequality condition:** the foregoing inequality (8) shows that given parameters \(q^B, \alpha, \delta\) and \(\gamma\), an upper bound for income inequality exists and is represented by the gap \(D^B_R - D^B_P\). The upper bound is set as the income gap \((Y_R - Y_p)\) that equalizes inequality (8). When the condition is not satisfied, the PS agents’ incentive compatibility condition does not hold.

**Values condition:** Equation 8 also imposes a limitation on the ratio \(\frac{\gamma}{\delta}\), which reflects the relative importance of different status attributes to the agents. We may rewrite Equation 8 to get:

\[
\delta \geq \frac{\gamma}{2} + 2 \left( \frac{D^B_R(p^L_R) - D^B_P(p^L_P)}{q^B(1-\alpha)} \right) \tag{9}
\]

An elite equilibrium cannot possibly exist (regardless of the level of inequality) when \(\delta \leq \frac{\gamma}{2}\). Furthermore, the levels of the inequality, visibility, and distinctiveness parameters establish a minimal ratio of \(\delta\) to \(\gamma\).

In sum, an elite equilibrium exists when both conditions – inequality is not too high and society is not too materialistic – are satisfied. Its existence depends on actual inequality in view of the other parameters: \(\alpha, q^B, \frac{\gamma}{\delta}\). The set of possible parameterizations is characterized by a tradeoff between income inequality and preference for a wealth-oriented status. The higher \(\delta - \gamma\), the more the equilibrium is supported until higher levels of income inequality are attained. The visibility of the product \((q^B)\) and the degree of distinctiveness \((1 - \alpha)\) of the product both have a positive effect on the feasibility of

\[\text{Note that the lower bound of this ratio is also the lowest ratio that ensures correct signaling by smart agents (see Section 4.2.1). Thus, if the society is not intellectual enough, PS may (wrongly) assume that they would do best to deliberately buy a bad B in an attempt to convince observers that they are foolish but rich.}\]
an elite equilibrium. (Higher visibility and distinctiveness promote higher possible limits of income inequality.)

3.4.2.2.2 Nouveau Riche Equilibrium

The nouveau riche equilibrium separates rich from poor and RS from RF due to the cultural product. When RS and RF buy Product B, the belief vectors are:

$$\beta^S(0, B^+) = \left(\frac{1}{1+\alpha}, \frac{\alpha}{1+\alpha}, 0, 0\right); \beta^S(0, B^-) = (0, 1, 0, 0); \beta^F(0, B) = \left(\frac{1}{2}, \frac{1}{2}, 0, 0\right);$$ and:

$$\beta^S(0, 0) = \beta^F(0, 0) = \left(\frac{1-q^B}{4-2q^B}, \frac{1-q^B}{4-2q^B}, \frac{1}{4-2q^B}, \frac{1}{4-2q^B}\right).$$

In equilibrium, society is divided into three groups: one of size \(\frac{1+\alpha}{4} q^B\) that enjoys a higher status; one of size \(\frac{1-\alpha}{4} q^B\) that is correctly identified as RF, and one of size \(\frac{(2-q^B)}{2}\) that has the lowest status.

The expected utilities of the four types of agents are: 

$$U^{RS} = u_e(Y_R - p_B) + \left(\frac{1}{2} + \frac{1-\alpha}{4(1+\alpha)} q^B\right) \delta + \left(\frac{1}{2-q^B}\right) \gamma; U^{RF} = u_e(Y_R - p_B) + \left(\frac{1}{2} - \frac{1-\alpha}{4(1+\alpha)} q^B\right) \delta + \left(\frac{1}{2-q^B}\right) \gamma;$$ and:

$$U^{PS} = U^{RF} = u_e(Y_P) + \frac{1}{2} \delta + \frac{1-q^B}{2-q^B} \gamma.$$

Finally, the incentive compatibility conditions (under the above beliefs) are:

- RF agents buy B: \(U^{RF}(L^{RF} = (0, 1)) \geq U^{RF}(L^{RF} = (0, 0))\)
- PS do not buy B: \(U^{PS}(L^{PS} = (0, 0)) > U^{PS}(L^{PS} = (0, 0))\)

This yields the following explicit equilibrium conditions:

$$D_R^B \leq -\frac{1-\alpha}{4(1+\alpha)} q^B \delta + \frac{q^B}{2-q^B} \gamma \quad (10)$$

$$D_F^B > \frac{1-\alpha}{4(1+\alpha)} q^B \delta + \frac{q^B}{2-q^B} \gamma \quad (11)$$

We use \(p^{NR}_B\) to denote the price that equals the RF agents’ incentive compatibility condition and \(p^{NR}_B\) to denote the price that equals the PS agents’ incentive compatibility condition.
Consequently, \( \frac{\partial P_{BR}^N}{\partial q^B} > 0; \frac{\partial P_{BR}^N}{\partial \alpha} > 0; \frac{\partial P_{BR}^N}{\partial \delta} < 0 \). The nouveau riche equilibrium, much like the elite equilibrium, exists under two necessary conditions relating to the inequality level and the values of society (preference of status attributes).

The values condition: Clearly, whenever the right side of Equation 10 is non-positive, the nouveau riche equilibrium cannot hold. To avoid this, the wealth parameters should be high enough:

\[
\gamma > \frac{(1-\alpha)(2-q^B)}{4(1+\alpha)} \delta
\]  

(12)

The inequality condition: regardless of the actual parameterization, the status surplus that PS agents may achieve surpasses that of RF. Hence, to support the nouveau riche equilibrium, the inequality level must be high enough that the total return to signaling is higher for RF than for PS. More formally, we may write the inequality condition at the minimal price, \( (p_{BR}^N) \), by subtracting Equation 11 from Inequality 10 above:

\[
D_p^B (p_{BR}^N) - D_R^B (p_{BR}^N) > \frac{1-\alpha}{2(1+\alpha)} q^B \delta
\]  

(13)

The utility-loss gap should be wider than a certain threshold that is set by the parameters \( \alpha, q^B \) and \( \delta \). Visibility, distinctiveness, and the importance of wisdom (\( \delta \)) promote an increase in the lower limit of inequality. Much as in the previous case, \( q^B \) is linked to higher limits of the price segment within which the nouveau riche equilibrium exists.

3.4.2.2.3 Uniqueness (Product B)

The foregoing existence conditions do not guarantee uniqueness. However, elite equilibria and nouveau riche equilibria exist uniquely under more rigorous conditions regarding the preference parameters.

Homogenous equilibria provide the largest status surplus for signaling agents in respect to buyers’ shared attributes (since buyers and no-buyers are totally separate in respect of

\[\text{Since the inequality gap is higher at any higher price (by construction), we need to confirm the inequality only at the lowest price.}\]
one attribute). Therefore, if this attribute is important enough, uniqueness can be supported, i.e., when the importance of wisdom ($\delta$) is high enough, we can find a price segment at which only an elite equilibrium exists. The case for a nouveau riche equilibrium is symmetric in respect to wealth ($\gamma$): if wealth is important enough relative to wisdom, a nouveau riche equilibrium will exist uniquely within a specific segment of prices.

**Proposition 6:**

- A unique elite equilibrium exist within price segment $[\underline{p}^\text{EL}_B \leq p_B \leq \overline{p}^\text{EL}_B]$ if wisdom is important enough relative to wealth: $\delta > z^{PS} \gamma$
- A nouveau riche equilibrium exists within price segment $[\underline{p}^\text{NR}_B \leq p_B \leq \overline{p}^\text{NR}_B]$ if wealth is important enough relative to wisdom: $\gamma > z^{RS} \delta$

Where $z^{PS}(q^B, \alpha) > 0$ and $D^P_B \left(\underline{p}^\text{EL}_B\right) = z^{PS}$. And: $z^{RS}(q^B, \alpha) > 0$ and $D^R_B \left(\underline{p}^\text{NR}_B\right) = z^{RS}$.

**Proof:** see Part 3 of the Appendix.

### 3.4.3 Two-Product (A and B) Setting

After having constructed the equilibria with one product only, we proceed to the case of two signaling devices in the same market. Generally, two products allow better signaling in respect of both attributes and facilitate stronger separation between agents. Contrary to the earlier outcome, with two products it is possible to support a full separation equilibrium in which all four types enjoy differentiated degrees of status. In addition, the introduction of a second product influences the foregoing outcome concerning possible equilibria in a one-product setting. Our analysis first reconstructs elite and nouveau riche equilibria within a two-product framework where agents actually buy only one product. Later, it discusses the elite and nouveau riche equilibria in cases where, in equilibrium, both Product A and Product B are bought. For both cases, we outline the effect of the availability of two signals on the strength of signals and the status separability of the different types of agents.
Due to the richness of the model and the multiplicity of possible equilibria, we need to use the simplifying limiting assumption of \( q^A = 1 \). As shown in previous sections of this study, visibility has a monotonous effect on prices but has no qualitative effect. Obviously, visibility is important when the difference between two products is being compared. By assuming \( q^A = 1 \), we also set \( q^A \geq q^B \). This is a reasonable assumption when we take into account the different nature of products A and B: Product A is consumed and identified in a straightforward way. If we recall the examples in the Introduction, it is more reasonable for agents to identify the brand of the car before they recognize (if at all) the book that is laid on its dashboard. The main technical effect of this assumption is that the no-buy signal becomes simpler in respect of Product A. (When A is not observed, signal receivers positively assume that it was not bought.) This chapter also continues to assume that out-of-equilibrium beliefs are consistent with a continuous \( q \). Stated differently, belief does not “jump” on \( q=1 \). Remember that \( q^A = 1 \) is one of the conditions that support the existence of all buy pooling equilibria. However, when out-of-equilibrium beliefs are continuous in respect to \( q \), it rules out the possibility of all-buy equilibria in respect of both products, A and B.

### 3.4.3.1 Definition: Elite and Nouveau Riche Equilibria with Multiple Products

Following our earlier definition of elite and nouveau riche equilibria, we define a homogeneous equilibrium (elite or nouveau riche) within the two-product framework as a case where any two types of agents who have the same identical attribute choose the same buying-decision vector (\( L \)) and buy the same products. Other types of agents either buy the alternative product or purchase no conspicuous-consumption product.

### 3.4.3.2 General Characteristic of the Two-Conspicuous-Product Framework

Equilibria that exist within a single-product framework may also be supported within two-product frameworks if the price level of the non-bought product is high enough. In addition to this trivial outcome, we show the condition that allows an elite equilibrium in Product B to be supported regardless of the price of A. No similar condition exists in respect to the nouveau riche equilibrium.
Our analysis of the two-product setting with purchase of both products is based on several elementary common features. First, under a given set of beliefs, Product A grants equal status to all non-B-buyers because all agents are able to send the same signal:

\[
(\beta^k(s_i(L^{RS}(1,0))) = \beta^k(s_i(L^{RF}(1,0))) = \beta^k(s_i(L^{PS}(1,0))) = \beta^k(s_i(L^{PF}(1,0)))
\]

Where \(k=\{S, F\}\)

Poor agents never buy Product A because it always gives them a negative return. (Remember that since we limit non-realistic out-of-equilibrium beliefs, an all-buy equilibrium is not supported.) Also, equilibria in which only RS buy A may not exist because it is always optimal for RF to join in such cases, since they can signal in respect of A as well as RS can. In the single-product setting, here the two rich types (RS and RF) may have different income levels. More specifically, when RS buy Product B, the cost that they incur in buying A increases, possibly leading them to weight the purchase of “A” differently than RF. As a result, the potential equilibria set captures the cases in which either only RF agents buy A or RS and RF agents buy A. In addition, due to the full visibility of A, when only one type of agent buys A it is never optimal for this type to buy another product (B). Buying A guarantees type identification with a probability of 1. Clearly, any additional signal may not yield extra status and may cause a loss of consumption utility.

Second, Product B yields the same higher-status utility for RS and PS and a lower (and again equal) status utility for RF and PF. Hence, when RS and RF have the same income level, if RF (PF) agents buy B it is certainly profitable for RS (PS) agents to buy B as well. As a result, PF agents never buy B in equilibrium. Similarly, when PS agents profit from buying B, it is also better for RS agents to buy the sophisticated product.

To conclude, in a setting inhabited by two conspicuous-consumption products, if both products are bought in equilibrium and under the assumption of \(q^A = 1\), there are seven equilibrium candidates:

21 The result and the main intuition that supports it follow. Formal proofs are trivial and are omitted for brevity.
Group 1: RF agents buy A + RS or (RS and PS) buy B (2 equilibria).

Group 2: Rich agents buy A + RS agents buy B (with or without RF) and / or PS agents buy B (5 equilibria).

3.4.3.3 Elite Equilibrium

An elite equilibrium exists when RS and PS agents buy Product B. Pursuant to the previous section, we see that two equilibria may qualify as elite: smart agents buy B when RF agents buy A, and smart agents buy B and no additional purchase is made. Consider the case in which an elite equilibrium holds within a single-product setting (i.e., both the inequality condition and the values condition hold – equations 8 and 9). When the possibility of buying Product A is introduced into the market, how would the signaling game change? Can an elite equilibrium be sustained?

An elite equilibrium provides smart agents with an effective tool for signaling themselves out as being smart. It does not, however, have any effect on the wealth attribute. Product A, especially when more visible than B, allows agents to gain wealth status. Hence the availability of A may decrease the value of signal B. Alternatively, when rich non-B buyers signal by using A, it makes the non-signaling group more undesirable and may push agents into buying conspicuous-consumption products.

3.4.3.3.1 Elite Equilibrium with No Buying of A

**Proposition 7:**

- Within a two-product framework, an elite equilibrium (smart agents buy B) without any purchases of additional products exists if:
  
  i. The importance of wisdom status is high enough: \( \delta \geq \frac{2-a^B}{2(1-a^B)^2} \gamma \)

  ii. Or the price of A is high enough: \( p_A > p^*_A \)

- The corresponding price B segment is identical to the elite-equilibrium price segment within the single-product framework: \( p^{EL}_B \leq p_B \leq p^{EL}_P \)

- The lower visibility of Product B promotes the likelihood of an elite equilibrium
Proof:

Consider the equilibrium in which RS and PS agents buy B and RF and PF agents buy no product.

The respective belief vectors are \( \beta^{S}(0, B^+) = \left( \frac{1}{2}, 0, \frac{1}{2}, 0 \right) \) ; \( \beta^{F}(0, B) = \left( \frac{1}{2}, 0, \frac{1}{2}, 0 \right) \) And: \( \beta^{S}(0, 0) = \beta^{F}(0, 0) = \left( \frac{1-q^{B}}{4-2q^{B}}, \frac{1}{4-2q^{B}}, \frac{1-q^{B}}{4-2q^{B}}, \frac{1}{4-2q^{B}} \right) \). The out-of-equilibrium beliefs shape the market outcome and for this reason their setting is crucial. Since the immediate candidates for the purchase of A or B are RF agents, I assign: \( \beta^{S}(0, B^-) = (0,1,0,0) \); and: \( \beta^{S}(1,0) = \beta^{F}(1,0) = (0,1,0,0) \).

The different types of utilities are identical to the elite-equilibrium outcomes because the actual signal does not change and, therefore, the status remains identical. (See Subsection 3.4.2.3.1 for a full description.) The incentive-compatibility conditions, however, need to cover a wider range of possibilities. First, we ensure that buyers prefer to buy (condition: PS buy B) and that they do not wish to deviate (RS do not buy A as well and RS do not buy A instead of B). For non-buyers, we demand non-profitability in the purchase of B (RF do not buy B) and A as well (RF do not buy A). More technically, we can derive five explicit incentive-compatibility conditions:

a) PS agents buy B (initial elite condition): \( D_{B}^{R} \leq \frac{q^{B}}{2-q^{B}} \delta \)

b) RF agents do not buy B(initial elite condition): \( D_{B}^{R} > \left( \frac{q^{B}}{2-q^{B}} - \frac{q^{B}(1-\alpha)}{2} \right) \delta + \frac{q^{B}(1-\alpha)}{4} y \)

c) RF agents do not buy A: \( D_{A}^{R} > -\frac{1-q^{B}}{2-q^{B}} \delta + \frac{1}{2} y \)

d) RS agents do not buy A: \( D_{R}^{B} > -\frac{(1-q^{B})^{2}}{2-q^{B}} \delta + \frac{1}{2} y \)

e) RS agents do not buy only A: \( D_{R}^{A} - D_{R}^{B} > -\frac{1}{2-q^{B}} \delta + \frac{1}{2} y \)

The three last conditions reflect a similar notion: the equilibrium cannot hold if the expected return to signaling via A is too high. More specifically, the existence of the elite

\[ \text{This condition means that } (U^{RS}(L^{RS} = (0,1)) - U^{RS}(L^{RS} = (1,0))) \geq 0. \text{ Or in other words it is not better for RS to buy A instead of buying B.} \]
equilibrium depends on the wisdom/wealth importance ratio and the relative difference in visibility between products A and B.

Note that Condition (e) is less restrictive than Condition (c) and can therefore be omitted. The remaining RF and RS conditions yield two interesting outcomes. First, when \( \frac{2-q^B}{2(1-q^B)^2} \gamma \leq \delta \), the right-hand side is non-positive and the conditions are satisfied regardless of \( p_A \). This means that an elite equilibrium is not affected by the introduction of Product A and the signaling social class continues to be composed of smart agents only. A society that follows this condition is characterized by such a strong bias toward wisdom as to make the wealth attribute almost non-important. A parallel representation of the foregoing condition may suggest that for \( q^B < 1 - \frac{\gamma + \sqrt{\gamma(\gamma + 8\delta)}}{4\delta} \), an elite equilibrium exists at all prices of A. The intuition is that an excessively high visibility of B reduces non-B buyers to a very low status and, in turn, gives outsiders a greater incentive to buy A. Low visibility supports the sustainability of the elite equilibrium. This leads us to the interesting conclusion that markets with stronger B signals are more susceptible to the entrance of non-sophisticated conspicuous-consumption products and a breakdown of the elite structure.

Finally, when the foregoing value condition is not satisfied, there exist a price \( p_A^* \) beyond which no agent buys A and the elite equilibrium is sustained. Using \( p_A^{\#} \) to denote the price that equals Condition (c) and \( p_A^{\#} \) as the price that equals Condition (d), \( p_A = \min(p_A^*, p_A^{\#}) \). Interestingly, price \( p_A^* \) correlates negatively with the relative visibility of Product B. The lower visibility of B promotes a lower \( p_A^* \), which makes an elite equilibrium more likely.

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23 Note that \( D_B^d < D_B^p \) but according to the first condition \( D_B^d \leq \frac{q^B}{2-q^B} \delta \) and hence we can replace \( D_B^d \) with \( \frac{q^B}{2-q^B} \delta \) on the fifth condition to get exactly \( D_B^d > \frac{1-q^B}{2-q^B} \delta + \frac{1}{2} \gamma \).

24 Note that the \( \delta/\gamma \) ratio still has to satisfy the value condition for the original elite equilibrium. This value condition (Equation 10) is \( \delta > \frac{\gamma}{2} \). The above current condition however is always more comprehensive.

25 Note that this is simply an alternative way of writing the foregoing wisdom vs. wealth condition. \( q^B \) can be larger than 0 only when can be larger than 0 only when \( \gamma < \delta \).


3.4.3.3.2 Elite Equilibrium with RF Agents Buying A

**Proposition 8:**

- An elite equilibrium (smart agents buy B) with RF agents buying A exists within price segments: \( \left( p_A^{II} < p_A < \bar{p}_A^{II} \right) \left( p_B^{II} < p_B < \bar{p}_B^{II} \right) \) if:
  
  i. The importance of wealth status is high enough: \( \gamma > \left( 1 - \frac{q^{\delta}}{2-q^{\delta}} \right) \delta \)

ii. The price difference between \( p_A \) and \( p_B \) is not very large (\( p_B^{II} \) is a positive function of \( p_A \))

- When the distinctiveness level is low enough, \( \alpha > \frac{3q^{\delta} - 2}{q^{\delta}(3-q^{\delta})} \), the price segment of B product is wider than the segment in a single-product elite equilibrium.

**Proof:** see Part 5 of the Appendix.

Buying A has two main effects on the scheme of agent incentives. First, it decreases the utility of agents who signal (0,0) because the unified group of buying agents leaves only poor and foolish agents inside the group of non-buyers. As a result, the relative return to buying a conspicuous-consumption product (A or B) increases. In this sense, this signaling outcome is stronger than the simple elite equilibrium because it produces a better incentive for buyers of the product. Second, due to the high (full) visibility of Product A, when RF agents buy it they are identified with probability 1. In this case, buying B in addition to A is never profitable because it does not send an additional informative signal. As a result, this equilibrium is more stable than others in the sense that it exists under relatively weaker conditions (since the condition that ensures that RF agents do not signal by using B is less restrictive).

Proposition 8 suggests that this equilibrium relies on the relative importance of wealth and on a high enough level of income inequality. Both conditions are the opposite of those of the elite equilibrium within a single-product framework. Although both conditions have some interchangeable segments (meaning that it is possible to switch

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26 We assume that the out-of-equilibrium belief is such that when A and B signals are presented together, it is associated with the more probable buyers of A product.
from one equilibrium to the other when Product A enters the market), the flipping of the conditions suggests that if inequality is too high and values are too materialistic, an elite equilibrium can be sustained only if it is joined by RF agents who buy the classical conspicuous-consumption good. Hence, potentially, the introduction of BMWs for rich and foolish agents facilitates the book reading of elite smart agents.

The intuition behind the foregoing conditions originates in the incentive-compatibility constraints. First, when RF buy A, they gain some wealth utility but lose some wisdom utility (the wisdom that is attributed to non-B buyers due to the limited visibility of B). If the total difference in status utilities is not positive, RF agents do not buy A and the equilibrium fails. The aim of the value condition is to satisfy the buying condition of A by RF. Second, the equilibrium requires RS not to prefer to buy A over B. To satisfy this condition, the relative return to buying B for RS has to be higher than the return to buying A. In the proof, we show that this entails a minimum level of income inequality.

For brevity, proof and full analysis of Proposition 8 are provided in Appendix 5.

3.4.3.4 Nouveau riche equilibrium

In a nouveau riche equilibrium, it is the rich agents who share a signaling device. A nouveau riche equilibrium with rich agents buying B may still be supported within a two-product framework (provided that $\frac{g_{1868}}{g_{3002}}/g_{3408}$ – see Appendix 6 for proof) but not both products are bought in equilibrium. The more interesting scenario includes rich agents buying A with or without PS agents buying B. Actually, when rich agents buy A, three related equilibria become possible: RS buying B, PS buying B, and all smart agents buying B. The analysis that follows starts by expending the nouveau riche equilibrium with one product into a two-product framework. The following proposition outlines the main results for the nouveau riche equilibrium when agents signal by using Product A:

**Proposition 9:**

- Assuming that all rich agents buy A, the purchase of Product B by smart agents depends on income inequality in the market:
  
i. At a low level of inequality: RS agents buy B when it is cheap but PS agents buy B when it is more expensive; then the nouveau riche equilibrium holds.
ii. At a medium level of inequality, within a specific price segment all smart agents buy B.

iii. At a high level of inequality – PS agents buy B when it is cheap and RS agents buy B when it is more expensive

- A nouveau riche equilibrium in Product A (with no other products purchased) exists if: \( p_B > p_B^{IV} \)

The intuition behind the proof is explained in the next subsections. For a formal proof, see Part 7 of the Appendix.

3.4.3.4.1 Nouveau Riche Equilibrium (without additional products purchased)

The availability of Product B generates a strong incentive for RS to quit the equilibrium path and buy B rather than (or in addition to) A. Depending mainly on the visibility of B, the return to signal B may be higher than the return to signal A and prompt RS agents to deviate. The two incentives-constraint conditions are:

a) RS do not buy B in addition to A: \( D_{R}^{RB} > \frac{q^B}{2} \delta \).
b) RS do not buy B instead of A: \( D_{R}^{B} > \frac{q^B}{2} \delta - (1 - q^B)\gamma + D_{R}^{A} \).

We use \( p_B^{IV} \) to denote the minimum price that satisfies both inequalities. Then, for \( p_B > p_B^{IV} \), a nouveau riche equilibrium in Product A can hold. Note that the right side is a positive function of the visibility of B, the importance of wisdom status, and the price of A. Hence, the higher their level, the more a breakdown of the nouveau riche equilibrium is promoted. From a different viewpoint, the condition may be rewritten into: \( \gamma > \frac{q^B}{2} \delta + (D_{R}^{A} - D_{R}^{B}) \)(1−q^B), meaning that for any price set, the nouveau riche equilibrium is supported if the preferences are materialistic enough.

3.4.3.4.2 Nouveau Riche Equilibrium in Product A When PS Agents Buy Product B

When all rich agents buy A, the wealth attribute is fully and correctly exposed. Product B becomes a supplement product that serves as a signaling tool in respect to the wisdom attribute only. For each signaling group – rich and poor – the initial probability of being
considered smart is 0.5. This makes the signaling problem both separable and symmetric: RS and RF agents’ decisions affect only the assignment of wisdom status to rich agents, while PS and PF agents’ decisions affect the assignment of wisdom status to poor agents. Therefore, buying decisions are simple: in equilibrium, buying is performed if the price of B is low enough to make it beneficial for smart agents (rich or poor) to buy it and high enough to prevent foolish agents (again, rich or poor) from trying to imitate the smart agents’ buying decision. The other driving force is the cost of signaling: the difference in actual cost is a function of the initial income inequality and the price of A. (A higher price of A limits rich agents’ available resources and may drive them out of the market if the price of B is too high). The effect of income differences between rich and poor smart agents yields different equilibrium patterns. Assuming that rich agents have more resources even after buying A, PS agents buy B when its price is low and RS agents buy B in a higher price segment. If the income difference is not very large, we should expect an interchange segment in which both RS and PS buy B. In the rare extreme case where the price of A is high enough to make rich agents’ income lower than poor agents’ income, the price segments flip: RS agents buy B within a lower segment than PS agents do.

The case in which all smart agents buy B allows maximal separation of agents depending on the visibility of Product B. If it is full, all agents in the society enjoy exactly the status they deserve in view of their actual attributes. In the other case, when the two segments do not overlap, the price of Product B affects the product’s clientele: usually, at high prices it would be the rich and smart who buy the product and, at lower prices, PS agents would buy it.

3.5. Discussion and Concluding Remarks

We have studied a model of cultural conspicuous consumption. Our results suggest that the conjunction of a society’s value system and economic performance (income inequality) shapes the outcome of the conspicuous-consumption market. Higher inequality and materialism are associated with a nouveau riche equilibrium; lower inequality and higher intellectualism are linked with an elite equilibrium. The introduction of a cultural-conspicuous consumption product promotes the existence of an
elite equilibrium that a classic conspicuous-consumption product environment cannot support.

We used a partial-equilibrium framework and discarded all direct supply-side effects on market outcome. This was done mainly because our interest in this study was to explore the potential structures and status stratification of societies. The supply side of conspicuous-consumption products (especially those of cultural orientation) is complex and is still an unsolved issue in the literature. Since Veblen, most studies have focused on demand and, therefore, imply a limited structural supply side, if any. Bagwell and Bernheim (1996) introduced a more advanced supply-side mechanism by using a relatively strong assumption. Notably, conspicuous-consumption signaling requires the existence of a few focal brands that are bought by a mass of consumers, rather than the typical competitive environment. A framework of monopoly or monopoly competition may be applied in some cases (Product A), but other cases (Product B) may resemble a public-good framework or a public monopoly.

An important branch of the conspicuous-consumption literature deals with the possibility of taxing luxury goods (Ng, 1987; Ireland 1998). The conventional wisdom is that taxing conspicuous-consumption goods may lead to Pareto improvements. While we do not allow taxation in our context, obviously an income tax (that mitigates inequality) pushes the market toward an elite equilibrium and a conspicuous-consumption tax would be expected to promote a nouveau riche equilibrium. In much the same context, Piccione and Rubinstein (2008) suggest that luxury goods may serve as a mechanism for redistribution and hint that conspicuous consumption may limit the inequality effect in society. Our model also shows that conspicuous consumption tends to mitigate inequality in regular consumption but generates inequality in the distribution of status. In this sense, it is no longer clear that allowing signaling is Pareto optimal for society.

Finally, the common-meritocracy hypothesis suggests that wisdom and wealth are linked: smarter people are expected to become richer. Thus, the actual composition of a society is a reflection of its level of meritocracy: where total meritocracy reigns, we would expect a

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27 In an exceptional case, Pesendorfer (1995) developed a model that explains the cycle in fashion and endogenizes the rate of fashion innovations.
person to be either rich and smart or poor and foolish (i.e., the sets of rich and foolish and poor and smart would be empty). At the other extreme, where there is no correlation between being smart and being rich, we would expect each wealth level to have the same proportion of smart agents. Clearly, an alternative view also exists. If we consider income level as the result of one’s performance and regard intellectual level (or cultural capital) as the outcome of a draw (of birthplace and family), the interpretation of the distribution of types may flip: a society that offers more equal opportunity would be characterized by a weaker correlation between the initial draw and the final market outcomes.

3.5.1 Future Directions of Inquiry

Our results suggest that visibility has a strong effect on equilibrium prices. Heffetz (2007) suggests that visibility may be endogenous because it is not an inherent feature of commodities and, for this reason, it may be the case that rich or famous people’s consumption would become more visible. Although our model allows type heterogeneity only in respect of product heterogeneity and not in respect of visibility, this seems to be a promising direction for future work. In addition, we defined Product B as useless apart from its signaling value. It may be fruitful to interpret the price of B as the supplemental cost of a bundle of goods that is incurred in order to make consumption visible relative to other non-visible goods. This may be done by considering visibility a characteristic of consumption (e.g., as in Lancaster, 1966). For our current purpose, it sufficed to consider the signal an expenditure on goods without any direct consumption value to the consumer. When we consider taking the model to the data, however, the possibility of much more general interpretations is needed.

Finally, the current work may be extended by adding a third conspicuous product, Z. This product would be modeled as a type of “secret handshake” among rich agents. Since only the rich would be able to identify the possession of such a product, agents may use it to signal rich agents only. The intuition behind this kind of product is the range of very expensive and luxurious labels that are familiar only to the very rich. We may assume that ordinary people cannot tell if a shoe or a pen is ordinary or ultra-expensive. Only other rich agents can identify and, therefore, interpret the signal. Such a product should allow us to better understand intra-type signaling behaviors.
3.A Appendix

3.A.1 Proofs and Definitions for Propositions 1 and 2

**Nouveau Riche Equilibrium**

There are two candidates for a separating equilibrium: the nouveau riche equilibrium and the case in which all poor agents buy Product B. Trivially, the latter can never exist because it yields a negative return to signaling. In a nouveau riche equilibrium, the respective belief vectors are given by:

\[
\beta^S(A, 0) = \beta^F(A, 0) = \left(\frac{1}{2}, \frac{1}{2}, 0, 0\right) \tag{A1}
\]

\[
\beta^F(0, 0) = \beta^S(0, 0) = \left(\frac{1-q^A}{4-2q^A}, \frac{1-q^A}{4-2q^A}, \frac{1}{4-2q^A}, \frac{1}{4-2q^A}\right) \tag{A2}
\]

The expected utilities of agents under this equilibrium are derived by summing up each agent’s status level. At probability \(q^A\) the actual sent signal is \((A, 0)\) and at probability \((1 - q^A)\) the sent signal is \((0, 0)\). Hence, the utility of rich agents becomes:

\[
U^R = U^{RS} = U^{RF} = u_c(Y_R - p_A) + q^A m\beta^S(1,0) + (1 - q^A)m\beta^S(0,0) \tag{A3}
\]

And after placing \(m\) and making some arrangements, we get:

\[
U^R = u_c(Y_R - p_A) + \left(0.5\delta + \frac{1}{2-q^A}\right) \tag{A3}
\]

Note that when RF agents join the nouveau riche equilibrium they gain not only wealth status but also higher (than their actual) wisdom status (because they have a 0.5 probability of being RS). Hence, in a nouveau riche equilibrium flaunting one’s wealth also promotes some intellectually associated status benefits. Stated differently, focusing on wealth allows RF to avoid being identified as foolish.

Poor agents do not purchase Product A and their sent signal is always \((0, 0)\). As a result, their utility is:

\[
\frac{1}{2} \tag{A3}
\]

Note that for \(q^A < 1\), the visibility of the conspicuous product is not complete and hence the belief vector given \(s_{ij} = (0,0)\) assigns positive probability to the first two types
Denote \( D^R_A \), \((D^P_A)\) as the decrease in the consumption utility of rich (poor) agents due to the purchase of Product A: \( D^R_A = u_c(Y_R) - u_c(Y_R - p_A) \). The utility loss variable \( D^R_A \), is a positive function of the price and negative function of the initial income level. Hence, the implicit incentive-compatibility conditions for the nouveau riche equilibrium are:

- Rich prefer to buy Product A: \( D^R_A \leq u_s(1,0) - u_s(0,0) = \frac{q^A}{2-q^A} \gamma \)
- Poor prefer not to buy Product A: \( D^P_A > u_s(1,0) - u_s(0,0) = \frac{q^A}{2-q^A} \gamma \)

By definition, \( D^R_A < D^P_A \) since the rich have higher income and consumption utility is concave. Therefore, a nouveau riche equilibrium always exists within some segment of prices. Denote \( \bar{p}^R_A \) as the price that satisfies \( D^R_A = \frac{q^A}{2-q^A} \gamma \); denote \( \underline{p}^R_A \) as the price that satisfies \( D^R_A = \frac{q^A}{2-q^A} \gamma \). Then, a separating equilibrium of all rich agents who buy A exists within the segment \( [\underline{p}^R_A, \bar{p}^R_A] \). The gap \( D^R_A - D^R_A \) which enables the equilibrium, is a function of the relative price of Product A and the inequality level \((Y_R - Y_P)\). The segment of \( p_A \) in which the equilibrium exists is extended as income inequality increases. In addition, both \( \underline{p}^R_A \) and \( \bar{p}^R_A \) are positively dependent on \( q^A \) since it increases the right-hand side of the conditions. This yields the intuitive result of a direct correlation between the visibility of the product and its price.

Note that the incentive-compatibility condition of poor agents is derived from the point of view of the atomistic individual. It follows that an agent considers the current belief vectors exogenous to her decision and does not internalize her effect on beliefs by buying the product. For example, when \( p_A = p_A \) a poor agent prefers to buy A rather than not to buy A. This is true, however, only for belief vectors that are based on the nouveau riche equilibrium. Clearly, if one poor agent deviates then all other poor agents will find it profitable to deviate. As a result, the equilibrium breaks down because the belief vectors are no longer consistent with agents' behavior. It is not immediate, however, that a new non-trivial equilibrium may form under the new circumstances. If we continue with the
foregoing example, when all poor agents buy A, the return to signaling decreases and the incentive-compatibility condition for poor agents no longer holds. To better understand these cases, we need to analyze the potential pooling equilibria.

**Pooling Equilibria**

A pooling equilibrium exists when all agents buy A. (Another trivial pooling equilibrium of no-buy is formalized in Appendix 1.) In general, pooling equilibria depend on out-of-equilibrium beliefs. The common problem involving such equilibria is that awkward yet non-dismissable out-of-equilibrium beliefs may result in an unreasonable equilibrium outcome. Partial visibility, however, makes the model less vulnerable to such problems. Whenever \( q<1 \), some agents appear as though they did not buy the product even in an “all-buy” pooling equilibrium. As a result, the out-of-equilibrium beliefs are determined by actual market participation and, de facto, unrealistic beliefs are excluded. When all agents buy A, the belief vector assigned to an empty signal is equal to the belief vector of the buying signal: \( \beta^F(A,0) = \beta^S(A,0) = \beta^S(0,0) = \beta^E(0,0) = \left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right) \). As a result, there is no status difference between buyers and non-buyers and the pooling equilibrium cannot hold.

An all-buy equilibrium is possible only if \( q^A = 1 \). Even then, it requires a strong assumption about the out-of-equilibrium belief vector, \( \beta(0,0) \). Specifically, we demand that the expected status utility without buying be lower than the expected status utility of buyers: \( \sum_{k=1}^{4} mE[\beta^k(A,0)] > \sum_{k=1}^{4} mE[\beta^k(0,0)] \). The minimum potential utility status is given by belief vector: \( \beta^F(0,0) = \beta^S(0,0) = \left(0, 0, \frac{1}{2}, \frac{1}{2}\right) \).\(^2\) yields the following explicit incentive-compatibility conditions:

- Rich agents prefer to buy A if: \( D^A_R \leq \frac{1}{2} \gamma \)
- Poor agents prefer to buy A: if \( D^A_P \leq \frac{1}{2} \gamma \)

---

\(^2\) As I address Smart and Foolish agents as the same in this chapter I didn’t allow the belief vector: \( \beta^S(0,0) = (0,0,0,1) \)
Since \( D_R^A \leq D_P^A \), only the second condition is binding. Hence, an all-buy pooling equilibrium is supported if \( q^A = 1 \) and \( p_A \) lies within segment \( 0 \leq p_A < p_A^{4B} \) where \( p_A^{4B} \) is the price that equals \( D_A^P = \frac{1}{2} \gamma \).

Note that since \( p_A^R(q^A = 1) > p_A^{4B} \) the separating nouveau riche equilibrium and the all-buy equilibrium never intersect. Furthermore, in this segment the equilibrium outcomes are dominated by the no-buy equilibrium.

**No-One-Buys-A Equilibrium**

The equilibrium in which no one buys Product A demands that agents have nothing extra to gain by buying A. When no agent buys A, the only signal is \((0,0)\). Correspondingly, the belief vector assigns equal probability to each of the types and the utility functions are simply given by: \( U^R = u_c(Y_R) + (0.5 \delta + 0.5 \gamma) \) and \( U^P = u_c(Y_P) + (0.5 \delta + 0.5 \gamma) \). If the out-of-equilibrium beliefs are such that \( \beta^P(A,0) = \beta^S(A,0) = \left( \frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4} \right) \), the incentive-compatibility condition becomes \( 0 < D_A^P \), which is always satisfied. However, any belief vector for which \( \sum_{k=1}^4 mE[\beta_k(1,0)] > \sum_{k=1}^4 mE[\beta_k(0,0)] \) meaning that the utility of status is higher when an agent deviates) may break the equilibrium.

I use an equilibrium refinement to clarify the situation. In segment \( [p_A, \bar{p}_A] \), we may use the “Intuitive Criterion” (Cho and Kreps, 1987) to eliminate the possibility of the no-buy pooling equilibrium because the out-of-equilibrium belief \( \beta^P(A,0) = \beta^S(A,0) = \left( \frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4} \right) \) is “unstable.” This happens because rich agents improve their status by buying A, which makes the pooling beliefs dominated and therefore eliminated. In any other price segment, buying A is not optimal and the intuitive criterion may not be applied. Therefore, a no-buy pooling equilibrium exists and passes the intuitive criterion for: \( 0 \leq p_A < p_A \) and for: \( \bar{p}_A \leq p_A \) the first segment reflects prices that are too low for the rich to signal and the second segment represents a price that is too high to signal. The effect generated by this structure resembles the Veblen effect: an increase in price increases the value of signaling and, in turn, increases demand.
3.A.2 Proofs and Definition for Propositions 3

**Non-Homogeneous Equilibrium: RS Agents Buy Product B**

When RS agents buy Product B, the belief vectors are: \( \beta^S(0, B^+) = \beta^F(0, B) = (1, 0, 0, 0) \) and \( \beta^S(0, 0) = \beta^F(0, 0) = \left( \frac{1-q^A}{4-q^A}, \frac{1}{4-q^A}, \frac{1}{4-q^A} \right) \). Following the beliefs, the expected utilities of the four types becomes: 

\[
U_{RS} = u_c(Y_R - p_B) + \frac{2+q^B}{4-q^B} (\delta + \gamma); \\
U_{RF} = u_c(Y_R) + \frac{2-q^B}{4-q^B} (\delta + \gamma); \quad \text{and} \quad U_{PS} = U_{PF} = u_c(Y_R) + \frac{2-q^B}{4-q^B} (\delta + \gamma).
\]

Equilibrium exists if, given the foregoing beliefs and utilities, RS agents prefer to buy B and all other types prefer not to buy. The immediate candidates are PS and RF. Unlike a smart agent, a RF agent understands that when she buys B the corresponding belief vectors are: \( \beta^S(0, B^+) = (1, 0, 0, 0) \) and \( \beta^S(0, B^-) = (0, 1, 0, 0) \). The latter vector is based on the out-of-equilibrium reasonable belief that a signal of \( B^- \) is sent due to a purchase made by RF and not by PF. The belief vectors of foolish agents do not change. Therefore, the expected utility function upon buying B is. After therefore: 

\[
U_{RF}^R = u_c(Y_R - p_B) + q^B \left( \frac{\alpha}{2} m \beta^S(0, B^+) + \frac{1-\alpha}{2} m \beta^S(0, B^-) + \frac{1}{2} m \beta^F(0, B) \right) + (1 - q^B) m \beta^S(0, 0).
\]

And after some placements and arrangements, we get:

\[
U_{RF}^R = u_c(Y_R - p_B) + \left( q^B \frac{1+\alpha}{2} + (1 - q^B) \frac{2-q^B}{4-q^B} \right) \delta + \left( q^B + (1 - q^B) \frac{2-q^B}{4-q^B} \right) \gamma \quad (A5)
\]

The expected perceived wisdom level is a function of. Perceived income is not affected by the because \( \alpha \) since even when the RF agent is exposed as foolish, she is still considered rich. Therefore, to conclude, the explicit incentive compatibility conditions are:

- **RS agents prefer to buy A if:** 
  \[ D_B^R \leq \frac{2q^B}{4-q^B} (\delta + \gamma) \]

- **RF agents prefer not to buy if:** 
  \[ D_B^R \geq \left( \frac{1+\alpha}{2} - \frac{2-q^B}{4-q^B} \right) q^B \delta + \frac{2q^B}{4-q^B} \gamma \]

- **PS agents prefer not to buy if:** 
  \[ D_B^R \geq \frac{2q^B}{4-q^B} (\delta + \gamma) \]
For any $\alpha < 1$, there exists a price level $p_B^*$ for which such an equilibrium exists. Denote $\bar{p}_B^{RS}$ as the price that satisfies $D_B^R = \frac{2q_B^R}{4-q_B^R}(\delta + \gamma)$. Denote $\bar{p}_B^*$ as the price that satisfies $D_B^R = \frac{1}{2}a - \frac{2a^B_\epsilon}{4-a^B_\epsilon}q^B_\epsilon \delta + \frac{2a^B_\epsilon}{4-a^B_\epsilon}q^B_\epsilon \gamma$ and denote $\bar{p}_B^{RS}$ as the price that satisfies $D_B^R = \frac{2a^B_\epsilon}{4-a^B_\epsilon}(\delta + \gamma)$. Then, an “RS buy B” equilibrium exists within price segment $[p_B^{RS}, \bar{p}_B^{RS}]$ where $p_B^{RS} = \max[p_B^*, p_B^{RS}]$.

The effect of visibility is positively monotonous at all price levels. Higher visibility expands both limits of the equilibrium segment. The effect of $\alpha$ on the equilibrium segment is negative: a higher $\alpha$ increase $\bar{p}_B^{RS}$ which eventually narrowess $[p_B^{RS}, \bar{p}_B^{RS}]$.

**Non-Homogeneous Equilibrium: RS, RF, and PS Agents Buy Product B**

In this equilibrium, three types of agents (RS, RF, and PS) buy the conspicuous-consumption product. Actually, this equilibrium resembles the all-buy equilibrium because agents buy the product mainly to avoid the negative effect of not buying it. In the “three-buy” equilibrium, however, beliefs are supported by the existence of non-buyers. Since only PF do not buy, the status of non-buyers is very low (also depending on visibility) in both attributes.

The respective belief vectors when three types of agents buy B are given by:

$$\beta^S(0, B^+) = \left(\frac{1}{2+\alpha}, \frac{1}{2+\alpha}, 0 \right); \beta^S(0, B^-) = (0, 1, 0, 0); \beta^F(0, B) = \left(\frac{1}{3}, \frac{1}{3}, \frac{1}{3} \right)$$ and:

$$\beta^S(0, 0) = \beta^F(0, 0) = \left(\frac{1-q^A}{4-3q^A}, \frac{1-q^A}{4-3q^A}, \frac{1}{4-3q^A}\right);$$

Following the foregoing beliefs, the expected utilities of the four types become:

$$U^{RS} = u_c(Y_R - p_B) + \left(\frac{q^B}{2+\alpha} + \frac{q^B}{3} + \frac{2(1-q^B)^2}{4-3q^B}\right) \delta + \left(\frac{q^B(1+\alpha)}{2(2+\alpha)} + \frac{q^B}{3} + \frac{2(1-q^B)^2}{4-3q^B}\right) \gamma;$$

$$U^{RF} = u_c(Y_R - p_B) + \left(\frac{q^B}{2+\alpha} + \frac{q^B}{3} + \frac{2(1-q^B)^2}{4-3q^B}\right) \delta + \left(\frac{q^B \frac{\alpha(1+\alpha)}{2(2+\alpha)} + \frac{1-\alpha}{2} + \frac{1}{3} + \frac{2(1-q^B)^2}{4-3q^B}}{4-3q^B}\right) \gamma;$$

$$U^{PS} = u_c(Y_R - p_B) + \left(\frac{q^B}{2+\alpha} + \frac{q^B}{3} + \frac{2(1-q^B)^2}{4-3q^B}\right) \delta + \left(\frac{q^B(1+\alpha)}{2(2+\alpha)} + \frac{q^B}{3} + \frac{2(1-q^B)^2}{4-3q^B}\right) \gamma;$$

$$U^{PF} = u_c(Y_R) + \frac{2(1-q^B)}{4-3q^B}(\delta + \gamma).$$
And the explicit incentive-compatibility conditions are:

- **PS buy B:** 
  \[ D^B_P \leq \left( \frac{1}{2+\alpha} + \frac{1}{3} - \frac{2(1-q^B_p)}{4-3q^B} \right) q^B \delta + \left( \frac{(1+\alpha)}{2(2+\alpha)} + \frac{1}{3} - \frac{2(1-q^B_p)}{4-3q^B} \right) q^B \gamma \]

- **RF buy B:** 
  \[ D^B_R \leq \left( \frac{\alpha}{2+\alpha} + \frac{1}{3} - \frac{2(1-q^B_p)}{4-3q^B} \right) q^B \delta + \left( \frac{1}{2+\alpha} + \frac{1}{3} - \frac{2(1-q^B_p)}{4-3q^B} \right) q^B \]

- **PF do not buy B:** \( \text{not buy B:} \)
  \[ D^B_P > \left( \frac{\alpha}{2+\alpha} + \frac{1}{3} - \frac{2(1-q^B_p)}{4-3q^B} \right) q^B \delta + \left( \frac{1}{2+\alpha} + \frac{1}{3} - \frac{2(1-q^B_p)}{4-3q^B} \right) q^B \gamma \]

The difference between the return to signaling of smart agents and the return to signaling of foolish agents is: \( \frac{1-\alpha}{2+\alpha} q^B (\delta - \frac{1}{2} \gamma) \). Hence, for \( \alpha < 1 \), and \( \delta > \frac{Y}{2} \) we find that the return to signaling (buying B) is greater for smart agents than for foolish agents. Denote \( p^3_B \) as the price that equals the PF incentive inequality. Denote \( \bar{p}^3_B \) as the minimum price that equals the RF incentive inequality and the price that equals the PS incentive inequality.

Then, since \( D^B_P > D^B_R \), a “three-buy” equilibrium exists within segment \( p_B \in [\bar{p}^3_B, \bar{p}^3_B] \).

Again, note that the effect of the product’s visibility is positive at all price levels. Counterintuitively, the effect of \( \alpha \) is not necessarily positive in respect to foolish agents’ demand. While \( \alpha \) increases increase the wisdom-oriented status utility of these agents, it also decreases the wealth-oriented status utility. The total effect of \( \alpha \) depends on the relative importance of the two status attributes. The next paragraph provides an interesting example.

Consider cases in which \( \delta \leq \frac{Y}{2} \). When \( Y \) is large enough, one gains more by signaling badly than one loses. In this case, it is actually better for RF to signal \( B^- \). Since smart agents know how to choose B properly, they are also able to choose \( B^- \) if it yields a higher return. Smart agents can imitate foolish agents and play the mixed strategy of choosing \( B^+ \) only at probability \( \alpha \). By doing so, they equal the return to signaling for both types of agents, making the buying behaviors of smart and foolish agents identical.

Hence, a “three-buy” equilibrium cannot hold because when PS agents buy B PF agents also prefer to buy B.
Non-Homogeneous Equilibrium: the All-Buy Equilibrium

The last potential homogeneous equilibrium occurs when all four types of agents buy Product B. When this happens, only smart agents can identify other smart agents. In respect to wealth, the signal gives no relevant information to both smart and foolish agents. However, the equilibrium may exist only under the assumption of $q^B = 1$ meaning that the product is fully visible. Otherwise, for any $q^B < 1$, the belief vector for not buying is $\beta^F(0,0) = \left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right)$ and then, for at least some groups of agents (foolish ones), it can never be optimal to buy B since the return will always be negative. For $q^B = 1$, a “four-buy” equilibrium may be supported by using the proper out-of-equilibrium beliefs—more specifically, if we use $\beta^s(0,0) = \beta^F(0,0) = (0,0,0,1)$. Such a belief vector assigns probability 1 to the non-buying agent’s being of the PF type. Clearly, such a belief may generate a positive return to signaling for all types. The incentive problem in this case narrows to the incentive of PF and can be presented by:

$$D^B_P \leq \left(\frac{1}{2} - \frac{1-\alpha}{4(1+\alpha)}\right) \delta + \frac{1}{2} \gamma.$$ 

Denote $p^B_P$ as the price that equals the foregoing inequality. Then, for any $0 < p_B \leq p^B_P$, a “four-buy” equilibrium exists if $q^B = 1$ and the out-of-equilibrium belief vector is: $\beta^s(0,0) = \beta^F(0,0) = (0,0,0,1)$. \[3.4\]

3.A.3 Proof of Uniqueness for Elite and Nouveau Riche Equilibria

To rule out all other equilibria, we must ensure that at least one of the incentive-compatibility conditions of each equilibrium is not satisfied as long as the elite (or nouveau riche) equilibrium still holds. More specifically, for each other equilibrium, uniqueness demands that either the PS (RF) status surplus in the elite equilibrium is higher or that the potential status surplus for RF (PS) upon buying Product B in the elite (nouveau riche) equilibrium is higher. Under both possibilities, if the demand is satisfied then there exists a price from which the elite (nouveau riche) equilibrium holds while the

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3 Full calculations are omitted for brevity.
other equilibrium breaks. The combined condition for all other equilibria guarantees uniqueness. Since we are interested in the existence of uniqueness, it suffices to show that for any non-elite (nouveau riche) equilibrium the surplus in respect to wisdom (wealth) for PS agents is lower than the equivalent surplus in the elite (nouveau riche) equilibrium. When this is the case, we can always find a high enough coefficient to ensure that the total status surplus in the elite (nouveau riche) equilibrium is higher.

In an elite equilibrium, the wisdom-oriented status surplus for PS is \( q_B \) and the corresponding \( q_3 \). The other equivalent surpluses for the other equilibria are all lower than:

- For the “RS-buy” equilibrium: \( \frac{2q_B}{4-q^B} < \frac{q_B}{2-q^B} \)
- For the “three-buy” equilibrium: \( \left( \frac{1}{2+\alpha} + \frac{1}{3} - \frac{2(1-q^B)}{4-3q^B} \right) q^B < \frac{q_B}{2-q^B} \)
- For the “all-buy” equilibrium (under \( q^B = 1 \)): \( \left( \frac{1}{2} - \frac{1-\alpha}{4(1+\alpha)} \right) < \frac{q_B}{2-q^B} = 1 \)

Similarly, in the nouveau riche equilibrium the wealth-oriented status surplus for RF agents is \( \frac{q_B}{2-q^B} \) and the corresponding. The other equivalent surpluses for the other equilibria are all parallel and lower than \( \frac{q_B}{2-q^B} \):

- For the “RS-buy” equilibrium: \( \frac{2q_B}{4-q^B} < \frac{q_B}{2-q^B} \)
- For the “three-buy” equilibrium: \( \left( \frac{1}{2+\alpha} + \frac{1}{3} - \frac{2(1-q^B)}{4-3q^B} \right) q^B < \frac{q_B}{2-q^B} \)
- For the “all-buy” equilibrium (under \( q^B = 1 \)): \( \frac{1}{2} < \frac{q_B}{2-q^B} = 1 \)

Denote, \( z_{RS}^{PS} \) as the maximal \( \frac{q_B}{2-q^B} \) that satisfies the uniqueness condition for the “RS-buy” equilibrium. Correspondingly, Denote \( z_{3B}^{PS} \) and \( z_{4B}^{PS} \) for the “three-buy” and the “all-buy” equilibria. Then, \( z^{PS} = \text{Max} [z_{RS}^{PS}, z_{3B}^{PS}, z_{4B}^{PS}] \) is the ratio of between \( \delta \) to \( \gamma \) that ensures the existence of a price segment in which the elite equilibrium is unique. Denote \( p_{EL}^\alpha \) as the

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price that satisfies \( D_B^p \left( p_B^{EL} \right) = z^R \) and the uniqueness segment exists at price: \([p_B^{EL} \leq p_B \leq p_B^{NR}]\). The parallel nouveau riche equilibrium price \( (p_B^{NR}) \) is defined symmetrically.

3.A.4. Eliminating the Option of RF Agents Buying Product A in Equilibrium XII

Consider the case in which foolish agents buy Product A and smart agents buy Product B. For \( q^A = 1 \), the belief vectors are given by: \( \beta^S(A,0) = \beta^F(A,0) = \left( \frac{1}{2}, \frac{1}{2}, 0 \right) \); \( \beta^F(0,B) = \beta^S(0,B^+) = \left( \frac{1}{2}, 0, \frac{1}{2} \right) \) and the: \( \beta^F(0,0) = \beta^S(0,0) = \left( \frac{1}{2}, \frac{1}{2}, 0 \right) \). The utilities are therefore: \( U^{RF} = u_c(Y_R - p_A) + 0.5\gamma \); \( U^{RS} = u_c(Y_R - p_A) + 0.5(\delta + \gamma) \) and: \( U^{PS} = u_c(Y_P - p_A) + 0.5(\delta + \gamma) \).

The incentive-compatibility constraints are:

- a) RF agents buy A if: \( D_B^A < 0.5(\gamma - \delta) \)
- b) PF agents buy A if: \( D_B^p < 0.5(\gamma - \delta) \)
- c) RS agents buy B if: \( D_B^p < 0. \)
- d) PS agents buy B if: \( D_B^p < 0. \)

Clearly (based on condition c and d), the conditions for smart agents do not hold and the equilibrium cannot be sustained.

3.A.5. Proof for Proposition 8

The respective belief vectors of the “elite + RF buy A” equilibrium are: \( \beta(A,0) = (0,1,0,0); \beta^S(0,B^+) = \left( \frac{1}{2}, 0, \frac{1}{2}, 0 \right) \); \( \beta^F(0,B) = \left( \frac{1}{2}, 0, \frac{1}{2}, 0 \right) \) and:

\[
\beta(0,0) = \left( \frac{1-q^B}{3-2q^B}, 0, \frac{1-q^B}{3-2q^B}, \frac{1}{3-2q^B} \right).
\]

The out of equilibrium beliefs are: \( \beta^F(A,B) = \beta^S(A,B^-) = \beta^S(A,B^+) = (0,1,0,0) \) and: \( \beta^S(0,B^-) = (0,0,0,1) \).

The utilities of different types are given by: \( U^{RS} = u_c(Y_R - p_B) + \frac{2-q^B}{3-2q^B}(\delta + \frac{\gamma}{2}) \);

\( U^{RF} = u_c(Y_R - p_A) + \gamma \); \( U^{PS} = u_c(Y_P - p_B) + \frac{2-q^B}{3-2q^B}(\delta + \frac{\gamma}{2}) \); and:
The incentive-compatibility conditions need to ensure the following outcomes: RF agents buy A and do not buy B; RS agents do not buy A; RS agents do not buy only A; PS agents buy B; and PF agents do not buy B. The explicit conditions are given by:

a) RF agents buy A: \( D_R^A \leq -\frac{2(1-q^B)}{3-2q^B} \delta + \frac{2-q^B}{3-2q^B} \gamma \)

b) RF agents do not buy B: \( D_R^{AB} > 0 \)

c) RS agents don’t buy A: \( D_R^{BA} > -\frac{2-q^B}{3-2q^B} \delta + \frac{4-3q^B}{2(3-2q^B)} \gamma \)

d) RS agents don’t buy only A: \( D_R^A - D_R^B > -\frac{2-q^B}{3-2q^B} \delta + \frac{4-3q^B}{2(3-2q^B)} \gamma \)

e) PS agents buys B: \( D_R^B \leq \frac{q^B}{3-2q^B} (\delta + \frac{\gamma}{2}) \)

f) PF agents don’t buy B: \( D_R^B > \left( \frac{q^B}{2} \left( \frac{1+\alpha}{2} \right) + \frac{(1-q^B)^2}{3-2q^B} \right) (\delta + \frac{\gamma}{2}) \)

The above 6 condition articulate the price limits within the specified equilibrium exists. Denote \( P_A^H \) as the price that equals Condition (a). Any lower price satisfies the condition. Note that Condition (a) can be satisfied only if its right-hand side is positive that yields: \( \gamma > (1 - \frac{q^B}{2-q^B}) \delta \). This value condition becomes less limiting as the visibility of Product B increases. The reason is that higher visibility diminishes the status utility of non-B buyers and, therefore, encourages RF to buy A and escape the low-status group. Also note that whenever the value condition of a pure elite equilibrium (no buying of A) is satisfied \( \frac{2-q^B}{2(1-q^B)^2} \gamma \leq \delta \), the above condition does not hold and the elite equilibrium with RF buying A does not exist.

---

6 This condition means that \( \left( U^{RS}(L^{RS} = (0,1)) - U^{RS}(L^{RS} = (1,0)) \right) \geq 0 \). Or in other words it is not better for RS to buy A instead of buying B.
Conditions (c) and (d) are partly coincident: since \( D^B_R > D^A_R - D^B_R \), condition d is more restrictive than c. Given \( p_B \) (and therefore \( D^B_R (p_B) \)), denote \( p^H_A \) as the price that equals Condition (d). Any price higher than this one satisfies the condition. To ensure the existence of the equilibrium, we need to make sure that \( p^H_A < p^H_B \). We do this by assigning \( p^H_B \) into \( D^A_R \). Hence, we may rewrite Condition (d) as:

\[
-\frac{2(1-q^B)}{3-2q^B} \delta + \frac{2-q^B}{3-2q^B} \gamma - D^B_R (p^H_A) > -\frac{2-q^B}{3-2q^B} \delta + \frac{4-3q^B}{2(3-2q^B)} \gamma \tag{A6}
\]

After some arrangements:

\[
-2(1 - q^B) \delta + (2 - q^B) \gamma - D^B_R (p^H_A) (3 - 2q^B) > -(2 - q^B) \delta + (2 - 1.5q^B) \gamma \tag{A7}
\]

And even more:

\[
D^B_R (p^H_A) < \frac{q^B (\delta + 0.5 \gamma)}{(3 - 2q^B)} \tag{A8}
\]

The foregoing inequality indicates that the price of \( B \) is connected to the price of \( A \). When the maximum price level of \( A \) rises, it induces an increase in the price paid for \( B \). We may also see that since \( D^B_R (p^H_A) < D^B_R (p^H_B) \), the foregoing condition already exists as Condition (e).

Last, denote \( p^H_B \) as the price that equals condition e and denote \( p^H_B \) as the price that equals condition f. Then, equilibrium II exists under the segment of prices \( \{p^H_A < p_A < p^H_B, p^H_B < p_B < p_B^H\} \) subject to: \( \gamma > (1 - \frac{q^B}{2-1-q^B}) \delta \).

Next, we compare the price limit of the two products elite equilibrium with the “B-only” elite equilibrium. Remember that the single-product elite equilibrium exists within price segment \([p^E_B, p^E_B] \). Comparing the two segments, we see that:

a) In both cases, the equilibrium demands a certain limitation on status attributes. The joint limits are:

\[
\frac{2-q^B}{2(1-q^B)} \gamma > \delta > \frac{\gamma}{2}.
\]
b) For any set of preferences that satisfies the preference limit of Equilibrium II, we get that $\overline{p}_B^\text{II} > \overline{p}_B^\text{EL}$. (Proof: assign $\gamma = \frac{2(1-q^B)}{2-q^B} \delta$ into Condition (e) and we get: $\frac{q^B}{2-q^B} \delta < D_B^\text{R}(\overline{p}_B^\text{II})$ for any $\gamma$ that is strictly below $\frac{2(1-q^B)}{2-q^B} \delta$. Since, $D_B^\text{R}(\overline{p}_B^\text{EL}) = \frac{q^B}{2-q^B}$, we get that: $\overline{p}_B^\text{II} > \overline{p}_B^\text{EL}$.)

c) The situation in regard to the lower bound of the price of Product B is less definitive; we can see that for any possible visibility and distinctiveness level $D_B^\text{R}(p_B^\text{II}) > D_B^\text{R}(p_B^\text{EL})$. However, this can’t ensure any strict relation between $p_B^\text{EL}$ and $p_B^\text{II}$ since for any given price $D_B^\text{R} > D_B^\text{R}$. After assigning the values condition $(\frac{2-q^B}{2(1-q^B)} \gamma = \delta)$ and the inequality condition (Equation 18), we find that for any $\alpha \geq \frac{3q^B-2}{q^B(3-q^B)}$, the prices satisfy: $p_B^\text{II} > p_B^\text{EL}$ which means that the segment under which the specified elite equilibrium exists begins at higher price.


Having assumed that such an equilibrium exists in one product, we now add an additional product to the analysis. We set the out-of-equilibrium beliefs of the signal (A, B) to reflect the fact that RF agents are the group most likely to deviate and buy Product A because their surplus from buying A is larger than the expected surplus for RS. Hence, the beliefs vectors are: $\beta^S(0, B^+) = \left(\frac{1}{1+\alpha}, \frac{\alpha}{1+\alpha}, 0, 0\right); \beta^S(0, B^-) = (0, 1, 0, 0); \beta^F(0, B) = (\frac{1}{2}, \frac{1}{2}, 0, 0)$, and: $\beta(0, 0) = \left(\frac{1-q^B}{4-2q^B}, \frac{1-q^B}{4-2q^B}, \frac{1}{4-2q^B}, \frac{1}{4-2q^B}\right)$. The out-of-equilibrium beliefs are: $\beta(A, 0) = (0, 1, 0, 0); \beta^S(A, B^+) = \beta^S(A, B^-) = \beta^F(A, B) = (0, 1, 0, 0)$. The corresponding utilities of the different types are given as follows: $U^{RS} = u_c(Y_R - p_B) + \left(\frac{1}{2} + \frac{1-\alpha}{4(1+\alpha)} q^B\right) \delta + \left(\frac{1}{2-q^B}\right) \gamma; \ U^{RF} = u_c(Y_R - p_B) + \left(\frac{1}{2} - \frac{1-\alpha}{4(1+\alpha)} q^B\right) \delta + \left(\frac{1}{2-q^B}\right) \gamma; \ U^{PS} = U^{RF} = u_c(Y_P) + \frac{1}{2} \delta + \frac{1-q^B}{2-q^B} \gamma$. The existence of such equilibrium depends on several incentive-compatibility conditions: rich agents need to prefer to buy B but not to buy A, and PS need to prefer not to buy B. From these, four explicit incentive-compatibility conditions may be derived.
a) RF agents buy B: \[ D^B_R \leq -\frac{1-\alpha}{4(1+\alpha)} q^B \delta + \frac{q^B}{2-q^B} \gamma \]

b) RF agents do not buy A instead of B: \[ D^B_R - D^A_R \leq \left(\frac{1}{2} - \frac{1-\alpha}{4(1+\alpha)} q^B \right) \delta - \frac{1-q^B}{2-q^B} \gamma \]

c) PS agents do not buy B: \[ D^B_P > \frac{1-\alpha}{4(1+\alpha)} q^B \delta + \frac{q^B}{2-q^B} \gamma \]

d) Poor agents do not buy A: \[ D^A_P > -\frac{1}{2} q^B \delta + \frac{1}{2-q^B} \gamma \]

Conditions (a) and (c) are equal to the single-product nouveau riche equilibrium; therefore, all the initial equilibrium conditions still hold. Conditions (b) and (d) limit the gains from buying A. More specifically, Condition (b) ensures that for RF the potential gains from signaling by means of A are lower than the gains from buying B. The right-hand side of Condition (b) is increasing in \( q^B \) which means that one of the driving forces that works against this nouveau riche equilibrium is the lower visibility of Product B relative to Product A. The higher visibility of B makes the purchase of B more favorable. Similarly, buying B yields a higher wisdom-oriented status and, for this reason, a higher \( \delta \) promotes this nouveau riche equilibrium. From Condition (b) we derive that whenever the wealth-status coefficient is high enough, \( \gamma > \frac{2-q^B}{1-q^B} \left(\frac{1}{2} - \frac{1-\alpha}{4(1+\alpha)} q^B \right) \delta \), nouveau riche equilibrium requires a higher price for A than for B. Note that since the initial value condition of the nouveau riche equilibrium (\( \gamma > \frac{(1-\alpha)(2-q^B)}{4(1+\alpha)} \delta \)) is always less limiting than the aforementioned condition, this price limitation is seldom needed. However, the price of A still must not be too low relative to the price of B. A possible lower bound of \( p_A \) is given by Condition (b). Condition (d) also sets a minimum price for A. Below this price, the nouveau riche equilibrium may fail due to poor agents who buy A. This scenario cannot hold if we shift the out-of-equilibrium belief to fit the current threat to the nouveau riche equilibrium. To conclude, the lower bound of \( p_A \) is the minimum of the two aforementioned prices; we denote it by \( p_A^{III} \). Note that the price of A has no upper bound in this equilibrium, since no agent actually buys it in equilibrium.

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7 Note that this condition also covers the possible deviation of RS.
3.A.7. Proofs for Proposition 9

Recall that within a price segment of $p_A < p_A \leq \bar{p}_A$, rich agents buy Product A (Section 3.4.1). For $q^A = 1$, the belief vectors are given by:

$$\beta^S(A, 0) = \beta^F(A, 0) = \left(\frac{1}{2}, \frac{1}{2}, 0, 0\right); \quad \beta^S(A, B^+) = \beta^F(A, B) = (1, 0, 0, 0)$$

and:

$$\beta^S(0, 0) = \left(0, 0, \frac{1}{2}, \frac{1}{2}\right).$$

The utilities are therefore:

$$U^R = u_c(Y_R - p_A) + 0.5\delta + \gamma$$

and:

$$U^P = u_c(Y_P) + 0.5\delta.$$ When PS agents buy product B, the relevant belief vector transforms into:

$$\beta^F(0, B) = \beta^S(0, B^+) = (0, 0, 1, 0); \quad \beta^F(0, 0) = \beta^S(0, 0) = \left(0, 0, \frac{(1-q^B)}{2-q^B}, \frac{1}{2-q^B}\right)$$

The utilities of poor agents become (the utility of rich agents doesn’t change): $U^{PS} = u_c(Y_P - p_B) + \frac{1}{2-q^B}\delta; \quad U^{PF} = u_c(Y_P) + \frac{1-q^B}{2-q^B}\delta.$ Note that whenever product B is bought, by either RS or PS the agents’ wealth-oriented status does not change relative to the initial nouveau riche equilibrium. Therefore, the return to buying B is equal for both RS agents and PS agents and it is equal to: $\left(\frac{1}{2-q^B} - \frac{1}{2}\right)\delta = \frac{q^B}{2(2-q^B)}\delta.$ Hence, for buying B the incentive compatibility constraints are as follows:

I. In the case of RS:

a. RS agents buys B: $D^{AB}_{\rho} \leq \frac{q^B}{2-q^B}\delta$

b. RF agent do not buy B: $D^{AB}_{\rho} > \left(\frac{a+1}{2} - \frac{1-q^B}{2-q^B}\right)q^B\delta$

II. In the case of PS:

a. PS agents buys B: $D^{B}_{\rho} \leq \frac{q^B}{2-q^B}\delta$

b. PF agent do not buy B: $D^{B}_{\rho} > \left(\frac{a+1}{2} - \frac{1-q^B}{2-q^B}\right)q^B\delta$

Since the decision to buy B as taken by rich (RS) and poor (PS) agents is fully separable, the segments of prices are mutually independent. Note that the signaling surplus is equal but the cost varies. Initially, the income of rich agents is higher than that of poor agents. After buying A, however the remaining income of RS may be lower than that of PS.
Denote \((p_B^{ll}, p_B^{l})\) as the segment of price B that satisfies the upper conditions (RS) and denote \((p_B^l, p_B^{ll})\) as the segment of price B that satisfies the PS conditions. The price segment is directly linked to the income: when \(Y_R - p_A > Y_P\) it implies that: \(p_B^{ll} > p_B^l\) and also: \(p_B^l > p_B^{ll}\). If \(p_B^{ll} > p_B^l\) overlap segment \(p_B^{ll} \leq p \leq p_B^l\) for which both RS and PS agents buy B exists, since all four incentive-compatibility conditions are satisfied.

A less reasonable case may also arise, in which rich agents’ income becomes lower than poor agents’ income: \(Y_R - p_A < Y_P\). This leads to: \(p_B^{ll} < p_B^l\) and \(p_B^{ll} < p_B^l\). Similarly, if \(p_B^l > p_B^{ll}\) then an overlap segment exists under \(p_B^{ll} \leq p \leq p_B^l\). Note that the overlap segments are actually identical to an elite equilibrium in which all smart agents buy B. Clearly the nature of the equilibrium depends on the relative values of \(D_B^B\) and \(D_p^{AB}\) (which is the cost of buying B for rich agents after buying A).

**Two-Signal Equilibrium: All Rich Agents Buy A; Poor & Smart Agents Buy B**

Consider the equilibrium where rich agents buy A and Ps buy B. For this equilibrium to exist, PS agents must prefer to buy Product B and PF agents must not, and RS agents must not prefer to buy Product B instead of or in addition to A.

Hence, the incentive compatibility constraints are:

- a) PS agents buys B: \(D_B^B \leq \frac{q^B}{2 - q^B} \delta\)
- b) PF agents don’t buy B: \(D_B^B > \left(\frac{\alpha + 1}{2} - \frac{1 - q^B}{2 - q^B}\right)q^B \delta\)
- c) RS agents don’t buy B in addition to A: \(D_R^{AB} > \frac{q^B}{2} \delta\)
- d) RS agents don’t buy B instead of A: \(D_R^B > \frac{q^B}{2(2 - q^B)} \delta - \gamma + D_A^A\)

Inequalities (c) and (d) establish a minimum price level of B: \(p_B^V\). This price satisfies \(p_B^V \leq p_B^{ll}\), which means that when PS agents buy B, RS agents have less of an incentive to deviate from the nouveau riche equilibrium in Product A.
Note that for $\alpha < 1$ we get $\left( \frac{a+1}{2} - \frac{1-q^B}{2-q^B} \right) q^B \delta < \frac{q^B}{2-q^B} \delta$ (comparing Condition (a) right-hand with Condition (b)), which ensures that PS agents indeed attain a larger increase in status than PF agents do.

Denote $p_{B^+}^W$ as the price that equals the condition (a). Denote $\overline{p}_{B^+}^V$ as the price that equals the PS condition. Equilibrium exists if $p_{B^+}^W < \overline{p}_{B^+}^V$ which depends on the level of income inequality. If income inequality is low enough, the condition is satisfied and equilibrium exists. Denote $p_{B^+}^W = \text{Max} \left[ p_{B^+}^W, p_{B^+}^W^* \right]$ then if $p_{B^+}^W < \overline{p}_{B^+}^V$, equilibrium exists in the price segment $\left[ p_{B^+}^W, \overline{p}_{B^+}^V \right]$.

Note that much as in the previous cases, an equilibrium in which all poor agents buy B may not exist unless $q^B = 1$ and if specific non-continuous out-of-equilibrium beliefs are present. Such an equilibrium requires a belief of $\beta^F(0,0) = \beta^S(0,0) = (0,0,0,1)$ where continuous (in respect to $q^B$) belief vector under the “all poor agents buy B” equilibrium yields $\beta^F(0,0) = \beta^S(0,0) = \left(0,0,\frac{1}{2},\frac{1}{2}\right)$.

**Two-Signal Equilibrium III: All Rich Agents Buy A; Smart Agents Buy B**

Finally, we discuss the possible overlapping of the two aforementioned price segments. Since the decision to buy B as taken by rich (RS) and poor (PS) agents is fully separable, the segments of prices are mutually independent. Note that the signaling surplus is equal but the cost varies. Initially, the income of rich agents is higher than that of poor agents. After buying A, however the remaining income of RS may be lower than that of PS. The price segment is directly linked to the income: when $Y_R - p_A > Y_P$ it implies that: $\overline{p}_{B^+}^L > \overline{p}_{B}^L$ and also: $\overline{p}_{B^+}^L > \overline{p}_{B}^L$. If $\overline{p}_{B}^L > p_{B}^L$ overlap segment $p_{B}^L \leq p < \overline{p}_{B}^L$ for which both RS and PS agents buy B exists, since all four incentive-compatibility conditions are satisfied.

A less reasonable case may also arise, in which rich agents’ income becomes lower than poor agents’ income: $Y_R - p_A < Y_P$. This leads to: $\overline{p}_{B}^L < \overline{p}_{B}^L$ and $p_{B}^L < p_{B}^L$. Similarly, if
if \( p_B^{ll} > p_B^l \) then an overlap segment exists under \( p_B^l \leq p \leq p_B^{ll} \). Note that the overlap segments are actually identical to an elite equilibrium in which all smart agents buy B.
References


パートリディ

「תקריב」

「תקציר」

מרות שסוגיות, באופן מפתיע, "טאבו השכר" אחד המאפיינים המעניינים של החברה בת זמננו הוא גובה משכורתו האישית, הקשורות לשכר הן מהותיות לדרך החיים הקפיטליסטית ולשוקי העבודה המודרניים, הפגין עושר כמו גם תכונות ויכולות אחרות נוטים אנשים ל, יחד עם זאת. נשמר על פי רוב בסוד, של כל עובד העבודה המוצגת, בהמשך לאבחנות אלה. באמצעות אימוץ דרכים שונות של התנהגות וצריכת ראותית.

מציעה שלושה מודלים כלכליים תיאורטיים המסבירים התנהגויות של סודיות שכר וצריכת ראווה, ומסביר את הפתרון של מציאת טורפדו ששגן בהברחת הכיתור ורשות השכר, יחד עם הפתרון של מציאת טורפדו ששגן בהברחת הכיתור ורשות השכר, יחד עם הפתרון של מציאת טורפדו ששגן בהברחת הכיתור ורשות השכר, יחד עם הפתרון של מציאת טורפדו ששגן בהברחת הכיתור ורשות השכר, יחד עם הפתרון של מציאת טורפדו ששגן בהברחת הכיתור ורשות השכר, יחד עם הפתרון של מציאת טורפדו ששגן בהברחת הכיתור ורשות השכר, יחד עם הפתרון של מציאת טורפדו ששגן בהברחת הכיתור ורשות השכר, יחד עם הפתרון של מציאת טורפדו ששגן בהברחת הכיתור ורשות השכר, יחד עם הפתרון של מציאת טורפדו ששגן בהברחת הכיתור ורשות השכר,jadi 함께 במודל מראה כיצד סודיות משפיעה על התועלת, כי אנשים מייחסים חשיבות למיקומם היחסי על סולם השכר סודיות השכר מפחיתה. יתיהם ועל נכונותם לשתף פעולה במקום העבודה של עובדים המתוגמלים פחות מעמ.


Paris School of Economics

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The model presented in this chapter shows how competition among employers leads to three outcomes in the equilibrium of wages. Companies that adopt wage policies that are low and reducing their wages, can compete with each other for employees, with a medium level of competition. Employees are then able to negotiate wages with their companies and maintain a wage policy of confidentiality. Employees who receive a job offer and external wage will receive a similar offer from their companies: the employees who do not receive such an offer are unable to negotiate a similar offer with their companies. Companies that are able to pay higher wages have an advantage in attracting employees. When the competition among employers is high, companies can raise the wages of their employed workers. When the competition among employers is low, companies can reduce the wages of their employed workers. The chapter concludes by analyzing the factors that determine the uniqueness of the equilibrium of wages.
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