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# Education, Dynamic Signaling and Social Distance

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## Abstract

The paper enriches a standard signaling model of education with issues of social distance defined over educational achievements. More specifically it considers the effects that the presence of conformist and status seeking individuals has on educational dynamics. Under very reasonable assumptions about the composition of the society, the model endogenously displays a growing average level of schooling. As education rises, signals get noisy and potentially harmful for what concerns firms' profitability. Firms, in order to adjust their screening process, react with an increase of their educational requirements. All these dynamics are in line with recent trends and other stylized facts about education.

*Keywords:* education, signaling, status seeking, conformist behaviour.

*JEL classification:* I20, D70, D82.

## 1 Introduction

In the last decades average educational level has been constantly increasing in almost every European country. Eurostat (2001) reports for instance that in 2001 over 75% of 25 to 29 year old had completed at least an upper secondary education compared with 52% of people aged 50-64. Or yet (Eurostat, 2005) that the total number of graduates in the EU25 increased by more than 30% between 1998 and 2003. The causes that have contributed in shaping such a massive phenomenon are obviously manifold: favourable sociopolitical situation, increasing wealth, sustained unemployment rates, rapid technological progress. In addition to these explanations (and possibly to many others which have not been mentioned), this paper shows that recent educational dynamics are easily accounted for by a simple signaling model (à la Spence, 1973) enriched by the presence of individuals that care about their relative position in the educational distribution.

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There are two kinds of reasons because of which people may care about their relative level of education. First, there are material reasons related with the chances of finding an adequate job in the labour market. In fact, together with the increase of the general level of education, or better as a consequence to it, the “value” of a given level of schooling has been decreasing. For instance holding a bachelor’s degree two generations ago was really a valuable asset as well as an effective signal to send to the labour market. Nowadays the same degree is much less informative and individuals need higher qualifications in order to differentiate themselves.

Second, there are social and psychological reasons given that the level of education is a signal that individuals send not only to the firms but also to the rest of the society. In many social contacts there is in fact a favourable bias towards more educated individuals as people are usually willing to interpret education as a proxy for respected qualities like brightness, knowledge and persistence. At the opposite, individuals with a low level of education are often stigmatized, no matter their effective abilities. Again this social evaluation of a given level of schooling depends on the average level in the society.<sup>1</sup>

Therefore an individual who has to decide about his level of schooling must consider not only his absolute level but also, and possibly mainly, his relative one. This means that individuals’ preferences about education are interdependent, a feature which is usually neglected by standard models of educational choices. An example that clarifies how the effectiveness of this double signaling effect (towards the firms and towards the rest of the society) is related with the average level of education is the one of a student who gets a high grade in an important exam. The utility the student enjoys from such an achievement is influenced by the average grade of the class. In fact, if the average is low, the signal the student sends to the teacher is more informative and thus it is more likely to help him in his scholastic career. At the same time the student sends a stronger signal also to his colleagues. The perception of this second component depends on the student’s preferences. For instance his ego could be gratified or, at the opposite, the student could feel some embarrassment in standing out so clearly.

This paper focuses on the choice about which level of education to reach, a choice that each individual has to make considering his innate characteristics as well as his ambitions. It combines a standard model of signaling with theories of social distance. More precisely the paper analyzes educational dynamics in a population in which heterogeneous agents have different productivity as well as different attitudes about their relative educational achievement. Some individuals, possibly the majority, are not influenced by social distance considerations (independent individuals), some try to differentiate themselves and reach a high status (status seeking individuals), some others adopt a more conformist behaviour (conformist individuals).

The presence of non selfish agents considerably modifies standard results of static signaling models.<sup>2</sup> In particular, under very weak assumptions about the composition of the society, the model endogenously displays a growing level of average education. For instance education is likely to increase even in a purely conformist society provided that the average productivity level is not too low. It is shown anyway that

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<sup>1</sup>Different individuals can be more or less sensitive to social pressures of this kind. For a specific empirical evidence about the effects that social considerations may have on educational choices see Cipollone and Rosolia (2004).

<sup>2</sup>Non selfish players are agents whose behavior is affected by the one of some other individual or reference group. See for instance Fehr and Fischbacher (2002).

the existence of agents with interdependent preferences, though necessary in the context considered, is not sufficient to trigger some positive educational dynamics. The model also rationalizes some other stylized facts. In fact, as average education increases, the signals the workers send to the labour market get less informative and potentially harmful for what concerns firms' profitability. Therefore employers progressively become more demanding in setting their educational requirements.

The paper is organized as follows: Section 2 reviews the relevant literature; Section 3 introduces and solves a repeated signaling game enriched with concerns about social distance. Section 4 studies the dynamics of the average educational level in the society. Section 5 analyzes the behaviour of the firms. Section 6 concludes.

## 2 Related literature

In this paper we provide an explanation for the *increase in education* of the last decades which is based on the combination of a *signaling* model with theories of *social distance and interdependent preferences*. This section briefly reviews the relevant literature in these three areas.

*Increase in education.* Various are the reasons that can explain the positive trend of average education in developed countries. A first and pretty obvious explanation is that people study more because, in doing so, they expect to get higher wages. Indeed the positive relationship between schooling and earnings is generally confirmed (see, among many, Ashenfelter et al. (1999) or Psacharopoulos and Patrinos (2004)) by the estimation of Mincerian equations.<sup>3</sup> Related to wage expectations is the literature that focuses on the effects that skill biased technological progress had on the wage distribution (see for instance Heckman et al., 1998). The idea is that the wage gap between unskilled and skilled workers widened considerably, providing incentives to pursue a higher level of education.

From a social point of view the increase in education can be seen as an investment in human capital which has beneficial effects on economic growth (Barro, 2001).<sup>4</sup> Indeed many government policies have been designed with the scope of raising the educational level in the society: increase and diversification of the supply of education, subsidies and other incentives, increase of the years of compulsory schooling. On the demand side, individuals face a trade off between studying and working and this trade off is affected by labour market conditions. For instance in periods of high unemployment the opportunity cost of proceeding in schooling is lower. Empirical evidences about this relationship appear in Giannelli and Monfardini (2000) and Dellas and Sakellaris (2003).

*Signaling.* The concept of signaling has been introduced in the seminal paper by Spence (1973) and rapidly became an important branch of the highly dynamic economics of information. Riley (2001) presents a very rich overview of all the applications that signaling models found. Signaling is an attempt to solve problems of asymmetric information. In such a situation the informed agent may have incentives to adopt behaviours (signals) that reveal some of his unobservable characteristics to the uninformed party. In

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<sup>3</sup>After Jacob Mincer who was the first one to study the relation between labor income and schooling in 1958.

<sup>4</sup>The book by Becker (1993) offers a deep analysis of the effects that education, training and on-the-job experience may have on an individual's human capital.

Spence's model the signal is the level of schooling an individual acquires. In fact education is assumed to convey information about unobservable and innate productivity.

Signaling games often have multiple equilibria. In some of these equilibria individuals with different characteristics send different signals (separating equilibria), in others they adopt the same behaviour such that signals are uninformative (pooling equilibria). Various concepts of equilibrium refinements have been proposed. The intuitive criterion (Cho and Kreps, 1987, see section 3.1 for an example) emerged as the leading one.

*Social distance and interdependent preferences.* Day to day life is plenty of evidences about individuals' preferences being somehow interdependent. Indeed to consider interdependent preferences means to acknowledge that sentiments like pride, esteem, shame or acceptance do affect agents' choices. The investigation of these issues started with the study of individuals' consumption patterns. In fact people usually care not only about their absolute level of consumption but also about their relative one. Duesenberry (1949) includes the average level of consumption into the utility function that individuals have to maximize so that an agent increases his utility if she is able to "beat the average". A slightly different methodology has been followed by Pollak (1976) who models preferences that depend on other people's *past* consumption. This way agents' behaviour is not strategic and the model becomes analytically more tractable. From a more theoretical point of view the incentives that move status seeking individuals were first described in Frank (1985). Robson (1992) considers the situation in which people are interested in the ordinal rank they occupy in the distribution of wealth while Hopkins and Kornienko (2004) study the case in which utility is affected by the amount of general consumption as well as by the consumption of a particular good which defines the status.

When preferences are defined over the relative amount of consumption or wealth, it is natural to assume a tendency towards a status seeking behaviour. Still, in other contexts, a more conformist attitude can be the rule rather than the exception. The classic work about conformism is Jones (1984) who studies examples of social influences in a college environment, in the army and in the workplace. Focusing on the last example, Jones analyses the effort workers decide to exert. Given that extreme behaviours are stigmatized, slowest (fastest) members of the working group feel the pressure to speed up (slow down). Moreover new workers imitate the behaviour of older colleagues. Evidences of these kinds of peer pressures come also from experiments (Falk and Ichino, 2003) while a more theoretical analysis of this tendency towards conformism is given by Bernheim (1994).

To sum up both status seeking and conformist individuals care about the social distance between them and some reference group. Because of this fact, externalities arise in both cases and thus the social efficiency of the final outcome is not ensured. Using simple formulations of utility functions, Akerlof (1997) shows that status seeking behaviour usually leads to overindulge in the status-producing activity (ex. over consumption).<sup>5</sup> The outcome deriving from conformist behaviour can instead range from underprovision to overprovision.

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<sup>5</sup>In an older paper, Akerlof (1976) describes the so called rat-race mechanism. The probability of winning a prize increases with the effort the agent exerts; given that everyone tries to beat the others this mechanism leads to an overprovision of effort.

### 3 The model

#### 3.1 A basic signaling model

Consider a population of potential workers.<sup>6</sup> A proportion  $\alpha_h \in (0, 1)$  is characterized by a high productivity ( $\theta_h = 2$ ) while the remaining part ( $\alpha_l = 1 - \alpha_h$ ) has a low productivity ( $\theta_l = 1$ ). At least two firms compete in order to hire them. These firms are not able to distinguish between the two categories given workers' observable characteristics. Then, if no signals were available, firms would offer a wage equal to the average productivity  $\bar{w} = \bar{\theta} = 2\alpha_h + \alpha_l$ , with  $\bar{w} \in (1, 2)$ . A more efficient outcome can be achieved through signaling.

Assume that firms have some beliefs about workers' productivity, i.e. they think that there exists a certain level of education  $\tilde{e}$ , such that, if worker  $i$  acquires a level of education  $e_i \geq \tilde{e}$ , then the candidate must be highly productive. On the other side if  $e_i < \tilde{e}$  then it must be the case that the individual has a low productivity. Given these beliefs and the specific costs of education (high types have a cost which is half of the cost of low types), the utility functions of the workers take the following form:

$$U_h(e) = 2 - \frac{1}{2}e^2 \qquad U_l(e) = 1 - e^2$$

Optimal educational levels have to be found subject to two incentive compatibility constraints which require high productivity individuals not to have any incentive in pretending to be low productivity types and vice-versa:

$$2 - \frac{1}{2}\tilde{e}^2 \geq 1 \qquad 1 \geq 2 - \tilde{e}^2$$

The constraints are satisfied by  $\tilde{e} \in [1, \sqrt{2}]$ . With any of these levels of education, different types of agents choose different levels of education (we restrict our attention to separating equilibria). In particular low productivity workers choose  $e_l = 0$  and high productivity workers choose  $e_h = \tilde{e}$ . Among all these perfect Bayesian equilibria, the intuitive criterion (Cho and Kreps, 1987) selects the least cost separating equilibrium: low productivity workers get the minimum level of education ( $e_l^* = 0$ ) while high productivity workers choose  $e_h^* = 1$ . This is the lowest possible level of education which cannot be profitably mimicked by low types. It follows that the average level of education in the society is given by  $\bar{e} = \alpha_h$ .

#### 3.2 A richer framework: signaling and social distance

Spence's signaling game covers only one period of time, i.e. it models the choices of a single generation of workers. Therefore its results are essentially static. Results remain static even considering a repeated version of the game (subsequent cohorts of workers facing the one shot signaling game). In fact, assuming average productivity to be equal among different generations, average education would remain constant

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<sup>6</sup>The model is almost identical to the one presented by Spence (1973) and it provides the starting point for the analysis in the next sections.

over time at the level  $\bar{e}_t = \alpha_h$ . In the standard model, firms' beliefs match workers' actual productivity such that neither workers nor firms have any incentive to modify their strategies.<sup>7</sup>

We study a richer framework that may display some dynamics. In our game two subsequent cohorts participate in a signaling game. Every cohort is formed by many individuals and every individual is characterized by a certain level of productivity and by some social preferences. Both the productivity level and the social preferences are assumed to be innate and fixed. In fact, prior to any decision of any players, two simultaneous moves of Nature determine the composition of each cohort. As in the standard model agents are split into two classes according to the (low or high) productivity. The other move of Nature defines the social preferences with respect to the average education in the society: some individuals, possibly the majority, simply do not have social preferences (lower index  $i$ , for independent) and they are therefore analogous to the agents in Spence's model, some are characterized by a conformist behaviour (lower index  $c$ ), some others are status seeking (lower index  $s$ ).

Each cohort of potential workers, whose size is normalized to 1, is thus partitioned as shown in Table 1. Obviously  $\alpha_{kj} \in [0, 1]$  for any  $k \in \{i, c, s\}$  and any  $j \in \{l, h\}$  and  $\sum_k \sum_j \alpha_{kj} = 1$ . The two cohorts are identical (same size and same  $\alpha_{kj}$ ). Therefore any movement in average education will be endogenously created by the model and it will not be due to population growth, changes in the productivity level or in the social preferences of the agents.

|                        | low productivity ( $l$ ) | high productivity ( $h$ ) |
|------------------------|--------------------------|---------------------------|
| independent ( $i$ )    | $\alpha_{il}$            | $\alpha_{ih}$             |
| conformist ( $c$ )     | $\alpha_{cl}$            | $\alpha_{ch}$             |
| status seeking ( $s$ ) | $\alpha_{sl}$            | $\alpha_{sh}$             |

Table 1: the composition of each cohort of individuals.

Once that Nature has moved the following happens:

- $t = 1$ : the first cohort of workers plays the signaling game.
- $t = 2$ : the second cohort of workers plays the signaling game.

We are interested in studying the dynamics of the average level of education. We indicate with  $\bar{e}_t$  the weighted average of the levels of education chosen by each class at time  $t$ .

$$\bar{e}_t = \sum_k \sum_j \alpha_{kj} e_{kj}^t \quad k \in \{i, c, s\}, j \in \{l, h\}$$

Before introducing the utility functions that characterize each class of individuals and whose maximization will lead to the optimal  $e_{kj}^t$ , we discuss two assumptions that underpin the analysis of this two stages game.

<sup>7</sup>Indeed the original paper postulates these self-confirming beliefs of the firms exactly to avoid studying a non stationary system (cfr. Spence, 1973, pp. 360).

1) Players that in  $t \in \{1, 2\}$  care about their relative educational position (i.e. conformist and status seeking individuals) are influenced by  $\bar{e}_{t-1}$ , the average level of education that emerged in period  $t - 1$ . In other words players are myopic.

Non selfish individuals consider the current average educational level and not the one that will arise at the time they will enter in the labour market.<sup>8</sup> Such an unsophisticated behaviour seems to be very common and a similar approach is usual in the literature (see for instance Pollak, 1976 and Jones, 1984). In the context of our model this means that social preferences do not play any role in  $t = 1$  (because there is not an average level  $\bar{e}_0$ ) while they matter in  $t = 2$  where agents' behaviour is influenced by the realization of  $\bar{e}_1$ . Indeed the game in the first period exactly resembles a standard signaling model and it just provides a starting point upon which the model develops in  $t = 2$ .

2) Firms maintain the same hiring strategy throughout the game.

Firms offer a wage  $w = 1$  to any individual whose educational level is such that  $0 \leq e^* < 1$  while they offer  $w = 2$  to all those agents with  $e^* \geq 1$ . This policy ensures a perfectly effective screening process in  $t = 1$  (standard signaling game) and firms stick to it also in  $t = 2$ . Firms are not forward looking and they may be surprised if individuals in  $t = 2$  behave differently with respect to their predecessors.

The fact that both the workers and the firms are myopic makes the analysis that follows depart from a standard rational one. Still it can be shown that the alternative assumption of workers and firms having perfect foresight would actually amplify the movements in the average level of education.

### 3.3 Time $t = 1$

In the first period individuals' choices are not influenced by social preferences because there is not a current average level of education to which to compare. This stage is analogous to the standard signaling model presented in Section 3.1. Therefore low productivity workers get a level of education equal to 0, while high productivity individuals choose a level of 1. Optimal levels of education are thus  $e_{il}^* = e_{cl}^* = e_{sl}^* = 0$  and  $e_{ih}^* = e_{ch}^* = e_{sh}^* = 1$ . The average at the end of  $t = 1$  is  $\bar{e}_1 = \alpha_{ih} + \alpha_{ch} + \alpha_{sh} = \sum_k \alpha_{kh}$ .

### 3.4 Time $t = 2$

At the beginning of the second period a new cohort of potential workers faces its educational choice. The choices of non selfish players are now influenced by their specific social preferences. Table 2 reports the utility functions of the six categories of agents (subscripts are omitted whenever unnecessary). The wage level is left in the implicit form  $w$  and it will be determined in accordance with the individual's optimal educational choice and with the hiring policy of the firms.

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<sup>8</sup>Still this can be a good proxy. For instance an individual considering the idea of enrolling in a one year master may use the current average level of education for evaluating his future relative position. Another, more practical, consideration is based on how people get informed about the available educational choices. Usual sources of information are provided by comments of older friends and by the reading of student guides and statistics about the likelihood of getting a job with a certain degree. All these information describe the current situation not the future one.



|                | low productivity   | high productivity  |
|----------------|--|--|
| independent    | $U_{il} = w - e^2$   | $U_{ih} = w - \frac{1}{2}e^2$  |
| conformist     | $U_{cl} = w - e^2 - (e - \bar{e}_1)^2$   | $U_{ch} = w - \frac{1}{2}e^2 - (e - \bar{e}_1)^2$  |
| status seekers | $\begin{cases} U_{sl} = w - e^2 - 2(e - \bar{e}_1)^2 & \text{if } e < \bar{e}_1 \\ U_{sl} = w - e^2 + 2\bar{e}_1(e - \bar{e}_1) - \frac{1}{2} & \text{if } e \geq \bar{e}_1 \end{cases}$ | $\begin{cases} U_{sh} = w - \frac{1}{2}e^2 - 2(e - \bar{e}_1)^2 & \text{if } e < \bar{e}_1 \\ U_{sh} = w - \frac{1}{2}e^2 + 2\bar{e}_1(e - \bar{e}_1) - \frac{1}{2} & \text{if } e \geq \bar{e}_1 \end{cases}$ |

Table 2: utility functions of the six classes of individuals.

Independent players are characterized by standard utility functions à la Spence. Utility functions for the players with interdependent preferences are slightly more complex. Beside the part which captures the trade off between wage and cost of education there is an extra term that models the social preferences. In accordance with many classical contributions in the field (see for instance Pollak, 1976, Jones, 1984, Bernheim, 1994, Akerlof, 1997) this last term enters additively in the utility functions. For the reasons which have been explained before (assumption 1), this social component is a function of  $\bar{e}_1$ , the average level of education that emerged in the first period. In line with the utility functions presented in Spence's original article (1973), this additional part appears as an explicit function which is as simple as possible.

Conformist individuals have a preference for being close to the average. The social term in the utility function assigns an increasing cost whenever their level of education differs from the average level  $\bar{e}_1$ . The utility functions of status seeking individuals are more problematic. A differentiation has to be drawn between two cases. If the level of education is below  $\bar{e}_1$  then status ambitions are frustrated. In this case the utility function resembles the one of conformist individuals but with a higher cost for falling behind. If, on the contrary, the educational level is above  $\bar{e}_1$ , then individual's utility is increasing in this distance. In this second case the function has to be corrected in some way. Consider for example the *sh*-class. The natural formulation for the case  $e > \bar{e}_1$  would be  $U_{sh} = w - \frac{1}{2}e^2 + (e - \bar{e}_1)^2$ . However this is a convex function with no internal maximum. To have a meaningful solution the utility function takes the form presented in Table 2.

From the analysis of Section 3.1, we already know the optimal choices of individuals with independent preferences. In particular  $e_{il}^* = 0$  (such that  $w_{il} = 1$ ) and  $e_{ih}^* = 1$  ( $w_{ih} = 2$ ). The following subsections are devoted to a more specific analysis of the behaviour of each of the last four classes. After having found optimal choices it will be possible to analyze educational dynamics between the two periods.

### 3.4.1 The “conformist + low productivity” class (*cl*)

Individuals belonging to this class face the problem  $\max_e U_{cl}$  where

$$U_{cl}(e) = w - e^2 - (e - \bar{e}_1)^2$$

which has solution  $\hat{e}_{cl} = \frac{1}{2}\bar{e}_1$ . Since  $\bar{e}_1 \in [0, 1]$  it follows that  $\hat{e}_{cl} \in [0, \frac{1}{2}]$  confirming that agents of this category get the low wage  $w = 1$ . Firms are in fact able to correctly categorize them as low productivity workers. Is it always optimal for an individual belonging to this class to choose  $\hat{e}_{cl}$ ? To answer this

question the utility the agent gets choosing  $\hat{e}_{cl}$  (function A) is compared with the utility stemming from some alternative educational levels.

$$\begin{aligned} \text{A) } U_{cl} \left( \frac{1}{2} \bar{e}_1 \right) &= 1 - \frac{1}{2} (\bar{e}_1)^2 & \text{C) } U_{cl} (1) &= -(\bar{e}_1)^2 + 2\bar{e}_1 \\ \text{B) } U_{cl} (0) &= 1 - (\bar{e}_1)^2 & \text{D) } U_{cl} \left( \frac{2}{3} \bar{e}_1 \right) &= 1 - \frac{5}{9} (\bar{e}_1)^2 \end{aligned}$$

Functions B) and C) consider the choices which were made by players of the previous cohort. Function D) depicts the utility a *cl*-player would get if he mimics agents belonging to the “conformist + high productivity” class.<sup>9</sup> The following figures provide a graphical analysis of the situation.

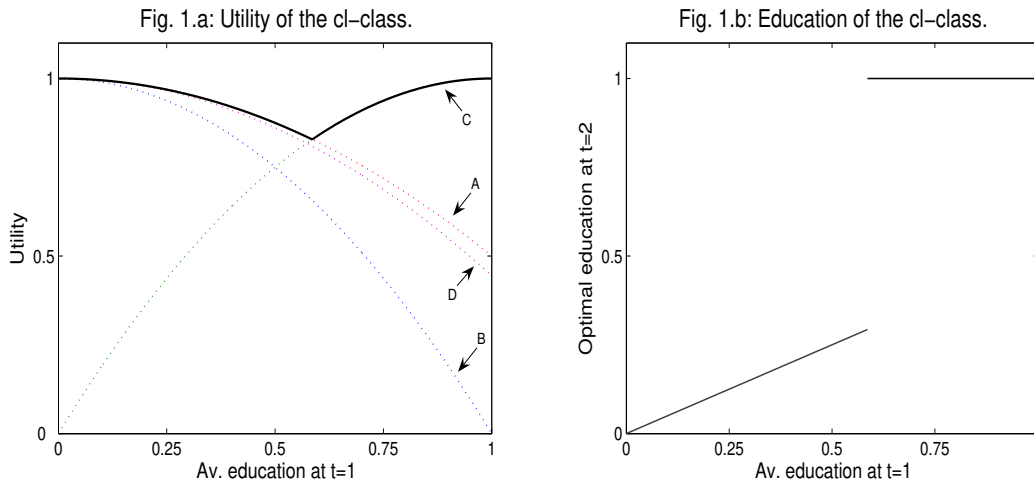


Figure 1.a plots the utility functions for  $\bar{e}_1 \in [0, 1]$ . From the upper contour set of these functions, the optimal level of education  $e_{cl}^*$  as a function of  $\bar{e}_1$  can be easily derived (Fig. 1.b). Up to a critical value of  $\bar{e}_1$  ( $\cong 0.586$ ), the optimal choice for a *cl*-individual is to get a level of education equal to half of the average level. If, at the opposite, the average level of education in  $t = 1$  is greater than the critical value, then it is more convenient to “jump” to  $e_{cl}^* = 1$ . The intuition for such a behaviour is clear. In fact, as far as the average level is low, a *cl*-agent can conform to it without investing too much in costly education. At the opposite if  $\bar{e}_1$  is high enough it is then better to choose  $e_{cl}^* = 1$ . In doing so the worker could be farther away from  $\bar{e}_1$  than playing the previous strategy.<sup>10</sup> Still, sending the signal  $e_{cl}^* = 1$ , the worker is able to make firms believe that he is highly productive such that he will be offered the high wage  $w = 2$ .

### 3.4.2 The “conformist + high productivity” class (*ch*)

Every worker belonging to this class has to solve  $\max_e U_{ch}$  where:

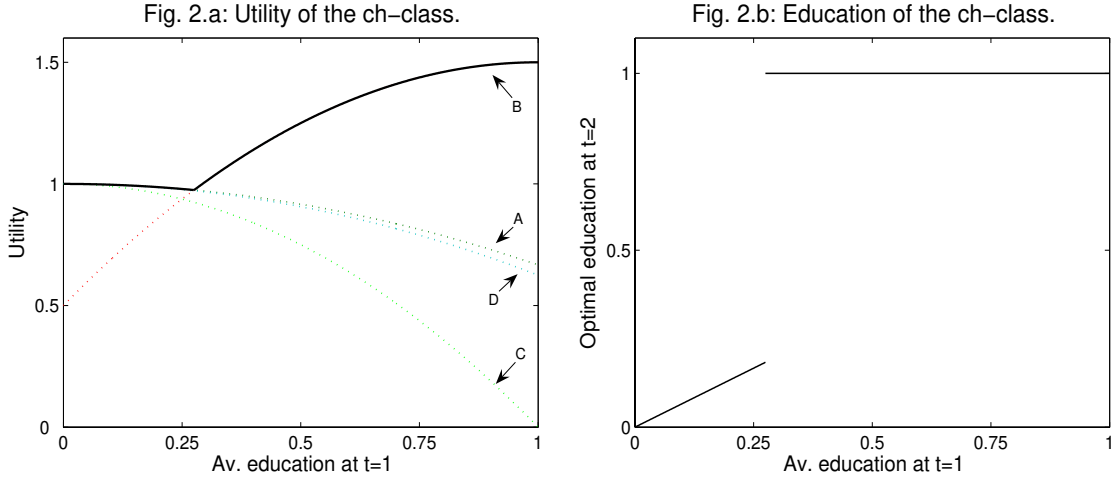
$$U_{ch}(e) = w - \frac{1}{2}e^2 - (e - \bar{e}_1)^2$$

<sup>9</sup>The optimal level for the *ch*-class is solved in the next subsection.

<sup>10</sup>Consider the case in which  $\bar{e}_1 = 0.6$ . Choosing  $e_{cl} = \frac{1}{2}\bar{e}_1$  the distance from the average would be equal to 0.3; choosing  $e_{cl} = 1$  the distance is larger being equal to 0.4.

The solution is  $\hat{e}_{ch} = \frac{2}{3}\bar{e}_1$  so that  $\hat{e}_{ch} \in [0, \frac{2}{3}]$ . Here a problem of effectiveness of the signal arises. Firms believe these workers to be little productive and they offer them the low wage  $w = 1$ . As in the previous subsection, the utility a worker enjoys from choosing  $\hat{e}_{ch}$  is compared with the utility he would get choosing some other particular levels of education.

$$\begin{aligned} \text{A) } U_{ch}(\frac{2}{3}\bar{e}_1) &= 1 - \frac{1}{3}(\bar{e}_1)^2 & \text{C) } U_{ch}(0) &= 1 - (\bar{e}_1)^2 \\ \text{B) } U_{ch}(1) &= \frac{1}{2} - (\bar{e}_1)^2 + 2\bar{e}_1 & \text{D) } U_{ch}(\frac{1}{2}\bar{e}_1) &= 1 - \frac{3}{8}(\bar{e}_1)^2 \end{aligned}$$



Figures 2.a and 2.b show that the optimal strategy is to maintain a level of education  $e_{ch}^* = 1$  as far as the average level in  $t = 1$  is not too low (the critical value is  $\bar{e}_1 \cong 0.275$ ). In doing so a worker effectively signals his productivity and gets the high wage. Below the critical value it is instead more convenient to choose  $e_{ch}^* = \frac{2}{3}\bar{e}_1$ . When the average is very low the pressures to conform are stronger than the incentives to signal the real productivity. Notice that there are no incentives in mimicking the behaviour of the  $cl$ -class given that curve D) is below some other curves for any  $\bar{e}_1 \neq 0$ . Still it could be the case that the  $cl$ -class and the  $ch$ -class are pooled together at a level  $e^* = 1$ .

### 3.4.3 The “status seeking + low productivity” class ( $sl$ )

The analysis of the behaviour of agents with status seeking preferences is more complex given the fact that two different utility functions have to be considered. If the agent’s optimal choice is below  $\bar{e}_1$  then  $\max_e U_{sl}$  has to be solved with:

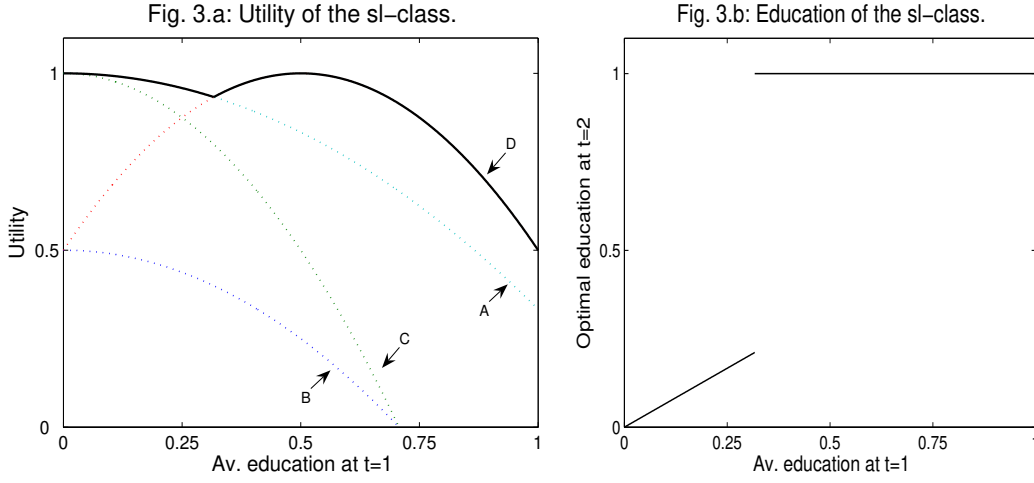
$$U_{sl}(e) = w - e^2 - 2(e - \bar{e}_1)^2 \quad \text{if } e < \bar{e}_1$$

which has solution  $\hat{e}_{sl} = \frac{2}{3}\bar{e}_1$ . Given that  $\hat{e}_{sl} < \bar{e}_1$  the solution can be accepted. With such a choice ( $\hat{e}_{sl} < 1$ ) the worker receives the low wage  $w = 1$ . If, on the contrary, the optimal choice is greater or equal than  $\bar{e}_1$  then the problem is  $\max_e U_{sl}$  with :

$$U_{sl}(e) = w - e^2 + 2\bar{e}_1(e - \bar{e}_1) - \frac{1}{2} \quad \text{if } e \geq \bar{e}_1$$

It is easy to see the positive effect of an increasing distance ( $e - \bar{e}_1$ ). This effect is amplified if the average level in  $t = 1$  was high. Still status concerns provide a positive additional utility only if  $2\bar{e}_1(e - \bar{e}_1) > \frac{1}{2}$ , i.e. only if the agent is able to reach a certain degree of differentiation with respect to the rest of the society. The maximization problem has solution  $\hat{e}_{sl} = \bar{e}_1$ . The comparison among different choices is depicted in Figure 3.a. Figure 3.b shows the optimal level of education for a generic  $sl$ -player.

$$\begin{aligned} \text{A) } U_{sl}(\frac{2}{3}\bar{e}_1) &= 1 - \frac{2}{3}(\bar{e}_1)^2 & \text{C) } U_{sl}(0) &= 1 - 2(\bar{e}_1)^2 \\ \text{B) } U_{sl}(\bar{e}_1) &= \frac{1}{2} - (\bar{e}_1)^2 & \text{D) } U_{sl}(1) &= \frac{1}{2} - 2(\bar{e}_1)^2 + 2\bar{e}_1 \end{aligned}$$



In comparison with the  $cl$ -class, the  $sl$ -class follows  $\bar{e}_1$  in a closer way ( $\frac{2}{3}\bar{e}_1$  vs.  $\frac{1}{2}\bar{e}_1$ ) when average education is low and it jumps before to the value  $e_{sl}^* = 1$  (the critical value at which this happens is approximately equal to 0.317).

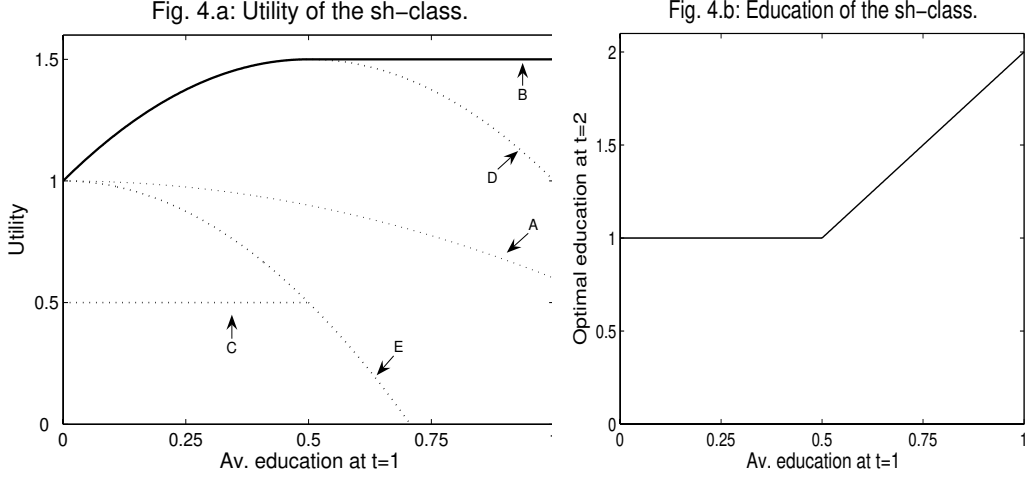
#### 3.4.4 The “status seeking + high productivity” class ( $sh$ )

The last class of individuals is characterized by utility functions:

$$\begin{aligned} U_{sh}(e) &= w - \frac{1}{2}e^2 - 2(e - \bar{e}_1)^2 & \text{if } e < \bar{e}_1 \\ U_{sh}(e) &= w - \frac{1}{2}e^2 + 2\bar{e}_1(e - \bar{e}_1) - \frac{1}{2} & \text{if } e \geq \bar{e}_1 \end{aligned}$$

The maximization of the first function leads to  $\hat{e}_{sh} = \frac{4}{5}\bar{e}_1$  which verifies the condition but it leads to the low wage  $w = 1$ . The second function has solution  $\hat{e}_{sh} = 2\bar{e}_1$  which can also be accepted. Now, as far as  $\bar{e}_1 \geq \frac{1}{2}$ , players receive the high wage  $w = 2$ . If, on the other hand,  $\bar{e}_1 < \frac{1}{2}$ , players get a level of education  $\hat{e}_{sh} < 1$ , they do not signal their real productivity and firms offer them the low wage. Figures 4.a and 4.b illustrate peculiar utility functions and the optimal choice  $e_{sh}^*$ .

$$\begin{aligned} \text{A) } U_{sh}(\frac{4}{5}\bar{e}_1) &= 1 - \frac{2}{5}(\bar{e}_1)^2 & \text{D) } U_{sh}(1) &= 1 - 2(\bar{e}_1)^2 + 2\bar{e}_1 \\ \text{B) } U_{sh}(2\bar{e}_1) &= \frac{3}{2} \text{ with } \bar{e}_1 \geq \frac{1}{2} & \text{E) } U_{sh}(0) &= 1 - 2(\bar{e}_1)^2 \\ \text{C) } U_{sh}(2\bar{e}_1) &= \frac{1}{2} \text{ with } \bar{e}_1 < \frac{1}{2} \end{aligned}$$



As far as  $\bar{e}_1 \leq 0.5$  it is optimal for a *sh*-player to keep a level of education  $e_{sh}^* = 1$ . In this case the distance between his choice and the average level is high enough to satisfy his status aspirations. On the contrary, if  $\bar{e}_1 > 0.5$ , it is then better to choose  $e_{sh}^* = 2\bar{e}_1$ . In this second case a *sh*-player realizes that his status is menaced and he chooses a higher level of education in order to keep the distance from the rest of the society.

## 4 Education dynamics

Having solved for the optimal behaviour of the six classes of agents it is now possible to focus on  $\bar{e}_2$ , the average level of education at time  $t = 2$ . The following table summarizes the behaviour of the six classes of individuals. We use the letter  $\lambda$  to indicate the critical value at which players' optimal choices present discontinuities.

| class     | prop.         | product. | $\theta$ | $e_1^*$ | $e_2^*$ for $\bar{e}_1 \leq \lambda$ | $e_2^*$ for $\bar{e}_1 > \lambda$ | $\lambda$ |
|-----------|---------------|----------|----------|---------|--------------------------------------|-----------------------------------|-----------|
| <i>il</i> | $\alpha_{il}$ | 1        |          | 0       | 0                                    | 0                                 | –         |
| <i>ih</i> | $\alpha_{ih}$ | 2        |          | 1       | 1                                    | 1                                 | –         |
| <i>cl</i> | $\alpha_{cl}$ | 1        |          | 0       | $\frac{1}{2}\bar{e}_1$               | 1                                 | 0.586     |
| <i>ch</i> | $\alpha_{ch}$ | 2        |          | 1       | $\frac{2}{3}\bar{e}_1$               | 1                                 | 0.275     |
| <i>sl</i> | $\alpha_{sl}$ | 1        |          | 0       | $\frac{2}{3}\bar{e}_1$               | 1                                 | 0.317     |
| <i>sh</i> | $\alpha_{sh}$ | 2        |          | 1       | 1                                    | $2\bar{e}_1$                      | 0.500     |

Table 3: optimal choices at  $t = 1$  and at  $t = 2$ .

At any period of time the average level of education is given by  $\bar{e}_t = \sum_k \sum_j \alpha_{kj} e_{kj}^t$  for  $k \in \{i, c, s\}$  and  $j \in \{l, h\}$  such that in  $t = 1$  we had  $\bar{e}_1 = \alpha_{ih} + \alpha_{ch} + \alpha_{sh}$ .

Notice that the two cohorts of players with independent preferences are characterized by a constant level of education. In fact  $e_{il}^* = 0$  and  $e_{ih}^* = 1$  in both periods. The model therefore predicts average

education to remain constant in a society in which no player is influenced by issues of social distance in educational achievements.<sup>11</sup> Indeed average education can change only if the optimal choices of the four classes with interdependent preferences do differ in different periods.

**Proposition 1** *If  $\alpha_{il} + \alpha_{ih} = 1$  then  $\bar{e}_2 = \bar{e}_1 = \alpha_{ih}$ . The presence of individuals with interdependent preferences is a necessary condition to observe a non constant average level of education.*

The average level of education in  $t = 2$  is a weighted average of the six classes' optimal choices. These choices are functions of  $\bar{e}_1$ . Moreover  $\bar{e}_1$  is a function of the  $\alpha_{kj}$ , the proportions of the different classes. It follows that  $\bar{e}_2$  is a discontinuous function of the  $\alpha_{kj}$ . More precisely the function for  $\bar{e}_2$  takes the following form:

$$\bar{e}_2 = \begin{cases} \alpha_{ih} + \alpha_{cl} \left(\frac{1}{2}\bar{e}_1\right) + \alpha_{ch} \left(\frac{2}{3}\bar{e}_1\right) + \alpha_{sl} \left(\frac{2}{3}\bar{e}_1\right) + \alpha_{sh} & 0.000 \leq \bar{e}_1 \leq 0.275 \\ \alpha_{ih} + \alpha_{cl} \left(\frac{1}{2}\bar{e}_1\right) + \alpha_{ch} + \alpha_{sl} \left(\frac{2}{3}\bar{e}_1\right) + \alpha_{sh} & 0.275 < \bar{e}_1 \leq 0.317 \\ \alpha_{ih} + \alpha_{cl} \left(\frac{1}{2}\bar{e}_1\right) + \alpha_{ch} + \alpha_{sl} + \alpha_{sh} & 0.317 < \bar{e}_1 \leq 0.500 \\ \alpha_{ih} + \alpha_{cl} \left(\frac{1}{2}\bar{e}_1\right) + \alpha_{ch} + \alpha_{sl} + \alpha_{sh} (2\bar{e}_1) & 0.500 < \bar{e}_1 \leq 0.586 \\ \alpha_{ih} + \alpha_{cl} + \alpha_{ch} + \alpha_{sl} + \alpha_{sh} (2\bar{e}_1) & 0.586 < \bar{e}_1 \leq 1.000 \end{cases}$$

The study of this function in its general form is not viable because it involves too many unknowns. Therefore we focus on some special cases that still are useful in understanding the effects that social preferences have on educational dynamics. In particular we study the cases of populations made by the two classes of individuals with independent preferences (that possibly cover the vast majority of the population) and by certain combinations of classes characterized by interdependent preferences. Our main interest lies in studying how average education changes between the first and the second period. Still a flavour of longer term dynamics ( $t > 2$ ) is given by the study of the function  $\bar{e}_t (\bar{e}_{t-1})$  which is assumed to mimic the function  $\bar{e}_2 (\bar{e}_1)$ .

## 1) Subpopulation with homogeneous social preferences

### 1.a) Independent and conformist individuals

A society with independent and conformist individuals implies the restrictions  $\alpha_{il} + \alpha_{ih} + \alpha_{cl} + \alpha_{ch} = 1$  and  $\bar{e}_1 = \alpha_{ih} + \alpha_{ch}$ . The function  $\bar{e}_2 (\bar{e}_1)$  and, most importantly, the difference in the average educational levels between the two periods ( $\Delta\bar{e} = \bar{e}_2 - \bar{e}_1$ ) are:

$$\bar{e}_2 = \begin{cases} \alpha_{ih} + \alpha_{cl} \left(\frac{1}{2}\bar{e}_1\right) + \alpha_{ch} \left(\frac{2}{3}\bar{e}_1\right) & 0.000 \leq \bar{e}_1 \leq 0.275 \\ \alpha_{ih} + \alpha_{cl} \left(\frac{1}{2}\bar{e}_1\right) + \alpha_{ch} & 0.275 < \bar{e}_1 \leq 0.586 \\ \alpha_{ih} + \alpha_{cl} + \alpha_{ch} & 0.586 < \bar{e}_1 \leq 1.000 \end{cases} \quad \Delta\bar{e} = \begin{cases} \alpha_{cl} \left(\frac{1}{2}\bar{e}_1\right) + \alpha_{ch} \left(\frac{2}{3}\bar{e}_1 - 1\right) & 0.000 \leq \bar{e}_1 \leq 0.275 \\ \alpha_{cl} \left(\frac{1}{2}\bar{e}_1\right) & 0.275 < \bar{e}_1 \leq 0.586 \\ \alpha_{cl} & 0.586 < \bar{e}_1 \leq 1.000 \end{cases}$$

In line with Prop. 1 the change in average education ( $\Delta\bar{e}$ ) is solely a function of the proportions of conformist individuals. Whenever  $\alpha_{cl} > 0$ , then average education increases from  $t = 1$  to  $t = 2$  (though

<sup>11</sup>This would be the case of a standard signaling game repeated over time.

with different speed) provided that  $\bar{e}_1 > 0.275$ . In other words at least 27.5% of the population has to be characterized by a high level of productivity. Education is therefore likely to grow even in a society in which there are just independent and conformist individuals.

**Proposition 2** *If  $\alpha_{il} + \alpha_{ih} + \alpha_{cl} + \alpha_{ch} = 1$  and  $\bar{e}_1 > 0.275$  then  $\bar{e}_2 > \bar{e}_1$ . Therefore the presence of status seeking individuals is not necessary to observe education growing over time.*

If  $\bar{e}_1 \leq 0.275$ , then average education could move in both directions depending on the specific composition of the cohorts. Consider for instance the case of  $\alpha_{il} = 0.5$ ,  $\alpha_{ih} = 0.2$ ,  $\alpha_{cl} = 0.25$  and  $\alpha_{ch} = 0.05$  such that  $\bar{e}_1 = 0.25$ . Optimal choices in  $t = 2$  are  $e_{il}^* = 0$ ,  $e_{ih}^* = 1$ ,  $e_{cl}^* = 0.125$  and  $e_{ch}^* = 0.166$  and they imply  $\bar{e}_2 = 0.239$ , i.e. average education decreased. Vice versa a different composition of the society that still has the same average level  $\bar{e}_1 = 0.25$  could display a growing level of education. For instance with  $\alpha_{il} = 0.3$ ,  $\alpha_{ih} = 0.2$ ,  $\alpha_{cl} = 0.45$  and  $\alpha_{ch} = 0.05$  we would have  $\bar{e}_2 = 0.264$  and thus a positive  $\Delta\bar{e}$ .

Obviously for any  $\bar{e}_1 \in (0, 0.275)$  there exists a specific relationship between the two proportions of conformist players such that education remains constant over time. This relation is found setting  $\Delta\bar{e} = 0$  such that  $\tilde{\alpha}_{cl} = \gamma\tilde{\alpha}_{ch}$  where  $\gamma = \frac{1 - \frac{2}{3}\bar{e}_1}{\frac{1}{2}\bar{e}_1}$  and  $\gamma > 1$ , for any  $\bar{e}_1 \in (0, 0.275)$ . Proportions of the kind  $\tilde{\alpha}_{cl}$  and  $\tilde{\alpha}_{ch}$  define a stationary outcome of the game.

**Proposition 3** *For certain intervals of  $\bar{e}_1$  and for appropriate values of the  $\alpha_{kj}$ , interior steady state levels such that  $\bar{e}_t \in (0, 1)$  and  $\bar{e}_t = \bar{e}_{t-1}$  for any  $t > 1$  exist. Therefore the presence of individuals with interdependent preferences is not sufficient to observe a non constant average level of education.*

These interior outcomes are not stable. In fact any  $\alpha_{cl} > \tilde{\alpha}_{cl}$  implies  $\bar{e}_2 > \bar{e}_1$  and, allowing for new cohorts education keeps increasing so to eventually reach the (stationary and stable) outcome at  $\bar{e}_t = \alpha_{cl} + \alpha_{ch} + \alpha_{ih}$ . We used the terminology “outcome” instead of “equilibrium” to define these situations. In fact we still did not analyze the behaviour of the other category of players involved in the game, i.e. the firms. Section 5 will elaborate more on this point.

To analyze the properties of these outcomes we need the following definition:

**Definition 4** *An outcome of the signaling game is called:*

- perfectly separating if  $e_{kl}^* \neq e_{yh}^*$  for any  $k \in \{i, c, s\}$  and any  $y \in \{i, c, s\}$ .
- partly separating if  $e_{kl}^* = e_{yh}^*$  for some  $k \in \{i, c, s\}$  and some  $y \in \{i, c, s\}$ .

In a perfectly separating outcome (like the equilibrium of the game in  $t = 1$ ) players with different productivity send different signals, i.e. they choose different levels of education. This is not the case of the stationary and stable outcome mentioned above (such that  $\bar{e}_t = \alpha_{cl} + \alpha_{ch} + \alpha_{ih}$ ) which is indeed partly separating. In fact conformist individuals with low productivity choose  $e_{cl}^* = 1$ , the same signal which is sent by the high productivity classes (*ih* and *ch*).<sup>12</sup> Partly separating outcomes easily arise in populations where conformist and/or status seeking individuals are present.

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<sup>12</sup>Similarly if  $\alpha_{cl} < \tilde{\alpha}_{cl}$  then  $\bar{e}_2 < \bar{e}_1$  and education approaches its minimum at  $\bar{e}_t = \alpha_{ih}$ . This is a stable outcome which is also partly separating given that *ch*-individuals fail to signal their real productivity.

**Proposition 5** *The presence of agents with interdependent preferences ( $\alpha_{il} + \alpha_{ih} < 1$ ) can turn perfectly separating outcomes in partly separating ones.*

Section 5 analyses the effects that the dynamics described by Proposition 5 can have on the hiring policies of the firms.

1.b) Independent and status seeking individuals

Such a restriction implies  $\alpha_{il} + \alpha_{ih} + \alpha_{sl} + \alpha_{sh} = 1$  and  $\bar{e}_1 = \alpha_{ih} + \alpha_{sh}$ . The function  $\bar{e}_2(\bar{e}_1)$  and the relative change in the average educational level are given by:

$$\bar{e}_2 = \begin{cases} \alpha_{ih} + \alpha_{sl} \left(\frac{2}{3}\bar{e}_1\right) + \alpha_{sh} \\ \alpha_{ih} + \alpha_{sl} + \alpha_{sh} \\ \alpha_{ih} + \alpha_{sl} + \alpha_{sh} (2\bar{e}_1) \end{cases} \quad \Delta\bar{e} = \begin{cases} \alpha_{sl} \left(\frac{2}{3}\bar{e}_1\right) & 0.000 \leq \bar{e}_1 \leq 0.317 \\ \alpha_{sh} & 0.317 < \bar{e}_1 \leq 0.500 \\ \alpha_{sh} (2\bar{e}_1 - 1) & 0.500 < \bar{e}_1 \leq 1.000 \end{cases}$$

The change in education between the two periods is never negative and  $\Delta\bar{e}$  can be equal to zero only if  $\alpha_{sl} = 0$  or  $\alpha_{sh} = 0$ .

**Proposition 6** *If  $\alpha_{il} + \alpha_{ih} + \alpha_{sl} + \alpha_{sh} = 1$  then  $\bar{e}_2 \geq \bar{e}_1$ . Education cannot decrease in a society with no conformist individuals.*

If  $\alpha_{sl} > 0$  and  $\alpha_{sh} > 0$  then education grows and it will reach the unique stationary outcome at the maximum level  $\bar{e}_t = \alpha_{ih} + \alpha_{sl} + 2\alpha_{sh}$ . As expected, the rat race effect among ambitious agents pushes average education up. Even in this case, and in line with Proposition 5, the signal that agents send can be misleading. In fact status seeking agents with low productivity can be pooled together with highly productive workers.

## 2) Conformist, low productivity + status seeking, high productivity

This case captures the situation in which agents' social preferences are correlated with their innate productivity. Low type individuals learn that they cannot shine and they develop a taste for conformism. High type individuals realize they have the talent and the potential to be above the average and thus they adopt a status seeking behaviour. If this is the case then  $\alpha_{il} + \alpha_{ih} + \alpha_{cl} + \alpha_{sh} = 1$  and  $\bar{e}_1 = \alpha_{ih} + \alpha_{sh}$ . The function for  $\bar{e}_2$  can then be formalized as:

$$\bar{e}_2 = \begin{cases} \alpha_{ih} + \alpha_{cl} \left(\frac{1}{2}\bar{e}_1\right) + \alpha_{sh} \\ \alpha_{ih} + \alpha_{cl} \left(\frac{1}{2}\bar{e}_1\right) + \alpha_{sh} (2\bar{e}_1) \\ \alpha_{ih} + \alpha_{cl} + \alpha_{sh} (2\bar{e}_1) \end{cases} \quad \Delta\bar{e} = \begin{cases} \alpha_{cl} \left(\frac{1}{2}\bar{e}_1\right) & 0.000 \leq \bar{e}_1 \leq 0.500 \\ \alpha_{cl} \left(\frac{1}{2}\bar{e}_1\right) + \alpha_{sh} (2\bar{e}_1 - 1) & 0.500 < \bar{e}_1 \leq 0.586 \\ \alpha_{cl} + \alpha_{sh} (2\bar{e}_1 - 1) & 0.586 < \bar{e}_1 \leq 1.000 \end{cases}$$

Education grows over time given that  $\Delta\bar{e}$  is positive. For low levels of  $\bar{e}_1$ , the growth is driven by individuals of the *cl*-class that try not to fall too behind. Then growth in education becomes even faster given that also status seeking individuals, feeling their status menaced, reach higher levels of schooling. Many outcomes are partly separating because *cl*-individuals are indistinguishable from *ih*-individuals for any  $\bar{e}_1 > 0.586$ . Still the *cl* and *sh* are never pooled together.



### 3) The general case

When all the six classes of agents are present (the two with independent preferences and the four with interdependent ones) only a qualitative solution is possible. Consider first the uniform distribution defined by  $\alpha_{kj} = \frac{1}{6}$  with  $k \in \{i, c, s\}$  and  $j \in \{l, h\}$  such that  $\bar{e}_1 = \alpha_{ih} + \alpha_{ch} + \alpha_{sh} = 0.5$ . Optimal choices in  $t = 2$  are  $e_{il}^* = 0$ ,  $e_{ih}^* = 1$ ,  $e_{cl}^* = 0.25$ ,  $e_{ch}^* = 1$ ,  $e_{sl}^* = 1$  and  $e_{sh}^* = 1$  which imply  $\bar{e}_2 = 0.71$  and thus an important increase in education. Given this example, it is easy to forecast that, under very weak assumptions regarding the  $\alpha_{kj}$ , average education increases over time. In fact, in order to have the opposite result, namely a decreasing level of education, the composition of the society has to be strongly biased towards low productive workers ( $\bar{e}_1 < 0.275$  is a necessary condition for average education to decrease) and, on top of that, the majority of individuals characterized by high productivity has to follow a conformist behaviour.

As a numerical example consider the case in which  $\alpha_{il} = 0.6$ ,  $\alpha_{ih} = 0.05$ ,  $\alpha_{cl} = 0.1$ ,  $\alpha_{ch} = 0.15$ ,  $\alpha_{sl} = 0.05$ ,  $\alpha_{sh} = 0.05$ . The resulting average education at time  $t = 1$  will be  $\bar{e}_1 = 0.25$ . Optimal choices at  $t = 2$  are  $e_{il}^* = 0$ ,  $e_{ih}^* = 1$ ,  $e_{cl}^* = 0.125$ ,  $e_{ch}^* = 0.166$ ,  $e_{sl}^* = 0.166$  and  $e_{sh}^* = 1$  so that  $\bar{e}_2 = 0.146$ , with  $\bar{e}_2 < \bar{e}_1$ .

## 4.1 Summary

The analysis of the previous sections highlighted the effects that interdependent preferences can have on educational dynamics. In particular it showed that the presence of individuals that care about their relative position in the educational distribution is necessary but not sufficient for observing an average level of education that evolves over time. Indeed it is the combination of social preferences and productivity levels that triggers the dynamics. The assumptions needed for the model to display a growing level of education are not particularly challenging. For instance average education is likely to increase also in a society in which, aside to standard agents with independent preferences, there are just a few conformist individuals. Therefore the presence of status seeking individuals is not necessary, even though it can surely contribute.

## 5 Firms' behaviour

The previous section focused on the change in average education between  $t = 1$  and  $t = 2$ . A key assumption that we adopted is that firms do not modify their hiring strategy. This hiring strategy is based on firms' initial beliefs which are confirmed by individuals' behaviour in  $t = 1$ . But then firms fail to anticipate agents' behaviour in  $t = 2$ . In fact they keep on offering the high wage to any worker with  $e^* \geq 1$  and the low wage to any worker with  $e^* < 1$ . Even if a formal discussion of a longer game is outside the scope of the paper, it is easy to understand that this assumption would become more and more restrictive as new cohorts of workers enter in the labour market. This is so because firms' beliefs may easily happen to be incorrect for  $t > 1$ . Indeed this is already evident in  $t = 2$ .

The model showed in fact that partly separating outcomes easily arise such that workers with different

productivity acquire the same educational level. In these situations signals become less informative as they are no more perfectly correlated with workers' productivity. In fact, from the firms' point of view, agents with the same  $e^*$  are ex-ante indistinguishable. Therefore firms are not able to properly screen the workers. Table 3 shows that, already in the second period, signals are precise and firms' beliefs are correct only in a short internal interval.

| Interval of $\bar{e}_1$ | Classes pooled together  | Firms' beliefs | Effects on profits |
|-------------------------|--|----------------|--------------------|
| [0.000, 0.275]          | $ch, sl$ at $e^* = \frac{2}{3}\bar{e}_1$ , $ih, sh$ at $e^* = 1$ | incorrect      | positive           |
| (0.275, 0.317]          | $ih, ch, sh$ at $e^* = 1$  | correct        | null               |
| (0.317, 0.500]          | $ih, ch, sl, sh$ at $e^* = 1$                                    | incorrect      | negative           |
| (0.500, 0.586]          | $ih, ch, sl$ at $e^* = 1$  | incorrect      | negative           |
| (0.586, 1.000]          | $ih, cl, ch, sl$ at $e^* = 1$                                    | incorrect      | more negative      |

Table 3: consequences on firms' profits in  $t = 2$ .

The last column of Table 3 focuses on the relation between firms' beliefs and firms' profitability.<sup>13</sup> In particular it shows that when beliefs are incorrect then profits are negatively affected in the vast majority of cases. For very low levels of  $\bar{e}_1$  (first row) firms actually gain because they pay the low wage to conformist individuals with high productivity ( $w_{ch} < \theta_{ch}$ ). But if  $\bar{e}_1 > 0.317$  then firms are overpaying some low productivity worker. In fact  $w_{sl} > \theta_{sl}$  in the interval (0.317, 0.586] and both  $w_{cl} > \theta_{cl}$  and  $w_{sl} > \theta_{sl}$  in the interval (0.586, 1.000]. This leads to the following proposition:

**Proposition 7** *For high levels of  $\bar{e}_t$  firms are more likely to be disappointed by workers' actual productivity.*

Proposition 7 is in line with the initial intuition of the paper. The average level  $\bar{e}_t$  is low when just a few individuals have a high level of education. Then these few agents stand out clearly and they send a very effective signal to employers. At the opposite a high  $\bar{e}_t$  indicates that a considerable fraction of the population has reached high levels of schooling. In this case signals get less informative and potentially harmful for what concerns firms' profitability.

Still employers learn workers' real productivity on the workplace and they realize if their screening process is inaccurate. If this is the case then firms will eventually change their hiring strategy. In particular, as average education grows, they will increase the minimum level of education they believe to be effective in discriminating between workers with different productivity. Such a behaviour seems to be consistent with various anecdotic evidences. For instance minimum educational levels required to get certain jobs have been increasing in the last decades, both in the public and in the private sector.

The fact that firms increase the discriminating level will affect the choices of subsequent cohorts of individuals. Because of economic incentives and social distance considerations, different categories of workers will progressively acquire this new higher level of education which over time will again lose its

<sup>13</sup>Firms break even whenever the wage they pay equals the real productivity of the workers. If firms pay higher wages they incur into losses.

separating power. According to this argument workers and firms are involved in a strategic interaction in which both reaction functions are positively sloped such that an escalation in the level of education takes place. A mechanism of this kind is likely to have contributed to the rise of average education in Europe.

## 6 Concluding remarks

The dynamics implied by the combination of theories of signaling and social distance can help explaining the educational trends of the last decades. In fact, under very reasonable assumptions about the composition of the society, the model endogenously displays an increasing average level of schooling. For instance the presence of status seeking individuals is not a necessary condition and education can easily grow even in a purely conformist society provided that there are enough high productivity individuals. The consideration that it is likely that, at least for some agents, the level of schooling may be a way to reach a respectable social position makes the result more robust. The model also rationalizes the fact that, as average education grows, signals get progressively less informative. The large and growing number of new postgraduate degrees that are activated every year provides an indirect evidence of the initial intuition. Today a bachelor's degree is by far a less effective signal with respect to 30 years ago and those who want to stand out need something more.

The social welfare implications of the model are not positive. Asymmetric information about workers' productivity and externalities stemming from interdependent social preferences suggest a tendency towards overprovision of education. This indeed seems to be the direction towards which many developed countries are moving.

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