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*Northwestern University
and IZA Bonn*

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IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
Email: iza@iza.org

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ABSTRACT

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This paper discusses the claim made in Altonji and Pierret (1997) and Lange (2005) that a high speed of employer learning indicates a low value of job market signaling. The claim is first discussed intuitively in light of Spence's original model and then evaluated in a simple extension of a model developed in Altonji and Pierret (1997). The analysis provided indicates that, if employer learning is incomplete, a high speed of employer learning is not necessarily indicative of a low value of job market signaling.

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Corresponding author:

Steffen Habermalz
Northwestern University
Department of Economics
3224 Andersen Hall
2001 Sheridan Road
Evanston IL 60208
USA
E-mail: s-habermalzs@northwestern.edu

Introduction

Ever since the seminal Nobel Prize winning works of Akerloff (1970), Spence (1973), and Stiglitz (1975) economists have shown great interest in the effects of asymmetric information on economic outcomes. In the field of labor economics there has been an ongoing and vibrant discussion centered on the information asymmetries between hiring firms and prospective workers.

Job Market Signaling (JMS), introduced by Spence (1973), proposes that high-ability workers differentiate themselves from observationally identical workers of lower ability by acquiring an educational signal which is observed by potential employers. If higher ability individuals find it less costly (both in monetary and non-monetary terms) to acquire an educational degree this process will lead to a separating equilibrium in which workers can be differentiated by their signals.

A related approach was introduced by Farber and Gibbons (1996) and further developed by Altonji and Pierret (1997 and 2001). In their models of Employer Learning (EL) they assume that employers statistically discriminate among prospective workers on the basis of a signal (usually education) which is related to the (unobserved) ability of a worker. Models of EL predict that information indicative of a worker's true productivity but only observed by the econometrician will be increasingly correlated with wages as the worker gains more labor market experience. The model also predicts that the estimated returns to education will decline with labor market experience when such a measure is included in the regression equation. Intuitively this happens because the employer receives (noisy) signals of a worker's true productivity and learns over time. Thus, actual information on the true productivity of the worker accrues over time and the

educational signal loses value. Altonji and Pierret (1997 and 2001) test this prediction using scores of the Armed Forces Qualification Test (AFQT) administered to participants in the National Longitudinal Survey of Youth 1979 (the measure only observed by the econometrician) and find both hypothesis empirically confirmed. Altonji and Pierret (1997, hereafter AP) also investigate the relationship between the speed of employer learning and the value of Job Market Signaling. The paper develops a simple signaling model in which employers learn very quickly. AP show that, in such a setting, workers only have an incentive to acquire education if the returns are exorbitantly high. They conclude that the value of signaling cannot be very high if employers learn quickly.

Extending the Employer Learning literature Lange (2005) estimates the speed at which employers learn about workers' true productivities. He concludes that employer learning is rather fast and, partially based on the argument provided by AP, uses this result to downplay the economic significance of JMS.

The contribution of this paper is to provide a different interpretation of results of Lange (2005) and AP and challenge the contention that a high speed of employer learning is indicative of a low value of signaling. The paper proceeds as follows: using insights from Spence (1973), Section 2 of the paper provides a descriptive and intuitive discussion of the signaling process as it pertains to the claims made in Lange (2005) and AP. In the simple quantitative analysis of Section 3 I extend AP's model by introducing the (realistic) possibility that EL is incomplete. The results of a simulation provide evidence for an important role of JMS even if employer learning is very fast. In accordance with the discussion in Section 2 the results also hint at the possibility that a higher speed of employer learning might increase the value of JMS. Section 3 attempts to reconcile the

contrasting views by discussing the relationship between the speed of EL and the *existence* of JMS. Section 4 concludes.

The Speed of EL and the Value of JMS: An Intuitive Discussion

Lange (2005) estimates the speed at which employers learn and finds that employers are able to reduce their average expectation error concerning the productivity of a worker by 50% over the first 3 years. He concludes (probably correctly) that this is rather fast. He then argues, partially based on the argument provided in AP, that Job Market Signaling is of limited value.

In Spence (1973) employers hire workers according to educational signals that are correlated with the workers' true productivity. In equilibrium the employers' beliefs about the informational content of the educational signals are confirmed. In order to achieve equilibrium and react to changes in the productivity/signal relationship it should be beneficial for employers to have their beliefs confirmed sooner rather than later. Figure 1 schematically illustrates the signaling process. Thus the findings of Lange (2005) imply that this process works rather efficiently and that employers need not wait long to confirm their hiring practices. It also implies that it does not take them long to detect workers that, for whatever reason, obtained the wrong signal and "masquerade" as high ability workers. This means that employers would rather learn quickly than slow and that the value of the educational signal should be positively correlated with the speed of employer learning. It also shows that employers would not value the JMS process if it would take a long time for their beliefs to be confirmed since it would be harder to detect underperforming workers and would render hiring based on educational signals less

efficient. The value of the signal to employers depends on their ability to select individuals of a particular productivity, the more efficient this mechanism works, the better.

Lange (2005) supplements his in-depth mathematical treatment with a graphical analysis of the relationship between the speed of employer learning and the value of signaling. Figure 2 reproduces his graph (Figure 3 in Lange (2005)). The figure shows two average productivity paths, a low one for low ability workers and a higher one for high ability workers. It also shows two earnings paths (dashed lines) for a low productivity worker who (wrongly) decides to go to college corresponding to two different speeds of employer learning. The area between the lower solid line and the dashed lines corresponds to the return to acquiring the college degree. It is clear from the graph that a higher speed of employer learning will limit the worker's return. Lange uses this argument to show the inverse relationship between the speed of employer learning and the value of an educational signal. While the graph seems intuitive, a different interpretation is forwarded here. The return shown is not the return to an educational signal originating in the JMS model. It is the return to an out-of-equilibrium choice of schooling. The person shown in the graph is "masquerading" as a high-ability worker. The JMS provides the means to overcome informational asymmetries by providing an educational signal which enables employers to separate observationally identical individuals into ability groups. The earlier individuals with the "wrong" signal can be detected, the more efficient the process of JMS is, implying that a higher speed of EL is beneficial. The above applies to workers with signals indicating productivities higher *or* lower than their actual productivities. Therefore, a higher speed of EL can be thought of

as decreasing the variance of the employers estimator of workers' true productivities. It makes the process more efficient. The results provided in Lange (2005) can thus be interpreted as evidence that a higher speed of EL makes JMS more valuable.

The Speed of EL and the Value of JMS: Extending AP's Model

AP's argument is based on the following model: Assume that there are 2 types of workers, 0 and 1, with productivities Y_1 and Y_0 ($Y_1 > Y_0$). The labor market is competitive so that workers are paid their expected productivity. Individuals choose between one year of schooling or no schooling at all. Schooling costs are higher for type 0. In signaling equilibrium $(1+k) = Y_1/Y_0$ represents the ratio of productivities of the two types of workers. Employers learn nothing for two years and then instantly acquire full information about the productivity of their workers. With zero interest rates this implies that the present value for a Y_1 type without schooling is

$$PV(Y_1, \text{No School}) = 2Y_0 + (T-2)(1+k)Y_0. \quad (1)$$

The present value of Y_1 with one year of schooling (no earnings while in school) is equal to.

$$(T-1)(1+k)Y_0$$

This implies that type Y_1 will choose school if

$$(T-1)(1+k)Y_0 > 2Y_0 + (T-2)(1+k)Y_0 \text{ or}$$

$$k > 1.$$

Type Y_1 individuals choose schooling only if they are paid twice as much as type Y_0 . Since empirical estimates of the returns to schooling are in the roughly between 5%-

10% AP reject the notion that the signaling value of education plays a significant role in determining the value of education in the labor market if employers learn sufficiently fast about workers' productivities.

To summarize, in AP's model a high productivity worker has two choices. He can attend school and, upon graduation, work for a high wage firm. The second possibility is not to attend school and, after a short stint at a low wage firm and upon the revelation of his true productivity, move to a high wage firm. The empirical ramifications of this process are somewhat disconcerting. Taken literally instant and complete revelation of a worker's true productivity unconditional on her current job would enable a worker to work in the food service industry for a short time before an instantaneous transfer into investment banking. While it is certainly not inconceivable that some workers in low paying jobs have the ability to be investment bankers, it seems very unlikely that employer information acquired in the low-wage job will pave the way. To achieve the same occupational success the worker in AP's model has to choose between putting in effort and acquiring an educational signal or staying in a low-paying job for a short time. In this environment it is obvious that only a very high wage differential could induce individuals to consider going to school at all and the speed of employer learning would indeed be inversely related to the signaling value of education. The following analysis will show that AP's model is an extreme case of a more general model that does not imply that JMS is of low value.

AP assume that EL is symmetric and complete. The former implies that the current employers do not have more information than potential employers. The latter

assumes that an employer is able to obtain complete information about a worker's true productivity. I will maintain the assumption of symmetric learning.

Aside from the pure ability to learn does an employer have an incentive to learn everything about a worker? The answer to this question depends on which talents are important to the firm. In general, it seems safe to assume that an employer is only interested in how much a certain worker fulfills her current job requirement (and maybe the requirements for a certain track). This implies that the firm most likely does not have an incentive to learn about a worker's ability completely, implying a limit in most cases. In addition Lange (2005) estimates that even with a high speed of employer learning, and after 40 years in the labor market, employers will only know 93% of the true productivity of a worker. How would such a limit on learning affect the conclusions drawn by AP? We can augment AP's model by assuming that, after L years (two in AP's model), the employer will know a fraction $(1-\alpha) < 1$ of the worker's true productivity. The model also allows for variable learning and schooling parameters. Therefore, a type Y_1 individual who chooses S years of schooling will have lifetime earnings equal to

$$(T - S) \cdot (1 + k) \cdot Y_0,$$

where T, as before, is the number of time periods and S represents the number of years of schooling¹. If the individual chooses no schooling his lifetime earnings are

$$L \cdot Y_0 + (T - L) \cdot [\alpha \cdot Y_0 + (1 - \alpha) \cdot (1 + k) \cdot Y_0],$$

Noting the that k needs to be adjusted for years of education, solving for k yields

$$k = \left(\frac{L + (T - L) \cdot \alpha}{(T - S) - (T - L) \cdot (1 - \alpha)} - 1 \right) \cdot \frac{1}{S}$$

¹ It is assumed that the individual either chooses 0 or S years of schooling.

Note that AP's model is a special case in which $S=1$ and $\alpha = 0$. To analyze the model Table 1 shows the average return to schooling necessary to induce an individual to choose schooling for different values of schooling and employer learning. Table 2 shows the minimum alpha (max. amount of EL) necessary to achieve empirically relevant returns to education of 10%.

The simulations in Table 1 show that (given $\alpha=1/3$ and $T=40$) limiting learning reduces the return necessary to induce an individual to attend school to a reasonable range. The results also show that, conditional on attending school, the return to an educational signal increases with the speed of employer learning. Table 2 provides more general results. It displays the alpha necessary to generate an average return to schooling equal to 10%. Note that an $\alpha=0$ implies that employers will have all information at the end of L years. It is a remarkable property of the model that, even if learning only takes one year, employers are allowed to learn between 60 and 75 percent of a workers ability without requiring the return to the educational signal to exceed empirical values. This necessary value far exceeds Lange's estimate (50% after 3 years) and shows that JMS is potentially valuable even when the speed of employer learning is high.

The Speed of EL and the *Existence* of JMS

One can potentially reconcile the conclusions of this papers with the views expressed in AP and Lange (2005) by examining the relationship between the speed of EL and the *existence* of JMS. Imagine a world in which EL is extremely slow.

Considering the inability of employers to confirm their beliefs (detect out-of-equilibrium choices) under such a regime it is very likely that JMS would not exist. Employers, on the other hand, would value an efficient signaling process highly. Furthermore, there is no room for JMS in a world where employers learn about the true productivity of a worker instantaneously after hiring. Employers would not be willing to pay much for a signal. Observing the speed of EL and the value of JMS in both worlds leads us to believe that there is a negative correlation between the two. However, it does not make sense to discuss this relationship in scenarios in which potentially JMS does not exist. The argument of this paper is that, if JMS exists, one should expect that a higher speed of EL does not imply a low value of JMS. Figure 3 illustrates this.

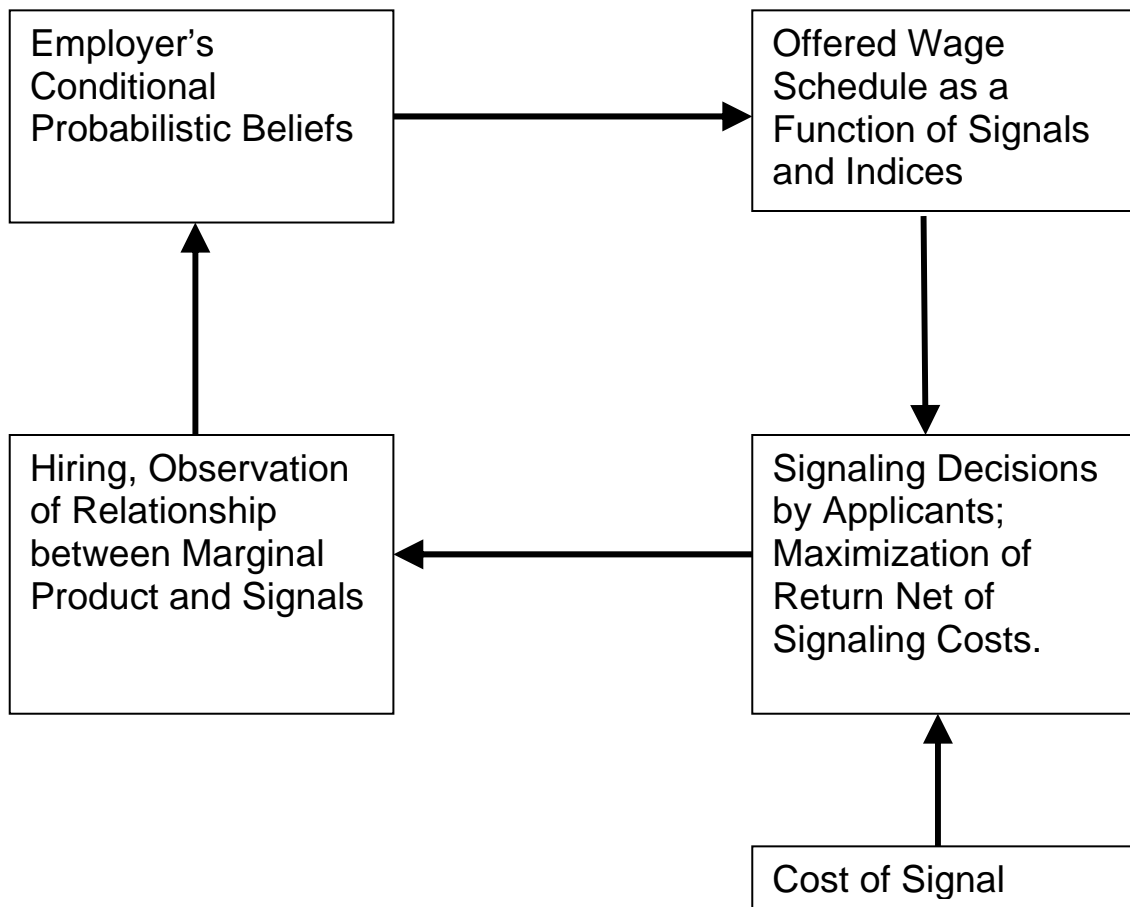
Conclusion

This paper provides evidence that challenges the views expressed in Altonji and Pierret (1997) and Lange (2005) that a high speed of employer learning implies a low value of job market signaling. It was first shown qualitatively that the postulated relationship seems at odds with Spence's original model. Furthermore, the paper illustrated that, when perceiving employer learning as an imperfect process with a sufficient degree of residual long-term uncertainty, the conclusion of Altonji and Pierret (1997) fails to hold. The main result of the paper is thus that the relationship between the speed of employer learning and the value of job market signaling cannot be determined without further inquiry. Based on the discussion in the paper future work should identify the relationship between the speed of employer learning and the *existence* of job market signaling in order to cast more light on the issue.

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Figure 1



Source: Spence (1973)

Table 1: Simulated Average Return to Schooling (%)

(alpha=1/3, t=40)

Years of Education

		1	2	3	4	5	6
L e a r n i n g	1	10.26	11.43	12.90	14.81	17.39	21.05
	2	9.52	10.53	11.76	13.33	15.38	18.18
	3	8.89	9.76	10.81	12.12	13.79	16.00
	4	8.33	9.09	10.00	11.11	12.50	14.29
	5	7.84	8.51	9.30	10.26	11.43	12.90
	6	7.41	8.00	8.70	9.52	10.53	11.76
	7	7.02	7.55	8.16	8.89	9.76	10.81
	8	6.67	7.14	7.69	8.33	9.09	10.00
	9	6.35	6.78	7.27	7.84	8.51	9.30
	10	6.06	6.45	6.90	7.41	8.00	8.70

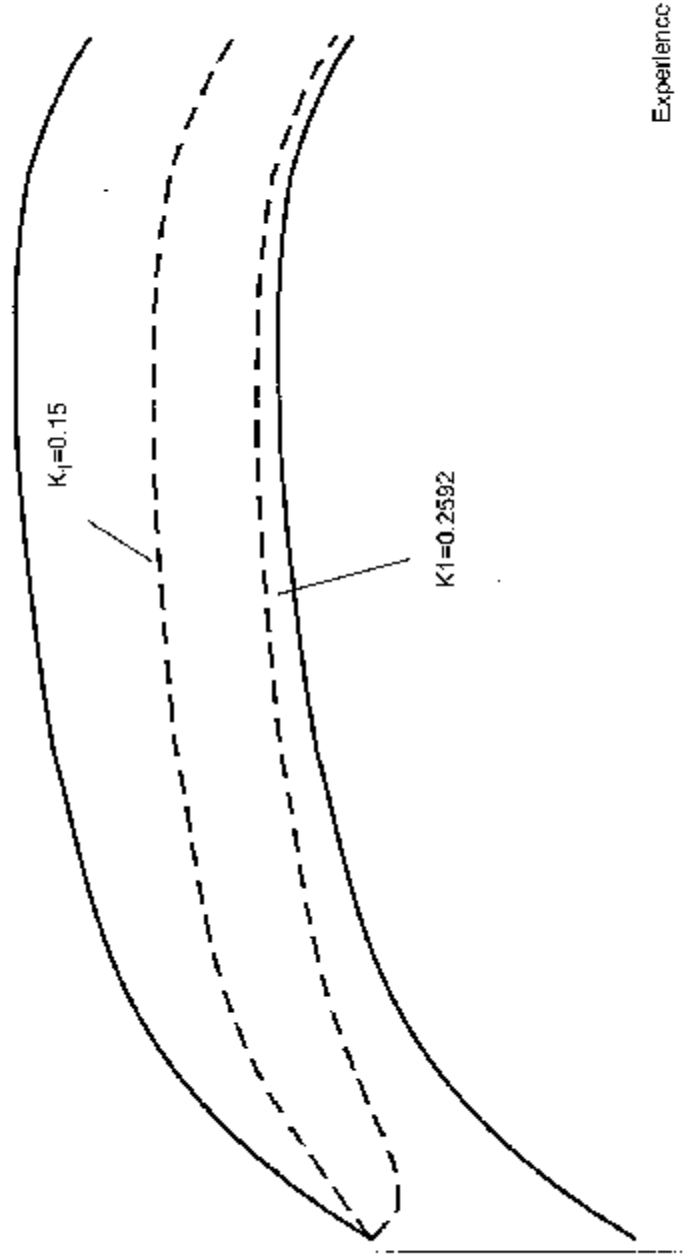
**Table 2: Minimum Alpha Necessary
for 10% Average Return to Schooling (t=40)**

Years of Education

		1	2	3	4	5	6
L e a r n i n g	1	0.26	0.28	0.31	0.33	0.36	0.38
	2	0.24	0.26	0.29	0.32	0.34	0.37
	3	0.22	0.24	0.27	0.30	0.32	0.35
	4	0.19	0.22	0.25	0.28	0.31	0.33
	5	0.17	0.20	0.23	0.26	0.29	0.31
	6	0.15	0.18	0.21	0.24	0.26	0.29
	7	0.12	0.15	0.18	0.21	0.24	0.27
	8	0.09	0.13	0.16	0.19	0.22	0.25
	9	0.06	0.10	0.13	0.16	0.19	0.23
	10	0.03	0.07	0.10	0.13	0.17	0.20

Figure 2

Figure 3) Expected Earnings in the Pure Signaling Model



The solid lines show average earnings profiles for high school and college graduates. The broken lines show expected earnings for workers with productivity of an average high school graduate if they choose to graduate from college. The figure is drawn under the assumptions that (i) schooling acts as a pure signal and has therefore no productivity augmenting effects, and (ii) employers do not observe any additional information about individual productivity.

Figure 3

