Signaling in the Labor Market

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The Signaling Model

The signaling model of education, usually attributed to Michael Spence (1973), is distinguished from the human capital theory of education by its premise that individual workers' innate productivity levels are identified by their years of schooling rather than enhanced by them. An implication of the model is that more-educated workers receive higher pay because education provides them with a credential, rather than because of acquired skills. Important variations on the signaling model include theories that have been developed by Arrow (1973), Layard and Psacharopoulos (1974), Riley (1975, 1979), Spence (1974, 1976), Stiglitz (1975), and Wolpin (1977). The terms signaling, screening, and sorting are often used interchangeably to describe variants of the same basic model.

Signaling theory is based on the following assumptions. (1) Individuals have different innate levels of productivity, which are not affected by their education. (2) Additional education incurs additional costs, which differ for high- and low-productivity workers. In particular, the psychic cost of schooling is higher for individuals with lower productivity levels. Those who learn easily can acquire the signal more cheaply than others. For example, they may need to spend less time studying. (3) There is asymmetric information with respect to workers' productivity: individual workers know their skill level, but potential employers do not. (4) Schooling levels can be observed without incurring a cost. As employers cannot observe potential workers' actual productivity, they instead use educational qualifications to predict productivity, make hiring decisions, and set wages, based on the assumption that individuals who have more years of education are more productive. In order for this assumption to be accurate, more productive workers must, in fact, choose more schooling. The model is based on the premise that individuals are rational and that they invest in education as long as the benefit of an additional year of schooling exceeds the cost. The benefit of an additional year of schooling is the same for high- and low-productivity workers, but the costs are higher for low-productivity workers. If the wage gain associated with education is sufficient for high-productivity workers to select into more schooling but not large enough for low-productivity workers to select more schooling, then education may sort differently skilled workers so that the employers' beliefs are ratified and equilibrium exists.

The signaling model hinges on the assumption that worker productivity is negatively related to the cost of acquiring the signal. As long as cost differences across workers result from differences in cognitive ability or tastes for learning, they may be indicative of differences in on-the-job productivity. However, if costs vary because of differences in family contributions toward tuition, etc. then individuals who face higher schooling costs may be no less productive than those who face lower schooling costs, and education will not allow employers to distinguish between high- and low-productivity workers.

An example to substantiate this is mentioned here which is based on Michael Spence (1973).

Suppose that there are two types of workers: more-productive workers have a productivity level equal to 2, and less-productive workers have a productivity level equal to 1. Suppose further that employers believe that job applicants with schooling levels equal to or greater than S^* will be type 2 workers and that those who have less than S^* years of education will be type 1. Firms pay workers according to their expected productivity level; so those with S^* or more years of schooling are paid a wage equal to 2, and those with less than S^* years of schooling are paid a wage equal to 1. Workers care about the (present discounted) value of lifetime earnings, which is $E1$ for those with less than S^* years of schooling and $E2$ for those with more than S^* years of schooling. The relationship between lifetime earnings and schooling is depicted in **Figure 1**.

Individuals will choose to invest in the level of education that maximizes their net benefits (total benefits minus total costs). For simplicity, assume that the only benefit that workers care about is their earnings. Then individuals will choose the level of education that produces the biggest difference between the (present) value of lifetime earnings and the cost of education. If education were costless then all workers would want to acquire the signal of S^*, but the signaling model hinges on the assumption that costs vary across individuals. Suppose as in **Figure 2**, that type 1 workers face a cost of C for each year of schooling but that type 2 workers, who find school easier, face a cost of $C/2$. It is easy to see that for type 1 workers the difference between lifetime earnings and C is maximized when they choose 0 years of education. On the other hand, for type 2 workers, the difference between lifetime earnings and $C/2$ is largest at S^*. Thus, type 1 and type 2 workers sort into different levels of schooling that

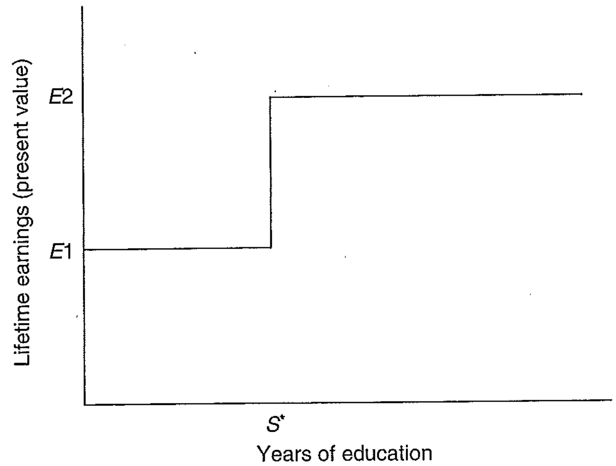

Figure 1 Lifetime benefits associated with education. Adapted from Spence, A. M. (1973). Job market signaling. *Quarterly Journal of Economics* **87**, 355–374.

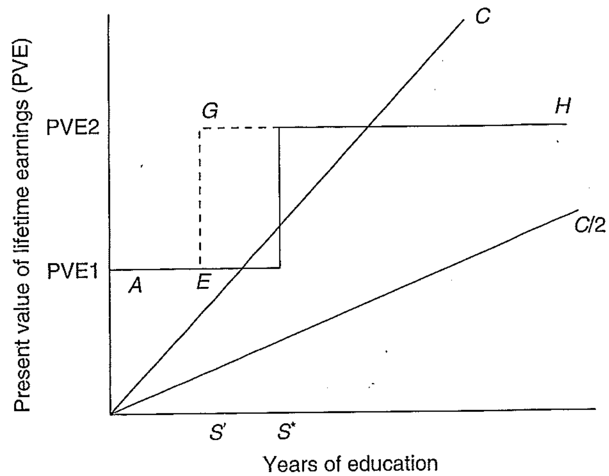

Figure 3 Benefits and costs associated with alternative signals. Adapted from Spence, A. M. (1973). Job market signaling. *Quarterly Journal of Economics* **87**, 355–374.

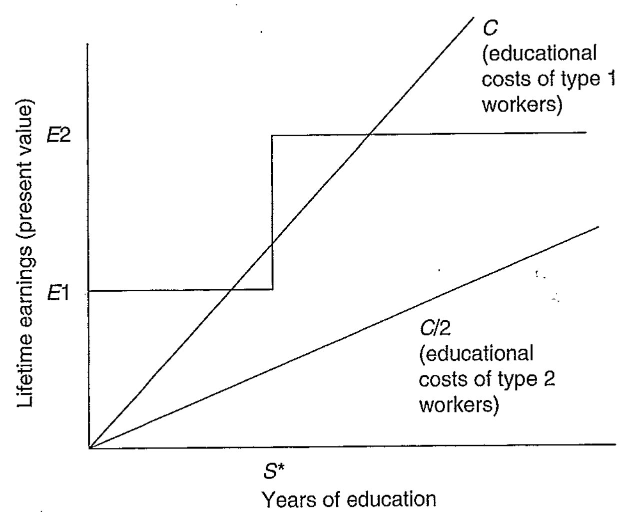

Figure 2 Lifetime benefits and costs associated with education. Adapted from Spence, A. M. (1973). Job market signaling. *Quarterly Journal of Economics* **87**, 355–374.

are consistent with the employers beliefs, and S^* works as a valid signal.

Note that not all years of education necessarily provide valid signals. For example, in **Figure 3**, employers use S' years of education instead of S^* to differentiate between high- and low-productivity workers. Therefore, the earnings structure is now depicted as the distance AEGH. Here, both type 1 and type 2 workers maximize the difference between lifetime earnings and the cost of education by choosing S'. Since all job applicants choose the same level of education, S' does not signal anything about workers' productivity.

As stressed by Weiss (1995), the human capital and signaling models of education are not necessarily mutually exclusive. Education may simultaneously enhance workers' productivity and act as a signal about their innate abilities. In such a case, signaling can be thought of as an extension of a human capital model in which some productivity differences that firms cannot observe are correlated with schooling costs.

Empirical Evidence

Empirically disentangling the relative importance of the human capital model and the signaling model has proven to be difficult. Both models predict that more-educated workers will earn higher wages, so the positive relationship that we observe between schooling and earnings does not provide useful information. There is no universally accepted method for separately identifying education's productivity-enhancing role from its signaling role.

One approach that has been used is to compare educational wage gaps for workers of different ages or years of work experience assuming that over time, it will become easier for employers to directly observe their employee's actual productivity (Cohn *et al.*, 1987; Layard and Psacharopoulos, 1974; Mendes de Oliveira *et al.*, 1989; Psacharopoulos, 1979; Rao and Datta, 1989; Wolpin, 1977). The idea is that if education is just a signaling device then it serves a useful function early in a worker's career, but as direct information on workers' actual productivity accumulates, the relationship between schooling and earnings should diminish. In fact, earnings differentials between more- and less-educated workers increase with age, which may be taken as evidence in favor of the human capital model. On the other hand, advocates of the signaling model argue that continued growth in earnings differentials occurs because the signal inherent in educational attainment is an accurate predictor of individuals' productivity.

Another set of studies compare earnings across industries or professions where signaling is likely to be important, to industries or professions where it is not. Cohn *et al.* (1987), De Wit and Van Winden (1989), Katz and Ziderman (1980), Riley (1979), and Wolpin (1977), for example, compare the education and earnings of self-employed and salaried workers, based on the assumption that signaling should be irrelevant to the self-employed. Since self-employed workers do not have to invest in educational signals for potential employers, they will invest in less schooling. These studies have produced mixed evidence on the relative importance of the two hypotheses.

A third set of studies focuses on sheepskin effects, or wage returns to particular credentials and/or diploma years. The argument is that the productivity-enhancing part of education should be proportional to the time spent in school; therefore, a wage return to the diploma itself, controlling for years of education, may be interpreted as evidence in favor of the signaling hypothesis. Groot and Oosterbeek (1994), Hartog (1983), Hungerford and Solon (1987), Jaeger and Page (1996), Layard and Psacharopoulos (1974), and Weiss (1983) have all estimated variants of sheepskin models. The studies by Hungerford and Solon, and Jaeger and Page both find that relative to a year of high school or college schooling, there are higher wage returns associated with high school and college graduation. However, both of these studies note that the existence of sheepskin effects is not necessarily a corroboration of the signaling model: it is impossible to tell whether the observed differences result from a signal about completers' versus noncompleters' abilities or whether those who actually complete their degree increase their productivity more than those who do not.

Tyler *et al.* (2000) address this issue when estimating the signaling value of the general equivalency diploma (GED) by comparing the earnings of individuals who had the same GED test scores but lived in states with different passing standards. Individuals with the same test score are assumed to have acquired equal amounts of human capital and to be equally productive. They find that whites who obtain a GED have earnings that are 10–19% higher than whites with the same test score who do not get the credential because they live in a state with a higher standard. This suggests that the GED has an important signaling effect on earnings. On the other hand, Cameron and Heckman (1993) and Heckman and LaFontaine (2006) find that the wages of those with a GED are no higher than the wages of high school dropouts, which suggests that the GED is not a substitute for high school.

Lang and Kropp (1986) test the signaling model by comparing enrolment rates of age groups that are bound by compulsory schooling laws to the enrolment rates of age groups that are not directly affected. The idea is that under the signaling model, a state compulsory school attendance law should increase the educational attainment of high-ability workers who are not directly affected by the law, because it lowers the average ability (and thus the wage) associated with the compulsory level of education. This gives high-ability individuals an incentive to get more schooling. Human capital theory predicts that such laws should only affect those individuals who are directly constrained. Lang and Kropp find that compulsory schooling laws do increase enrolment rates for age groups that are not directly affected, which supports the notion that education acts as a signaling device.

In a similar vein, Bedard (2001) compares high school dropout rates in labor markets with differential university access. The signaling model predicts that an environment in which more individuals are constrained from entering college will be characterized by higher high school graduation rates: when there are fewer barriers to college, then some previously constrained but relatively high-ability students will become university enrollees, and the average skill of high school graduates who do not go on to college will fall. There will be a commensurate decline in the wage associated with a high school diploma, which will reduce the incentive to obtain one. As a result, the least-able high school graduates will choose to drop out instead. Bedard finds evidence of such responses.

Kroch and Sjoblom (1994) suggest that if education acts as a signal, then within a cohort, the signal should be related to an individual's position in the distribution of education. They estimate models that include both absolute and relative years of education and find that while years of education are always positively associated with earnings, one's rank in the education distribution is not statistically significant. They interpret this as evidence that the value of schooling is not primarily due to signaling.

Weiss (1995) summarizes a number of additional studies that provide indirect evidence on the prevalence of signaling in education, including detailed discussions of Altonji's (1995) and Kang and Bishop's (1986) papers on the earnings effect of course work in school, and Card and Krueger's (1992) paper on the effects of school quality on wage returns to education. He concludes that labor economists have been unreasonably skeptical of signaling theory, given its ability to explain empirical regularities that are not explained by other models – such as why wage returns to education seem to be so much larger than the returns to courses taken in secondary school, and why the variance of wages increases with education.

In summary, empirical tests of the signaling model were most prevalent during the late 1970s and 1980s, but many of these tests were of questionable validity. Since the late 1980s, there have been fewer studies that have attempted to identify the role that signaling plays in the labor market, but the literature has laid more emphasis on finding external sources of identification. Recent studies that use plausibly random variation in degree receipt while controlling for observable measures of productivity (such as the study by Tyler *et al.*, 2000) find evidence in support of signaling for certain degrees (such as the GED). There are also labor-market relationships such as those discussed by Weiss (1995) that seem to provide indirect evidence in support of the signaling model. However, the number of studies that use convincing empirical strategies to test the signaling model is short, and the evidence to date is mixed.

Conclusion

More than 30 years have passed since the signaling model first gained attention; yet, much is still unknown about the relative importance of signaling versus human capital theories. Many of the implications of the two models are the same, thus it has proven hard to empirically distinguish between them. The results of existing research do not conclusively reject the signaling theory, and more recent work has produced evidence that signaling does play a role in the labor market. Nevertheless, the extent to which education acts as a sorting device in addition to (or instead of) augmenting productivity, is still unknown.

See also: Human Capital; Returns to Education in Developed Countries.

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