Signaling and Screening: Theory and Evidence
Ec 423. Labour Economics
Lent Term 2009

Papers:
Stigliz
Spence
Lang and Kropp

Spence, QJE 1973
"Job Market Signaling"
The big point:
If there is a heterogeneity of types and there exists a signal which has a cost that is negatively correlated with productivity then there exist an infinite number of equlibirium which produce perfect information.
Spence hopes to generate a model that "a considerable variety of market and quasi-market phenomena like admissions procedures, promotion in organizations, loans and consumer credit can be usefully viewed through."
This may generally be useful in cases where the incentive for truthfully revelation is low and thus observable characteristics become the basis of decisions.

The key assumptions: Signal cost must be negatively correlated with ability. This is a prerequisite for the an observable, alterable characteristic to be a persistently informative signal in the market.

The model works: There is an information feedback loop. As new market information comes into an employer (through either observation, hiring, etc.) they form beliefs on productive capabilities which are related to observable signals and adjust their beliefs accordingly

An equilibrium is when "a set of employer beliefs...generate offered wage schedules, applicant signaling decisions, hiring and ultimately new market data over time that are consistent with the initial beliefs."

To find an equilibrium: we guess a set of self-confirming beliefs and then check that they are indeed confirmed by the feedback loop.

The striking features of this are that
1. there are an infinite number of equilibrium for a given level of education that generates a maximum productivity that perfectly inform the employer.
2. The equilibria are not equivalent in terms of welfare
3. There are also equilibria that do not perfectly inform the employer.
4. The assumption of negative correlation between signal cost and productivity is necessary but not sufficient for signaling. We need a significant number of signals

Stigliz, AER 1975
"A Theory of Screening, Education, and the Distribution of Income"

The Big Points:
Education when used as a screening mechanism can actually lead to worse social conditions because if education provides information as well as skills, then it is working within a market that fails. Why does this happen?
1. Social returns to education differ from private returns. Thus, while screening has productivity returns, it will decrease equality. Thus for some regions there is a tradeoff between efficiency and distributional concerns.
2. There is also a region in which education expenditure may both increase inequality and decrease net national income. Overspending happens because the median voter does not pay the median share of education and thus has an incentive to overconsume—especially in publicly funded schools
3. Attempts to curtail education as screening may just shift screening and actually lead to worse conditions

Stigliz explicitly notes that these results are based on his highly stylized model and may not hold without these assumptions:
1. The more able are better in every relevant sense, so there is an unambiguous ranking of abilities
2. Labor is inelastically supplied
3. Individuals have perfect information
4. There is not method of on-the-job screening
5. The screening is accurate
6. The information acquired is "general", i.e. not firm specific

The Model:
We have a population with individuals with ability level θ , where the probability of being of type θ is $h(\theta)$. Productivity p is defined as L
$p=m\theta$ where m is set to unity WLOG

Then make the following assumptions:
1. ability is private information
2. absent information, all firms (which are risk neutral) treat individuals the same.
3. Productivity of a single employee cannot bet determined

Then consider the simplifications with two types 1 (high ability) and 2 (low ability)
Where there is an accurate screening mechanism which costs c/individual and labor supply is inelastic. Parameterize c as follows:
1. $\theta_1 - \theta_2 > c > \theta_1 - \theta_{avg}$
2. $\theta_{avg} = E(\theta_{avg})$

Then we get 2 equilibrium:
1. Pooling:
    Contact—Everyone gets θ_{avg}
    High ability types have no incentive to screen because by 1 they make more than if they screened because they would only get $\theta - c < \theta_{avg}$

2. Separating:

Contract—If you screen you get θ_1 -c

If you do not screen you get θ_2

Important aspects of these results:
1. there may be multiple equilibria
2. The equilibria can be pareto ranked
3. In both equilibria the presence of the lower type decreases the wage of the higher type while the presence of the high type gives the low type at least their marginal product and maybe more
4. Social returns to screening mechanisms (e.g. education) differ from private returns. Which causes a divergence between pareto optimality and equality.

The separating equilibrium may not exist in the following cases:
1. If there are self-employment opportunities that can realize the same returns that would have been realized by accurate screening without the screening
2. If individuals are perfectly certain of their abilities and can demonstrate them on the job
3. If individuals are very risk averse and not perfectly certain of their abilities

The Social benefits from Screening:
1. If screening costs are low and labor supply is elastic then everyone can be made better off from screening by using an appropriate redistributive tax to compensate the worse off.
2. If there are returns to group homogeneity, then matching with screening may produce better allocation of labor

Empirical Evidence on Signaling/Screening

Does the signaling model share any implications with the Human Capital model?
1. People who attend additional years of schooling are more productive. YES.
2. People who attend additional years of schooling receive higher wages. YES.
3. The rate of return to schooling should be roughly equal to the rate of interest. NO PREDICTION.
4. People will attend school while they are young, i.e., before they enter the workforce. YES.

How do you empirically distinguish the human capital and signaling models?
1. Measure whether more educated people are more productive? (Would be true for either model.)
2. Measure people's productivity before and after they receive education — see if it improves. (Conceptually okay, very difficult to do.)
3. Test whether higher ability people go to school? (Could be true in either case—certainly true in the signaling case.)

4. Find people of identical ability and randomly assign some of them to go to college. Check if the college educated ones earn more? (Both models say they would.)
5. Find people of identical ability and randomly assign them a diploma. See if the ones with the diploma earn more. (A pure test of signaling.)

Because their empirical implications appear so similar, many economists had begun to conclude that these models could not be empirically distinguished. The empirical papers on the syllabus by Lang and Kropp (1986) and Bedard (2001) offer some evidence. Weiss
(1995) provides a survey.

All of the empirical papers implement closely related indirect tests of the signaling model along the following lines. If we are initially at a separating equilibrium, how does an exogenous decline in the cost of schooling for one group affect the education choices of other worker groups who are not directly affected by the price change?

Lang and Kropp look at college going as a function of school leaving laws (which primarily directly affect secondary school attendance). The General Idea: Compulsory schooling should have different effects on educational attendance depending on whether education is a tool for human capital accumulation or if it is a form of signaling.

The two potential effects:
In a signaling model if the lowest ability increase their educational attainment so will some higher abilities since they must do this to differentiate themselves from the lowest type. If CAL imposes a certain signal for the lowest type, then the signaling hypothesis suggests some individuals not bound by the law will still increase their educational attainment.

In the human capital model, a change in the CAL will not change the return to education (by using the factor price equalization assumption). Therefore, workers for whom the return to schooling sufficiently low as to choose dropping out will be bound to stay in school if they are affected by the law. However, individuals who are not bound by the law should be unaffected.

The Results:
To test this, they use a SUR with time and state fixed effects for two age groups, 16 year olds (affected by the law) and 17-18 year olds (unaffected by the law). The educational attainment of non-affected groups (i.e. the 17-18 year olds for whom the law was non-binding) increased and thus Lang and Kropp conclude that this is consistent with the signaling hypothesis.

Some Problems:
Factor price equalization: It is not clear that that this is operable

1. wages are the same across states for the same education-ability pair
2. the return to education is the same in each state

3. If there is correlation between ability and mobility the theorem will fall apart

There may be some of both going on: There may be some value to the signal but there are also productivity gains. More broadly, this test is pretty weak because they are testing second order predictions of the signaling model without testing if there is an actual value for a "signal" which is the first order prediction of the model. The issue is we need a signal which has no impact on human
capital production and is as if randomly assigned to otherwise identical expected productivity. A clever paper by Tyler, Murnane, and Willet (TWM) does just that.

TMW are interested in knowing whether the General Educational Development (GED certificate
(GED) raises the subsequent earnings of recipients. This is not just interesting for the signaling model but also for public policy—there is pretty big differences in high school completion rates between states, income and race/ethnicity groups (see table 1 of the paper)

Of course we cannot simply compare GED holders to High School grads because of the obvious self-selection problems: GED holders probably would have earned less than HS Diploma holders regardless. But they are also not really comparable to other high school drop outs. We can see this in the summary statistics provided by TMW where relative to other dropouts, GED holders have more years of schooling and socioeconomic/demographic characteristics associated with higher incomes.

TMW use the variation in GED passing standards by U.S. states to generate random variation. Some test takers who would receive a GED in Texas with a passing score of 40 − 44 would not receive a GED in New York, Florida, Oregon or Connecticut with the identical scores. If GED score is a good measure of a person's ability/productivity, then people with same 'ability' (40 − 44) are assigned a GED in Texas but not in New York. The use 3 of the 7 possible different standards in the US.

(1) a minimum score of at least 40 or a mean score of at least 45
(2) a minimum score of at least 35 and a mean score of at least 45
(3) a minimum score of at least 40 and a mean score of at least 45

Using these groups they can define 3 distinct, treatment control group? (as you read this think: who is the marginal candidate in each of these groups? This is where the identification is coming from).
In the language of the paper
"Experiment 4" variation in GED status by state is in group

- the treatment states are those states that award a GED in score groups 4 and higher
- the comparison states are those that award a GED in score groups 5 and higher

"Experiment 3" variation in GED status by state is in group 3

- the treatment states are those states that award a GED in score groups 3 and higher
- the comparison states are those that award a GED in score groups 5 and higher

“Experiment 3*” variation in GED status by state is in group 3

- the treatment states are those states that award a GED in score groups 3 and higher
- the comparison states are those that award a GED in score groups 4 and higher.

The identifying assumption in this quasi-experiment is that the state of taking the test is effectively randomly and thus randomly assigns the GED ‘signal’ to people with the same GED scores across different U.S. states. We’ll return to this assumption shortly. We also must assume that firms cannot observe worker ability independent of the GED. Given the quasi-experimental setup, the signaling model predicts that workers with GED scores of 40 − 44 will earn more if they receive the GED certificate than if they do not. The Human Capital model implies that since ability is comparable among these groups, wages will also be comparable.

Using a difference in difference-estimate they find some signal value (though the magnitude is somewhat sensitive to the definition of the control and treatment group).

Part of what makes this such an excellent paper is that TMW now take the next step of considering what might make their identifying assumption invalid. The answer is that different passing standards influence individual behavior in systematic ways. They separate this into different responses:
(1) the decision to attempt the test. They can’t test this and it would likely upward bias the estimates
(2) the decision to migrate to another state: They can test the effect on migration. They should observe individuals who would have been in high standard states migrating but there is not much empirical evidence of this
(3) the decision about how much effort to exert on the test: There may be clumping in the values around the standard—thus we don’t observe a true distribution of abilities since workers *know* that the employers can’t observe their true ability. In this case, our GED level is not a good control for underlying human capital. They model this and find their results are robust.

Separately they also note that the results for minorities differed dramatically from those of whites. There’s a couple of reasons for this: First, many minority men take GED while incarcerated. The stigma of incarceration may depress the post-prison earnings of dropouts, and eliminate any positive signaling value of the GED credential. Additionally, if ,any dropouts who obtained a GED while incarcerated may have zero earnings five years later because they are still in prison. Second, there is likely heterogeneity in why individuals decide to get a GED. Consider two groups
Group 1: value on the credential or they perceive that employers place a value on the credential.
Group 2: ‘‘quasi-compulsory’’ in a social program from which they are seeking benefits.
In this situation, the GED may be a signal of productive attributes for group 1 and a signal of ‘‘government program participation’’ for group 2. Employers discount the value of the ‘‘incidental’’ GED (group 2) . If the distributions of groups 1 and 2 differ by race

and employers statistically discriminate blacks will tend to experience lower returns than whites. #

General Conclusions

To the disappointment of some, signaling models have not dramatically changed the way most economists view education. In fact, economic interest in the efficiency of educational production has burgeoned in the last decade — which would not be true if economists generally believed that schooling is about testing how long students can tolerate sitting in a chair. Nevertheless, it's reasonably clear that signals do carry value in some markets, and that this could possibly give rise to distortions like those envisioned by Spence. It's unclear whether those distortions are economically significant.

The link between human capital, signaling, and wages opens up three important questions

(1) Can employers "learn" about workers continuously (that is why is education the signal?)
(2) If the signal is different for different groups, what happens (is this "discrimination")?
(3) If there is sorting across different types of occupations/sectors, what is the "signal" for each sector (example: illegal markets)