

Job Market Signaling

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Some intuitive questions

- Why is it so important **where you graduated from** as an undergraduate when applying to postgraduate schools?
- Why do investment banks, prestigious accountancy firms and law firms have so-called **target school lists** when hiring?
- Have you ever seen "**985, 211 or 双一流 preferred**" on a recruitment poster?
- What is “**选调**” in the Civil Service Recruitment Examination?

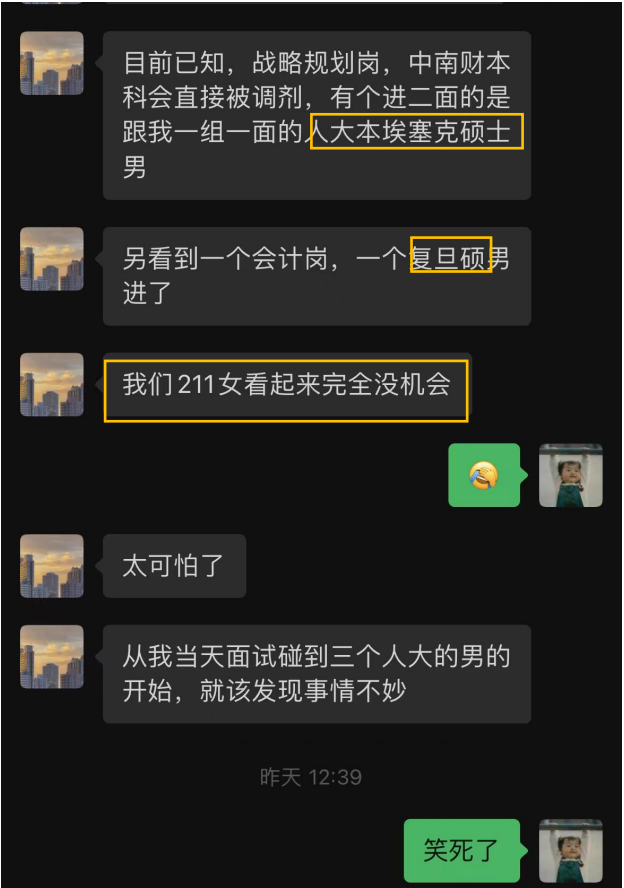
Signaling Signaling and Signaling!

Some intuitive questions

券商投行或研究所的target school list是指特定的学校还是按世界排名？世界排名前50？

匿名用户

某国内排名15左右的公募基金，公司投研今年不招人，招人标准国内本硕必须都是清北复交，国外牛剑这一档。我只了解公募基金的情况，一般公募基金的标准会比同等级的券商要求高很多。我们公司中后台很多交大高金、复旦经院、上财金融的同事。在基金这一块，除非碰到大牛市，一般来说本硕都是海外qs前50可能都进不了中型大型的投研部门。



腾讯战略发展部实习生 - 社交&短视频方向 - 深圳/北京

【地点】

base深圳总部或北京总部，尽快入职

【岗位职责】

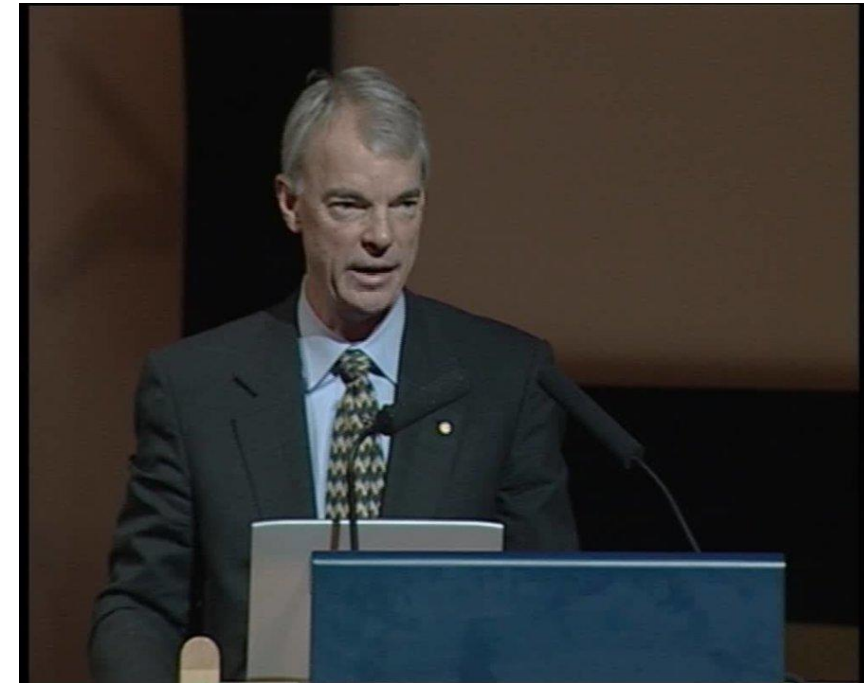
- 1、分析社交&短视频领域互联网产品的产品思路、商业模式
- 2、监测行业数据、竞品动态，对重点公司/业务情况深入分析
- 3、协助进行用户研究（包括焦点小组、问卷调查等），撰写洞察报告

【岗位要求】

- 1、对商业分析兴趣浓厚，有互联网或咨询公司实习经历优先
- 2、快速学习能力强，充满好奇心，对互联网行业充满热情
- 3、沟通及人际交往能力突出，熟练使用英文
- 4、熟练掌握 EXCEL、PPT等分析工具
- 5、985重点院校，硕士研究生优先

Introduction to the author

- Andrew Michael Spence (born Nov.7,1943) is a Canadian-American economist.
- Spence is the William R. Berkley Professor in Economics and Business at the Stern School of Business at New York University, and the Philip H. Knight Professor of Management, Emeritus, and Dean, Emeritus, at the Stanford Graduate School of Business.
- Together with George A. Akerlof and Joseph E. Stiglitz, Spence is a co-recipient of the 2001 Nobel Memorial Prize in Economic Sciences, *"for their analyses of markets with asymmetric information."*
- Spence is noted for his **job-market signaling model, which inspired research into this branch of contract theory.**



Hiring process and applicant signaling

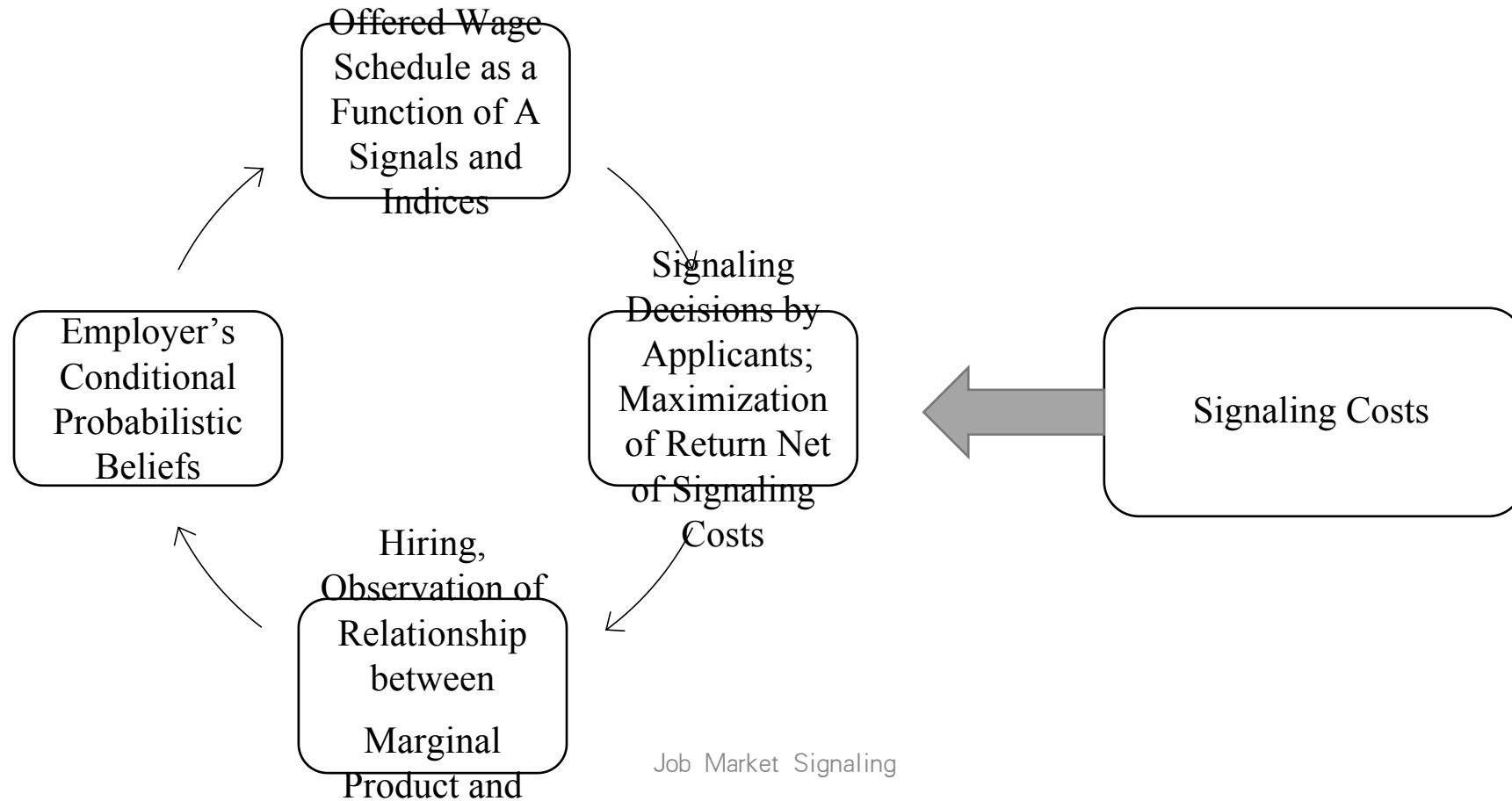
- Hiring is like investing or even buying a lottery, it is full of risks.
- As an employee, when submitting a CV for a job, there are a limited number of characteristics that an individual can be observed for: sex, age, race, whether or not they have committed a crime, education...
- Distinctive definition
 - ✓ Indices: attributes that can **not** be changed (born with)
 - ✓ *Signals*: attributes that can be changed (you can make efforts to change)
- From one point of view, then, signals and indices are to be regarded as parameters in shifting conditional probability distributions that define an employer's beliefs or perceptions.

Hiring process and applicant signaling

- Some critical assumptions
 - ✓ The employers are risk-neutral.
 - For each set of signals and indices that the employer confronts, he will have an expected marginal product for an individual who has these observable attributes.
 - Potential employees therefore confront an offered wage schedule whose arguments are signals and indices.
 - ✓ Individuals are assumed to select so as to maximize the difference between offered wages and signaling costs, **but not on purpose(rational person)**.
 - ✓ Signaling costs are negatively correlated with productivity.
 - ✓ Signaling costs are to be interpreted broadly to include psychic and other costs, as well as the direct monetary ones.

Hiring process and applicant signaling

- Information feedback and equilibrium
 - ✓ There is informational feedback to the employer over time.
 - ✓ The game: As new market information comes in to the employer through hiring and subsequent observation of productive capabilities as they relate to signals, the employer's conditional probabilistic beliefs are adjusted, and a new round starts.

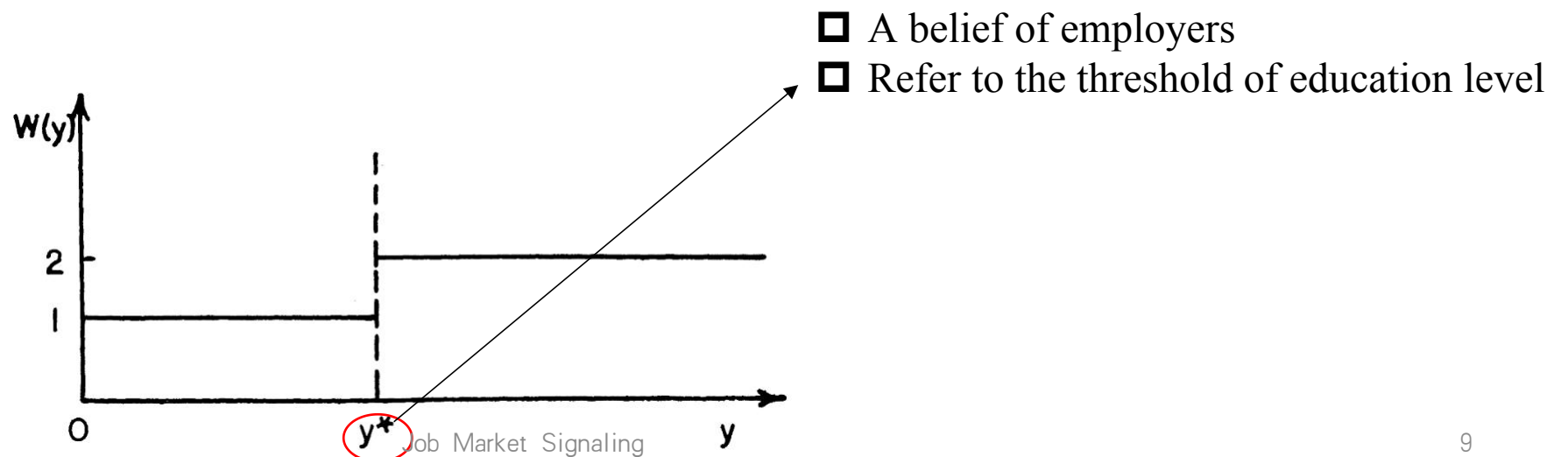


Hiring process and applicant signaling

- Information feedback and equilibrium
- ✓ The underlying data of numerical example

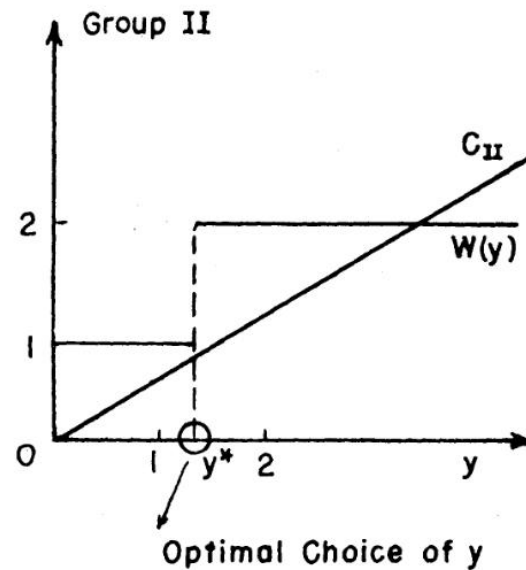
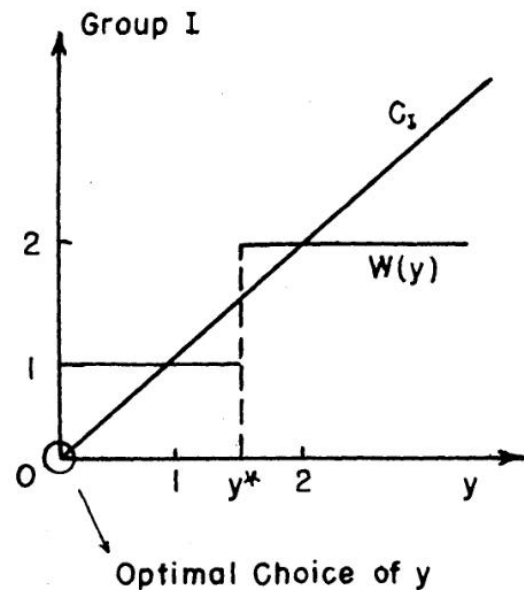
Group	Marginal Product	Proportion of population	Cost of education level
①	1	q_1	y
②	2	$1-q_1$	$y/2$

- ✓ Offered Wages as a Function of Level of Education



Hiring process and applicant signaling

- Information feedback and equilibrium (continuing)
- ✓ Optimizing Choice of Education for Both Groups

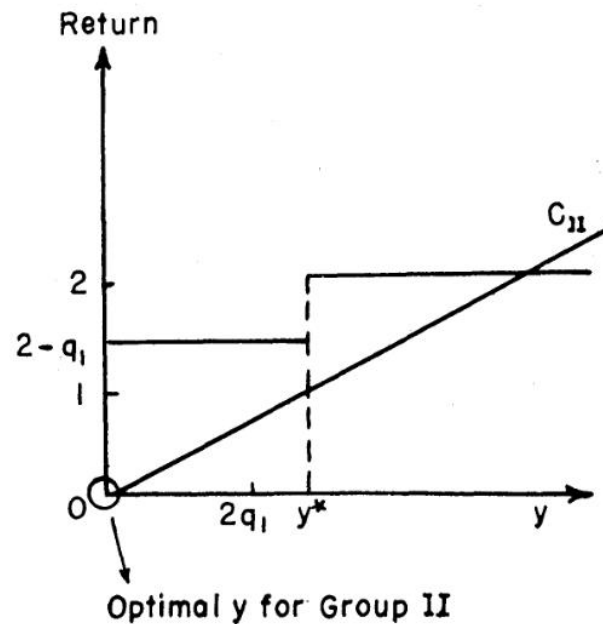
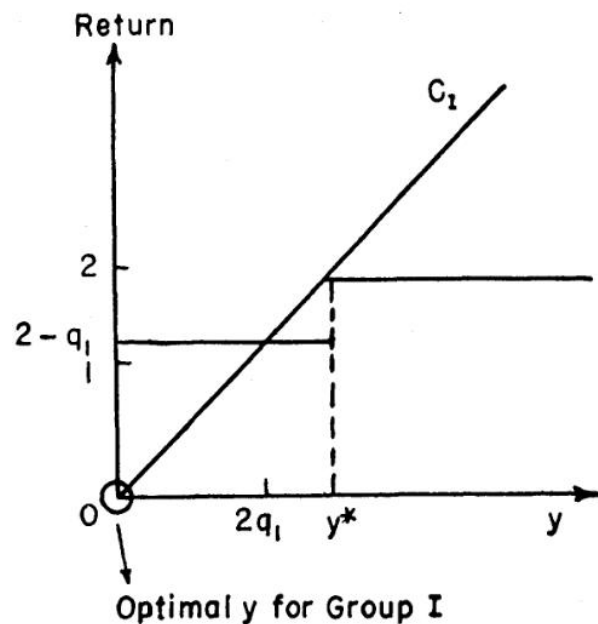


- If $y < y^*$, $y=0$; $y > y^*$, $y= y^*$
- Condition of group1 choose $y=0: 1 > 2 - y^*$
- Condition of group2 choose $y= y^*: 2 - y^*/2 > 1$
- Equilibrium: $1 < y^* < 2$

- ✓ There is an infinite number of equilibria.
- ✓ The equilibria are not equivalent from the point of view of welfare.
- ✓ With signal: Increases in the level of y^* hurt Group 2 while Group 1 is unaffected.

Hiring process and applicant signaling

- Information feedback and equilibrium (continuing)
- ✓ Optimal Signaling Decisions for the Two Groups



✓ If no signal:

□ $q_1 + 2(1 - q_1) = 2 - q_1$

□ Let q_1 be 0.5, the average payoff is 1.5

- ✓ Both Group 1 & 2 may be worse off with signaling than it was without signaling.
- ✓ Everyone would prefer a situation in which there is no signaling.

Hiring process and applicant signaling

- Welfare analysis
 - ✓ Looked at from the outside, education might appear to be productive. It is productive for the individual, but, in this example, it does not increase one's real marginal product at all.
 - ✓ Really?
 - ❑ Private and social returns differ and the social return is not zero.
 - ❑ We have an information problem and misallocation in the society, education as a signal can be a solution(helping us to allocate the right people to the right jobs properly)。
 - ❑ When we talk about the effectiveness of education as a signaling, ***other*** market matching systems must be considered.
 - ❑ There are **Pareto inferior** signaling equilibria in the market when other matching systems fail.

Hiring process and applicant signaling

- Welfare analysis

✓ Signaling always make people's welfare worse? No.

□ Proportion of population of each group matters, that is, the value of q_1 makes a difference.

✓ Consider the example above, we can find an equilibrium making the return of group 2 with signaling better than without it: $y^*/2 > 2 - q_1$, that is, $q_1 > y^*/2$, at least, q_1 must be greater than the minimum of $y^*/2$, $q_1 > 1/2$.

✓ It suggests when Group 2 is a **minority**, then there exists a signaling equilibrium in which the members of Group 2 improve their position over the no-signaling case.

Group	Marginal Product	Proportion of population	Cost of education level
①	1	q_1	y
②	2	$1 - q_1$	$y/2$

Hiring process and applicant signaling

- Welfare analysis

- ✓ Consider a more general case, If signaling cost of group1 and group2 are $a_1 y$ and $a_2 y$, respectively ($a_2 < a_1$)

- 1- $a_1 y^*$ and 2- $a_2 y^* > 1$, so that $\frac{1}{a_1} < y^* < \frac{1}{a_2}$

- Now, if Group 2 is to be better off for some signaling equilibrium, then 2- $q_1 < a_2 y^* < \frac{a_2}{a_1}, q_1 > \frac{a_2}{a_1}$

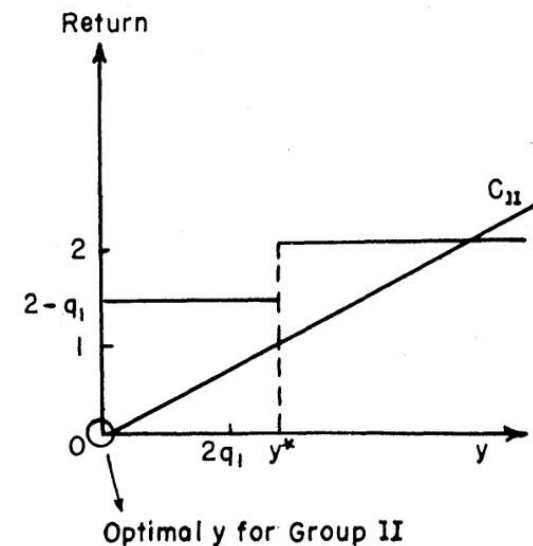
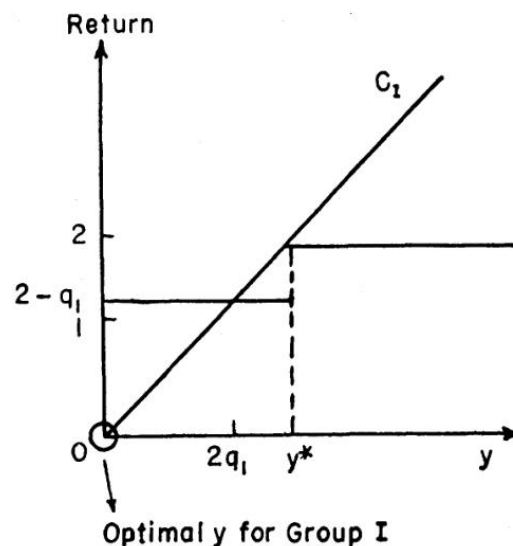
- ✓ $\frac{a_2}{a_1}$ *How small* a "minority" Group 2 has to be to have the possibility of benefiting from signaling **depends upon the ratio of the marginal signaling costs of the two groups.**

- ✓ Interestingly, if a_2 is small enough, the second group is no longer a "minority".

Hiring process and applicant signaling

- Other equilibria under employers' beliefs
- ✓ Suppose that the employer's expectations are of the following form

Condition	Group	<i>Probability</i> of applicants within the group
$y < y^*$	①	q_1
	②	$1 - q_1$
Condition	Group	<i>Probability</i> of applicants within the group
$y \geq y^*$	①	0
	②	1



- ✓ As long as $y^* > 2q_1$, group 1 & 2 will choose $y=0$. If they both do this, then the employer's beliefs are confirmed, and we have an equilibrium.
- ✓ In fact, we have reproduced the wages and information state of the employer in the *no-signaling model*, as a signaling equilibrium.

Hiring process and applicant signaling

- Other equilibria under employers' beliefs(continuing)
- ✓ Suppose that the employer's expectations are of the following form

Condition	Group	<i>Probability</i> of applicants within the group	Condition	Group	<i>Probability</i> of applicants within the group
$y < y^*$	①	1	$y \geq y^*$	①	q_1
	②	0		②	$1 - q_1$

- ✓ As long as $y^* < 1 - q_1$, group 1&2 will choose $y = y^*$. If they both do this, then the employer's beliefs are confirmed, and we have an equilibrium.
- ✓ If they as individuals did not invest, they would incur lower wages, and the loss would exceed the gain from not making the educational investment.
- ✓ Again, the education level **conveys no useful information, but in this instance individuals are rationally investing in education.**
- ✓ The implication of this version of the signaling equilibrium is that there can **be stable prerequisites for jobs** that convey no information by virtue of their existence and hence serve no function.

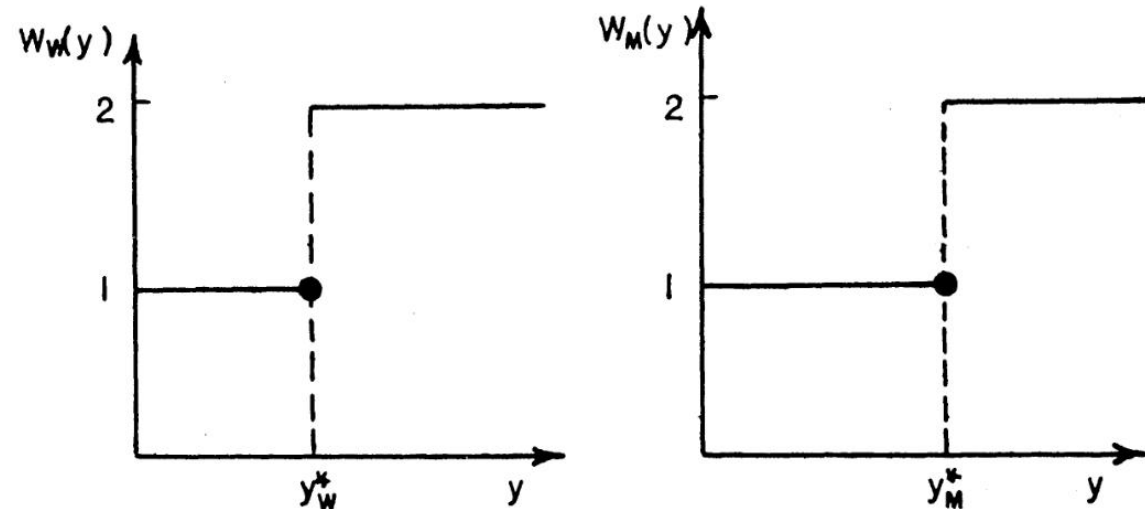
Informational impacts of indices

- Take sex as the example.
- ✓ Just as education can stand for any set of observable, alterable characteristics in the first model, sex can stand for observable, unalterable ones here.
- Assume that there are two groups, men and women.
- Sex and productivity are uncorrelated in the population.
- The opportunity sets of men and women of comparable productivity are not necessarily the same. Actually, sex is just **like a kind of signal now**.

Sex	Productivity	Education costs	Proportion within group	Proportion of total population
W	1	y	q_1	$q_1(1-m)$
W	2	$y/2$	$1-q_1$	$1-q_1(1-m)$
M	1	y	q_1	q_1m
M	2	$y/2$	$1-q_1$	$(1-q_1)m$

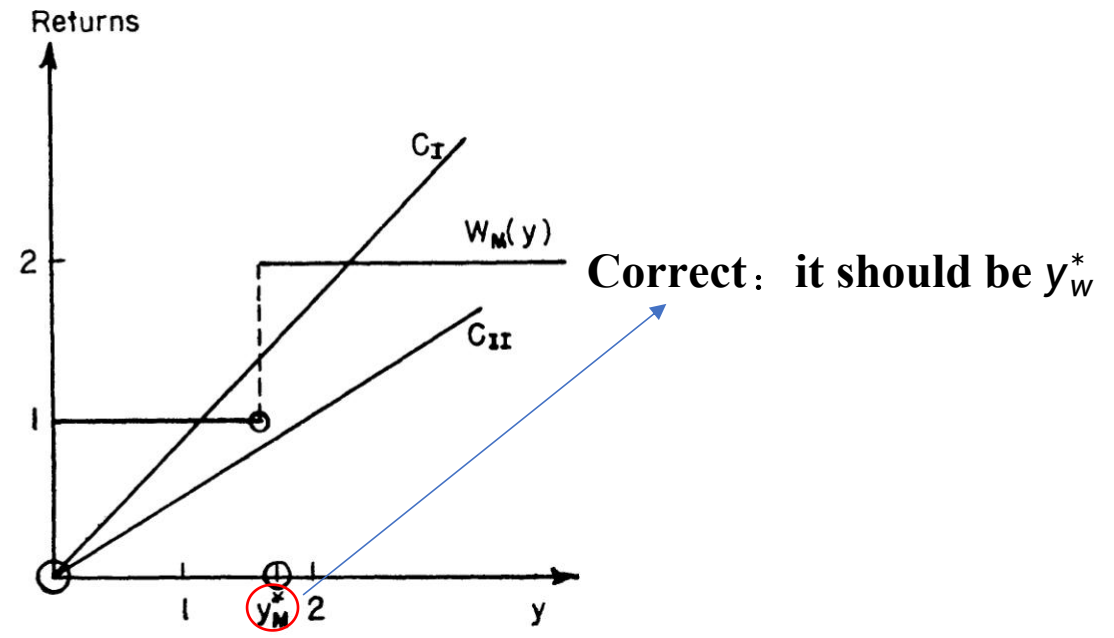
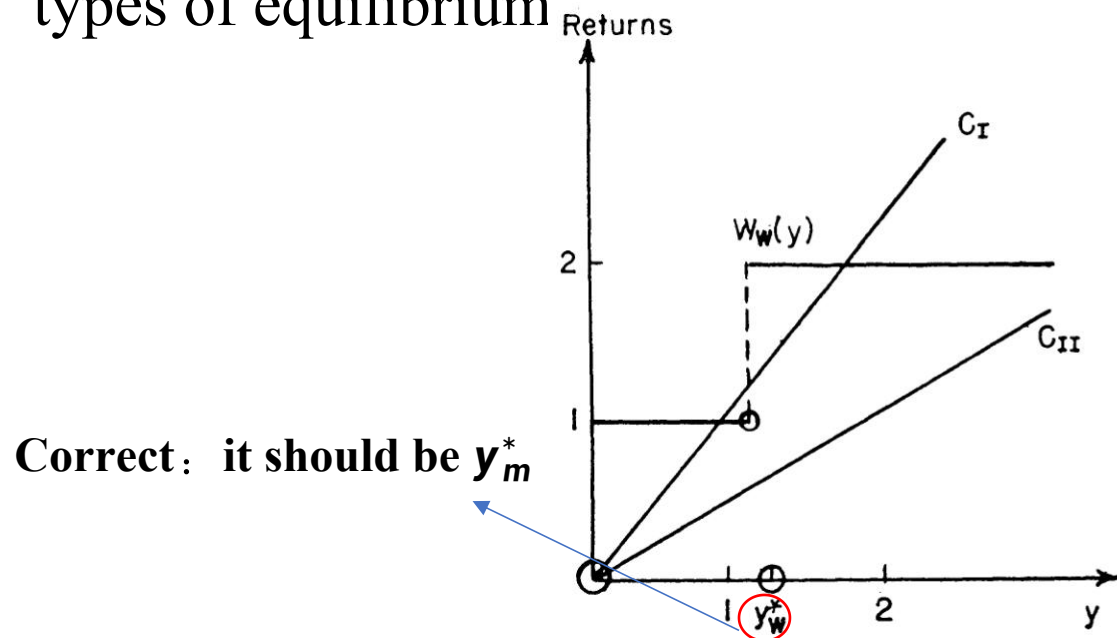
Informational impacts of indices

- Because groups W and M are distinguishable(**separate equilibrium**).
- According to the model before, $1 < y_w^* < 2$, $1 < y_m^* < 2$,
- There is at least the logical possibility that men and women will settle into different stable signaling equilibria in the market and stay there.



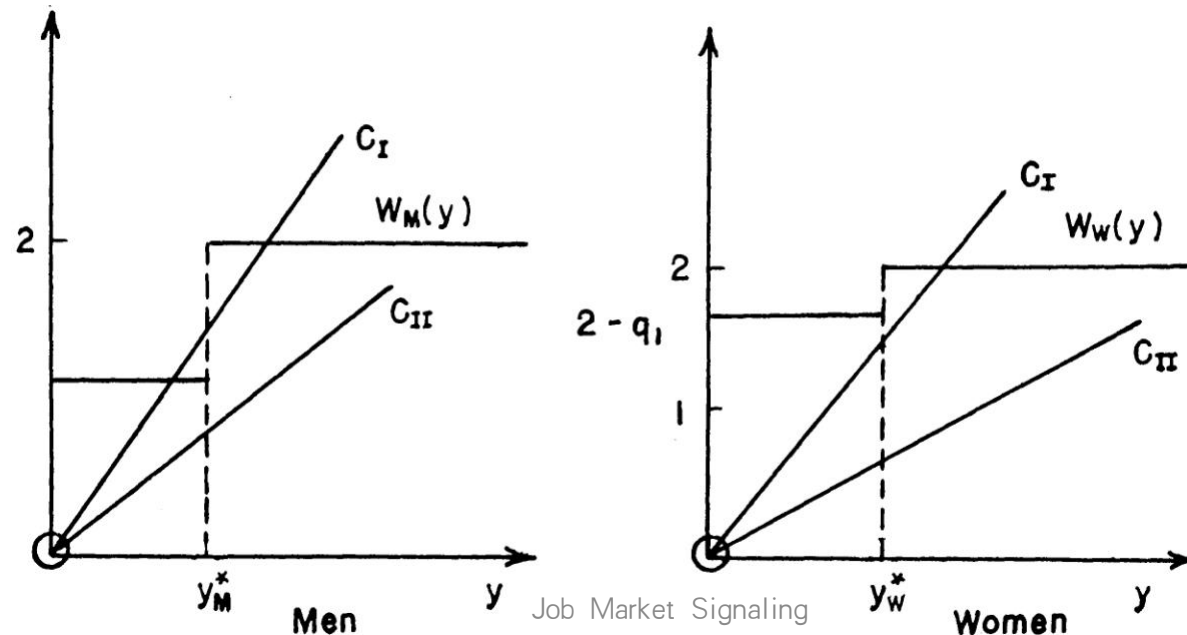
Informational impacts of indices

- The signaling equilibria are not equivalent from the point of view of social welfare.
- The higher that y_w^* (or y_m^*) is, the worse off is the high-productivity portion of the group.
- The proportions of high- and low-productivity people in each group do not affect the signaling equilibrium in the market.
- E.g.: $y_m^* = 1.1$, $y_w^* = 1.9$, what will happen? Men and women might settle into different types of equilibrium



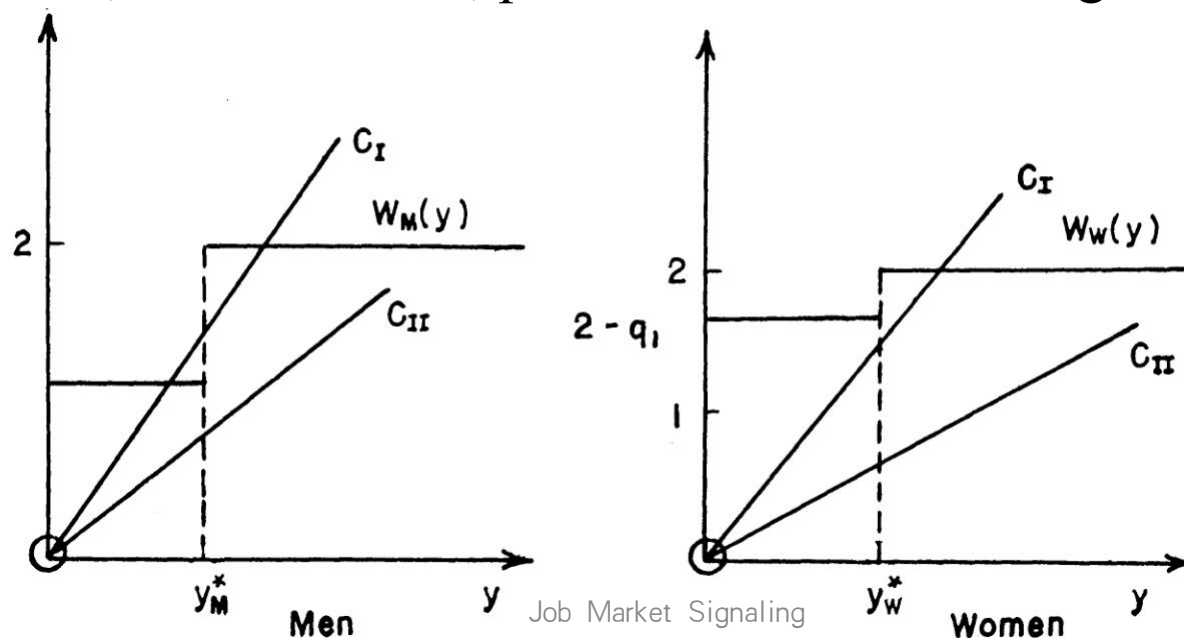
Informational impacts of indices

- All women, including lower productivity women, would be paid more than low productivity men in this situation. High-productivity women would be hurt in terms of wages received.
- Stereotype: women receive lower wages than some men because of a lack of education, which keeps their productivity down. (wrong)
- The source of the signaling and wage differentials is in the informational structure of the market itself.



Informational impacts of indices

- How can it be possible?(man will invest education while women not)
- ✓ If the value of y_m^* is small (like the example before, 1.1), so that
 - Men signal $y_m^* = 1.1$ if they are also in the higher productivity group, while other men set $y=0$.
 - As for women, if $2 - y_w^*/2 < 2 - q_1$, that is, $y_w^* > 2q_1$, all of them will not have signaling because of the higher cost and less net return.
 - The situation of the disadvantaged group as a lower level equilibrium trap, which conveys the notion of a situation that, once achieved, persists for reasons endogenous to the model.



Conclusion, discussion and extension

- This paper uses the relationship between employers and job seekers in the job market as an example to illustrate a widespread information asymmetry in reality:
 - ✓ Only the job seekers themselves know their true capability.
 - ✓ While employers cannot directly distinct them and can only infer their abilities from the characteristics(e.g., education level, sex).
 - ✓ The "**signal**" for job seekers to inform employers of their abilities: for example, if the cost of education is negatively correlated with ability, then under the right conditions, more capable job seekers are willing to receive a higher level of education to distinguish themselves from weaker job seekers; although weaker job seekers can also imitate, but the high cost of education will prevent them from doing so.
 - ✓ Ultimately, the employer can correctly infer the ability of the applicant based on his or her education level and set the correct wage schedule.
- The use of this signal is particularly important in those sectors of the economy where the productivity of employees is difficult to measure, and where wages and educational attainment are closely related from the very beginning of a candidate's employment.

Conclusion, discussion and extension

- What is the effect of cooperative behavior on the signaling game?
- What is the informational impact of randomness in signaling costs?
- What is the effect of signaling costs that differ systematically with indices?
- In a multiple-market setting, does the indeterminateness of the equilibrium remain?
- What kinds of discriminatory mechanisms are implicit in, or interact with, the informational structure of the market, and what policies are effective or ineffective in dealing with them?

Thanks for your attention !