Arithmetics of Research Specialization

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Q: Does it make sense?

A: Maybe.

Setting

- Two fields, 1 and 2.
- A population measure 1 of *candidates*.
  - for each field, candidate can be *good* and *not good*.
  - $P[\text{good at } i] = P[\text{good at } i | \text{good at } j] = \lambda$.
- Each candidate gets 2 ideas in each field
  - $P[\text{good idea in } i | \text{good at } i] = p$.
  - $P[\text{good idea in } i | \text{not good at } i] = \alpha p$.

$$\Big(\underbrace{0}_{\text{good at 1}}, \overbrace{0}^{\text{good at 2}}, \underbrace{1, 0}_{\text{1 good idea in topic 1}}, \overbrace{0, 1}^{\text{1 good idea in topic 2}} \Big)$$

- Candidates choose two ideas to work on: this is their CV.

Hiring

Universities

- See candidates, make a decision based upon their *focusing*
  - There's probably other stuff like the alma mater, the advisor, recommendations, etc; we assume *ceteris paribus*
- Their decision should be consistent with candidates' optimal choice.
- They make decisions based on $P[\text{good at something}|\text{focus}]$

Candidates

- They like working on good ideas
- If indifferent, they'll do whatever gets them more money

Equilibrium

- If universities think that focus is NOT useful as a signal, they would not pay more money for focus in equilibrium.
- If universities think that focus is a good signal, they would pay more money for focus in equilibrium [or more likely to hire; or getting less teaching; etc].
- there is a chance that focus is a *bad* signal, but we're not gonna go there.

So questions:

- If there is no premium for focus, who focuses?
- If there is a premium for focus, who focuses?

$$P[\text{good}|\text{focus}] \gtrless P[\text{good}|\text{no focus}]$$

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Answer: wrong people focus!

What are universities looking for?

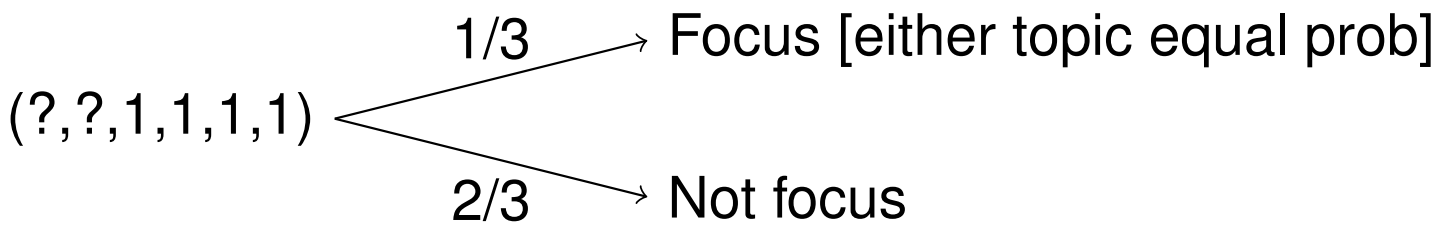
Two approaches:

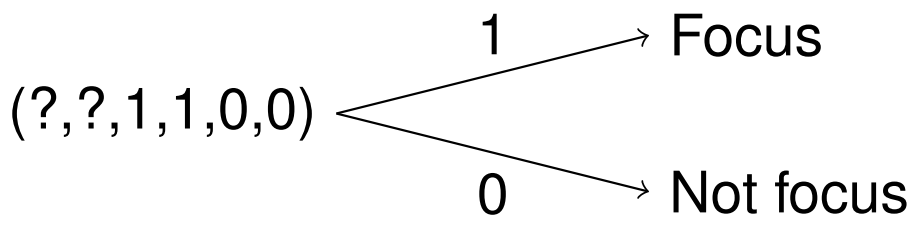
- Find candidates who are good at *something*.
- Find candidates who are good at topic 1.

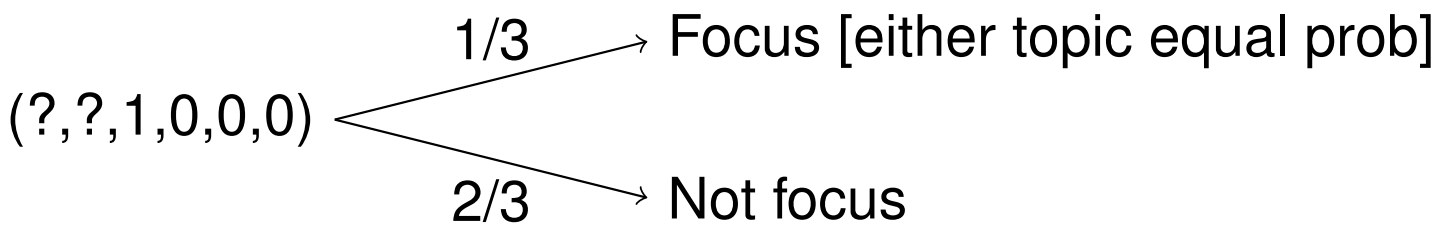
For each of these two, we ask for which (p, α, λ) having (or not) the premium is consistent with candidates' behaviour.

Candidates' Decisionmaking

If there is no premium for focus, ideas gets chosen at random, among good ones if possible.

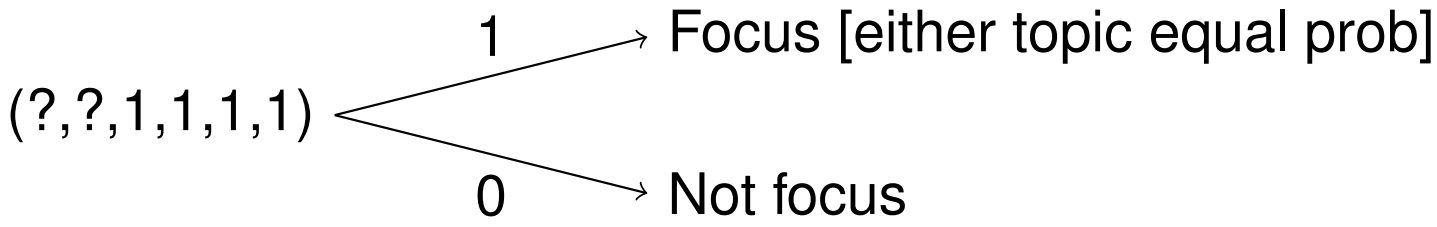


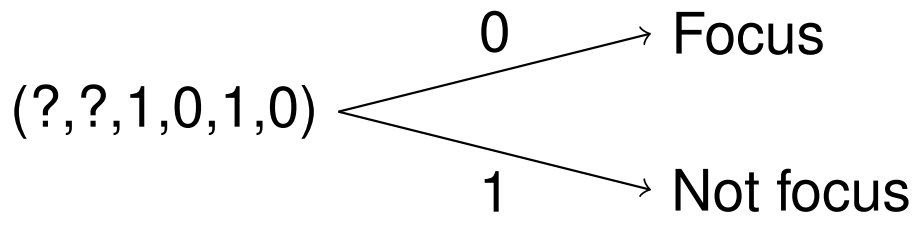


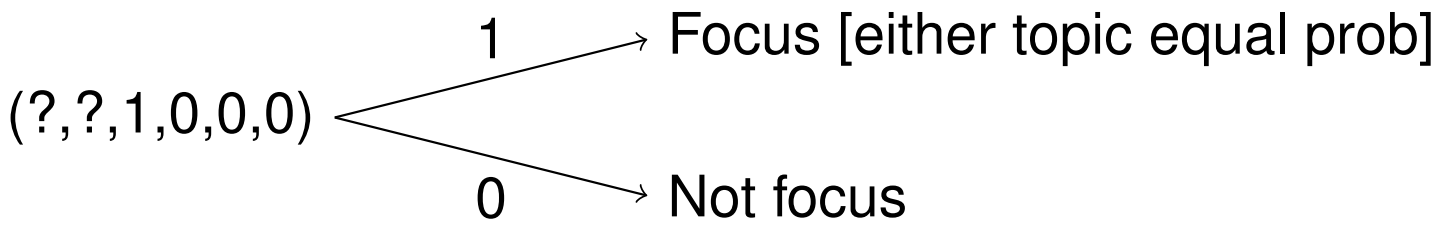


Candidates' Decisionmaking

If there *is* a premium for focus, ideas gets chosen among good ones if possible, focusing if able.







Results

If universities want to hire those who are more likely to be good at *something*:

Result 1

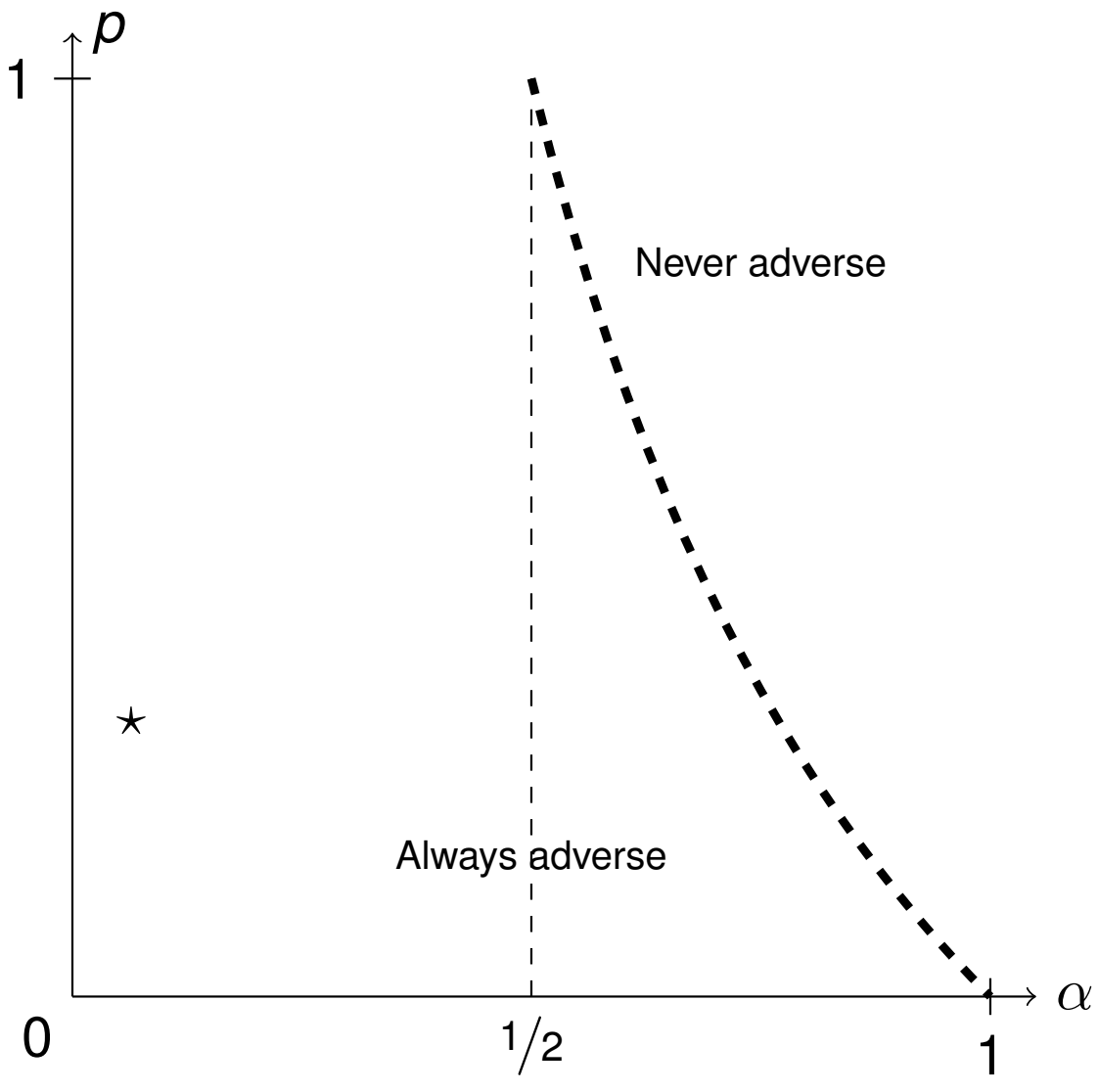
If there is no premium for focusing, those who focus are better than those who are not focusing.

Result 2

If there is a premium for focusing, those who don't focus are better than those who focus if $p(1+\alpha) > 1$.

Adverse outcome: when rewarding for focusing, non-focusing candidates are better on average, but when not rewarding for focusing, focusing candidates are better.

Adverse outcome: Result 2



Results

If universities want to hire those who are more likely to be good at *Topic 1*:

Result 3

If there is no premium for focusing, those who focus are better than those who are not focusing.

Result 4

If there is a premium for focusing, those who don't focus are better than those who focus if $p < t^* \approx 0.3281$ *or* $\alpha p < t^*$ *and* λ *is large enough.*

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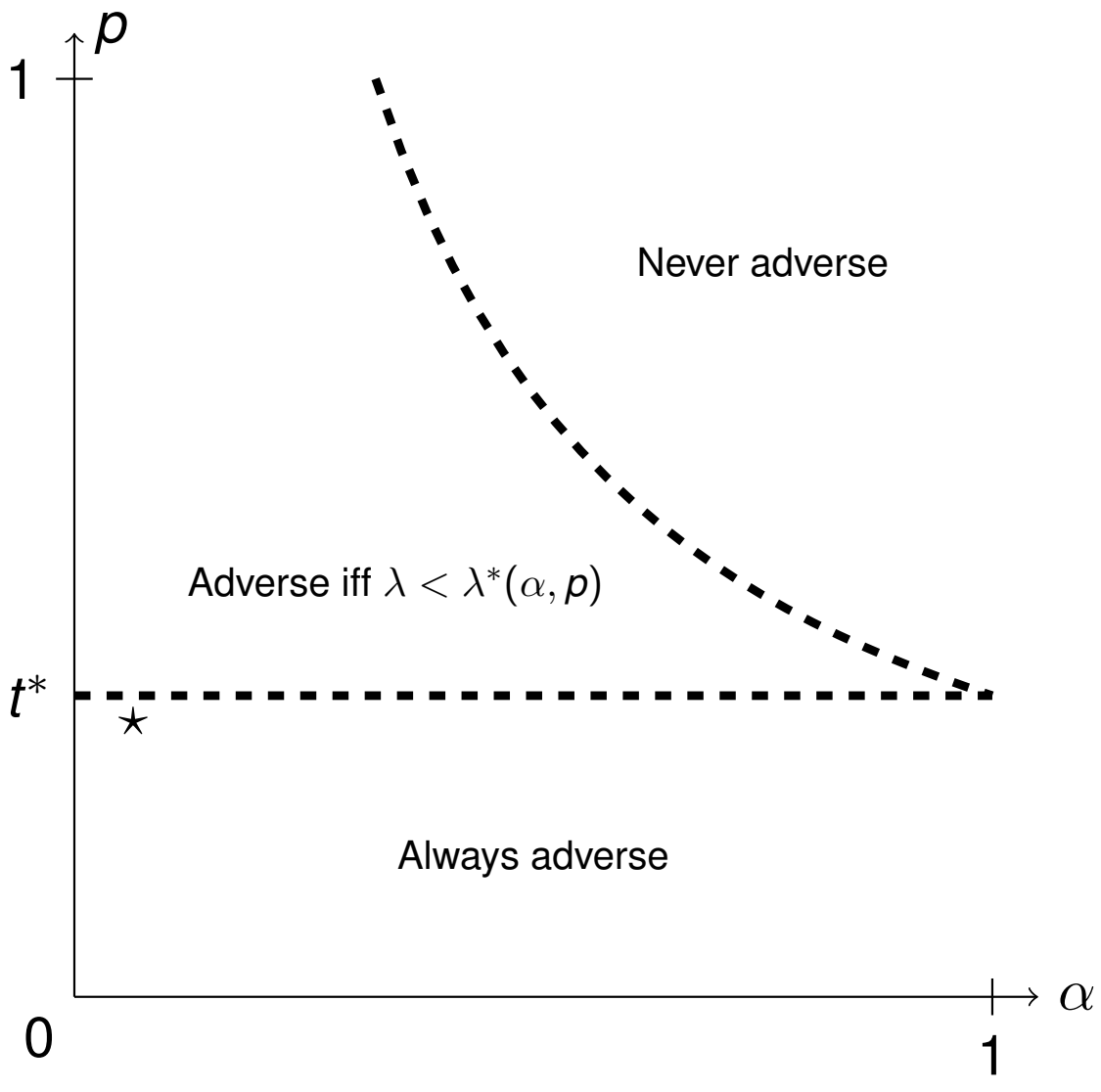
Adverse outcome: Result 4



Economics

- If you don't reward focusing, both $(\cdot, \cdot, 1, 1, 1, 1)$ and $(\cdot, \cdot, 0, 0, 0, 0)$ behave identically, unlikely to focus. Those who are likely to focus have a type like $(\cdot, \cdot, 1, 1, 0, 0)$ and these are likely to be good in their type if α is small enough.
- When you do reward focusing, the only type that does not focus is $(\cdot, \cdot, 1, 0, 1, 0)$. These are likely to be good in at least one topic, especially if p is small enough.

What's The Point of Tenure-Track?

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- Admin: can't give tenure to everybody.
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- Our contribution: to create incentives for $(1, \cdot, 1, 0, 1, 0)$ types to focus on Topic 1
- Candidates want to work on good ideas. Tenure track gives them time to have more good ideas.
- $(0, 0, 1, 0, 1, 0)$ types are unlikely to get more good ideas and will not focus.
- But $(1, 0, 1, 0, 1, 0)$ types will be happy to forego their good idea in Topic 2 if they expect that they'll have more good ideas in Topic 1 during tenure track.
- same for $(1, 1, 1, 0, 1, 0)$
- So if the tenure-track is long enough, those who don't focus under tenure-track system will be bad, and those who focus will be on average better.

Tenure-Track Game

1. Nature assigns ability types
2. Candidates decide on their ideas that will make up their CV, they maximize their expected lifetime quantity of publications; ideas that are not part of the CV at this time get developed by other people and can't be recovered
3. Universities make a hiring decision based on whether CV is focused or not
4. Those who are hired get N more ideas in each topic to work on
5. Those who work on at least 2 good ideas get tenure: M more ideas in each topic.

Backward Induction

5 The expected amount of good ideas after you get tenure is Mp if one is good at the topic and αMp if one is not good at the topic. The chance to get tenure is

- 1 if you have 2 good ideas
- $1-(1-p)^{2N}$ if you are good in both topics and you have one good idea
- $1-(1-p)^{N}(1-\alpha p)^{N}$ if you are good in one topic and have one good idea
- $1-(1-\alpha p)^{2N}$ if you are not good in any topic and have one good idea

-4 We want an equilibrium where if you have a type $(\cdot,\cdot,1,0,1,0)$ and good in at least one topic, you choose to focus, and you choose to not focus if you are bad at both topics

.... more Induction

3. Universities have a hiring strategy where the probability of hiring $q(\text{focus?}) \in (0,1)$ is consistent with expected quality of focusing and non-focusing candidates:

$$q(\text{focus}) > q(\text{no focus}) > 0.$$

2. So a candidate with a type $(1,0,1,0,1,0)$ needs to decide

$$q(\text{focus})[1 + [1 - (1-p)^N(1-\alpha p)^N](W_H + (1+\alpha)Mp)]$$

$$> q(\text{no focus})[2 + (1+\alpha)(N+M)p]$$

And a candidate with a type $(0,0,1,0,1,0)$ needs to decide

$$q(\text{focus})[1 + [1 - (1-\alpha p)^{2N}](W_L + 2\alpha Mp)]$$

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where $W_H = E[B(N,p) + B(N,\alpha p) | B(N,p) + B(N,\alpha p) \geq 1]$ and $W_L = E[B(2N,\alpha p) | B(2N,\alpha p) \geq 1]$

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Concusion

- We think there is some weird decisionmaking when arguing about candidates' ability using focusing as a signal.
- We think it makes some sense when we are providing candidates an opportunity to have more ideas (tenure-track, US-style) but does not if we are in the world when the hiring is final (UK-style).
- Very much under development, any ideas are welcome.