Scientific workforce

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Spring 2015

The economics of science

- Excellent general reference: Paula Stephan's 2012 book *How Economics Shapes Science*
- Chapter 7: market for scientists and engineers
  - Gestation (training) period is quite long
  - Job prospects at time of graduation difficult to predict in advance
  - Aspirants often lack information on job outcomes of recent graduates
  - She argues that career decisions in this market may largely be made in the dark due to scientists' "love" of the subject
- Today: focus on two papers investigating some of these issues
  1. Borjas-Doran (2012)
  2. Stern (2004)

1. Roy model (loosely defined!): Borjas-Doran (2012)

2. Compensating differentials
   - Stern (2004)
   - Linking back to theory: Aghion et al. (2008)
   - Linking back to empirics: Murray et al. (2012)

3. Looking ahead

Borjas-Doran (2012)

- Investigate how a large, post-1992 influx of Soviet mathematicians affected the (publication) productivity of US mathematicians
- Key idea: prior to collapse of Soviet Union, little collaboration and infrequent exchanges between Soviet and Western mathematicians; after collapse of Soviet Union, $\sim 1,000$ Soviet mathematicians migrated to other countries, and many mathematicians who stayed became part of the globalized publication market

Historical context

- Following establishment of Soviet Union in 1922, long period of development of ideas independent from Western ideas
- To varying degrees between 1922 and 1992, Soviet government instituted strict controls on:
  - Which scientists could communicate with Western peers
  - Parameters of scientific travel
  - Acceptable outlets for publication
  - Access to Western research materials

Figure 1A: Differences in specialization

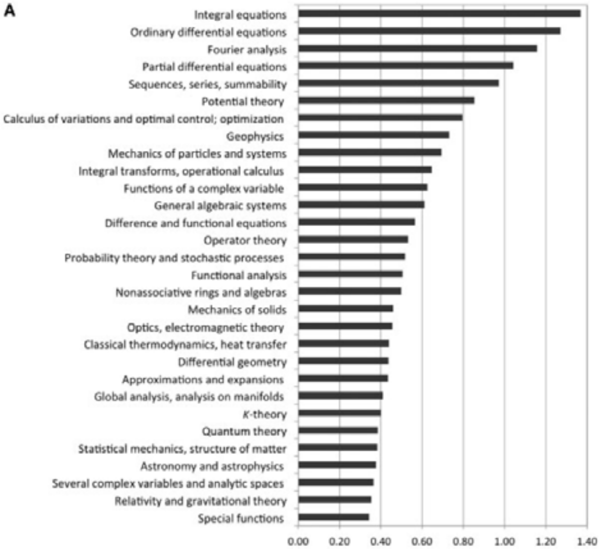

Figure 1B: Differences in specialization (continued)

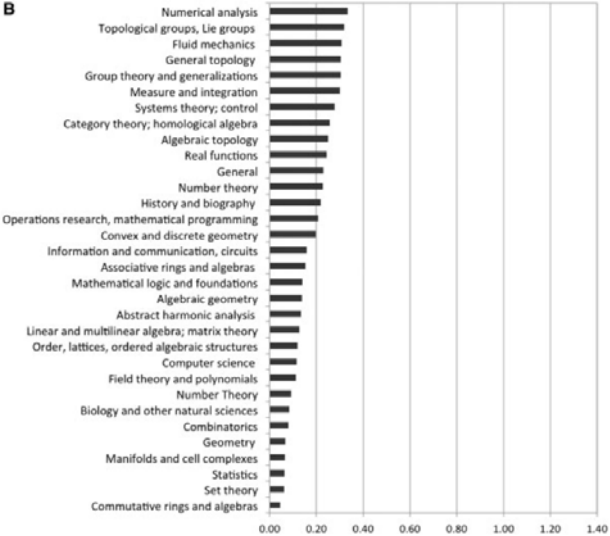

Figure 2: Soviet / US collaborations

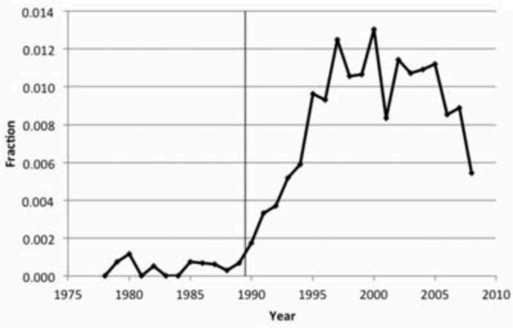

FIGURE II

Trend in Coauthorship Rate between Soviet and American Mathematicians

The denominator of this fraction is the number of papers published each year where at least one author reports an American affiliation. The numerator is the number of such papers in which one other author also reports a Soviet affiliation.

Figure 3: Aggregate employment statistics

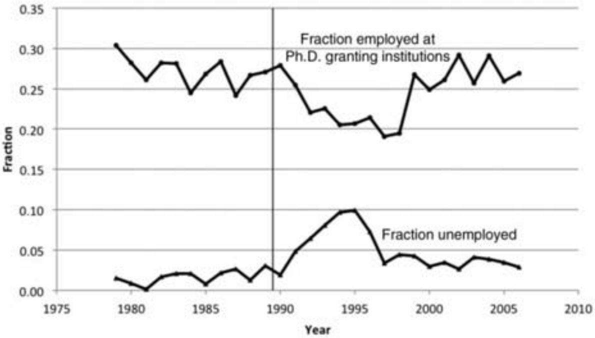

FIGURE III

Employment Trends for New Mathematics Doctorates Granted by North American Institutions

Source: Data compiled by the authors from American Mathematical Society (various issues).

Data

Construct a data set on authorship of every mathematics paper published over past 70 years based on a databases from the American Mathematical Society (AMS), supplemented by archives from Thomson Reuters ISI Web of Science and Mathematics Genealogy Project

What was difficult about this:

- Unique researcher IDs (incentives to curate)
- Institutional locations (not always reported)
- Citation outcomes (data accuracy)

Table 1: Positive selection of migrants

SUMMARY STATISTICS FOR SAMPLES OF AMERICAN AND SOVIET MATHEMATICIANS

	Group of mathematicians			
Variable	Americans	Soviet émigrés to U.S.	Soviet émigrés elsewhere	All other Soviets
Number of mathematicians	29,392	336	715	11,173
Papers published, 1978–1991				
Mean papers per mathematician	6.7	17.8	14.6	8.1
Median papers	3.0	13.0	10.0	5.0
Maximum number of papers	232.0	104.0	152.0	180.0
Papers published, 1992–2008				
Mean papers per mathematician	6.8	27.2	28.8	7.6
Median papers	1.0	21.0	22.0	1.0
Maximum number of papers	768.0	128.0	317.0	311.0
Citations, AMS, 1978–1991				
Mean citations per mathematician	29.1	74.6	32.8	8.6
Median citations	1.0	10.0	6.0	0.0
Maximum number of citations	5550.0	1276.0	1441.0	2928.0
Citations, AMS, 1992–2008				
Mean citations per mathematician	33.6	177.4	110.3	13.4
Median citations	0.0	62.0	37.0	0.0
Maximum number of citations	3404.0	1709.0	1988.0	1287.0
Citations, ISI, 1978–1991				
Mean citations per mathematician	110.2	185.1	79.8	25.3
Median citations	20.0	25.5	11.0	3.0
Maximum number of citations	20,274.0	7232.0	3040.0	3054.0
Citations, ISI, 1992–2008				
Mean citations per mathematician	52.1	209.0	156.2	27.3
Median citations	0.0	88.5	60.0	0.0
Maximum number of citations	11,688.0	3371.0	4442.0	1258.0
Median number of fields	2.0	5.5	5.0	2.0
Percent first published after 1980	45.2	40.5	46.7	48.8

Figure 7: Event study for productivity

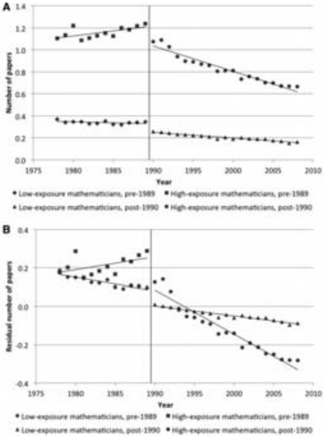

FIGURE VII

Impact of Index of Similarity on Output of American Mathematicians

(A) Annual number of papers per mathematician, (B) Annual number of papers per mathematician, removing individual fixed effects

The low-exposure group consists of mathematicians in the bottom quartile of the distribution of the index of similarity, and the high-exposure group consists of mathematicians in the top quartile. The residual papers in Panel B are calculated from a regression that contains individual fixed effects (demeaning the data for each individual).

Take-aways

- Really cool that you can see the effects in aggregate
- Thoughtful, careful data construction
- Attempt to get at a variety of related questions
- Welfare is hard to assess here

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Stern (2004): Motivation

Aims to understand incentives shaping knowledge production

- Input into innovation, economic growth

"Science" (Dasgupta-David 1994, Merton 1973)

- Incentive system
- Researchers offered substantial discretion in choosing projects
- Rewards based on establishing intellectual priority
- Journal publications

Why might a science-oriented approach be pursued?

1. Scientists may have a "taste" for science. Researchers may have preferences for interacting with discipline-specific communities and for receiving recognition for their discoveries. Stern refers to this as the "preference effect."
    - Some of you seem skeptical :)
    - Example: economists
2. Science may have productivity benefits, especially for firms. Firms may adopt science-oriented approach to increase R&D productivity. Stern refers to this as the "productivity effect."

Comparing/contrasting these two explanations

- No inherent conflict: scientists may have a taste for participating in science (preference), and some firms may find it worthwhile to participate in science (productivity)
- But: different implications for scientific labor market
  - Preference: negative association between science, wages
    - Compensating differential
  - Productivity: positive association between science, wages
    - As long as there is "rent-sharing" between firms, researchers (e.g. Van Reenen 1996)

Selection

In observational data, also expect selection. Why?

- "Winner-take-all" nature of scientific reward system
  $\Rightarrow$ benefits to science are higher for higher-ability researchers
    - Higher ability scientists will have a higher preference for science
    - Higher ability scientists may use some of their higher earnings capacity to "purchase" science: $cov(SCI, A_i) > 0$
    - Firms employing higher ability scientists will adopt science (Zucker and Darby 1996; Zucker, Darby, Brewer 1998)
- Some aspects of individual productivity likely unobserved
- Unobserved ability $\Rightarrow$ more science, higher wages

Conceptual framework

- Rosen-style model (*e.g.* inelastic labor supply)
- Two stages
  - Stage 1: firm j chooses $SCI = 1$ or $SCI = 0$
  - Stage 2: firm j hires a single researcher with ability γ_i
- γ_i: unobserved by econometrician
  - Drawn from firm-specific distribution $g_j(\gamma)$
  - Bounded below at zero with mean $\bar{\gamma}_j$
- Assume scientists of higher ability place higher value on SCI
- Scientists' utility depends on offered wage + preference for SCI:

$$U_i = \lambda_0 + \alpha_s \gamma_i SCI_j + w_j$$

Conceptual framework (continued)

Firms earn profits as a function of the ability of hired scientists, the wages paid (w_j), and their science-orientation (note: fixed fee δ):

$$\pi_{i,j} = \gamma_i(\beta_0 + \beta_s SCI_j) - w_{i,j} - \delta SCI_j$$

$SCI = 1$ firms earn quasi-rent: $\phi \in (0,1)$ shared with scientists

$$w^*_{i,j} = \gamma_i\beta_0 + \gamma_i(\phi\beta_s - \alpha_s)SCI_j$$

If compensating differential α_s is larger than part of quasi-rent extracted by scientist, then wages will be decreasing in SCI

Possible that the preference effect reflects career concerns (still an alternative to the productivity hypothesis)

Key idea: multiple job offers

Stern's key insight: in job markets for "novice" professionals, many candidates receive multiple job offers prior to accepting an offer

For candidates receiving multiple offers, can construct different points on wage-amenity curve for a given worker at a given time.

Important: job offers confer legal responsibility on the firm $\Rightarrow$ firm is willing to employ worker, probability of acceptance is non-zero

Key assumptions

- Assumes observed job offers are comparable in "seriousness" (presents some tests of this assumption)
- Assumes candidates who receive multiple offers are drawn independently from the distribution of candidates (presents some tests of this assumption)
- Assumes scientific orientation is uncorrelated with alternative unobserved sources of variation in R&D productivity (tried his best to design survey to avoid this problem)
- Assumes differences in firms' information about candidates is uncorrelated with scientific orientation

Data: self-run survey

- "Final" offers to biology PhDs completing first post-doc
  - Sample: post-docs in job market for long-term employment
- Small sample: 164 offers to 66 PhDs receiving multiple offers
  - Stern also examines data on individuals receiving a single offer: 223 offers to 107 PhDs receiving any offer
  - 90% of the sample receives between 2 and 4 offers
  - Offer-level regression (individuals can appear more than once)

Key variables

Key variables are SALARY (baseline salary) and a series of variables measuring scientific orientation of the employers:

1. PERMIT_PUB: are researchers allowed to publish discoveries?
2. INCENT_PUB: how strong are incentives for publication?
3. CONTINUE RESEARCH: are researchers allowed to continue postdoctoral research projects?
4. SCIENCE INDEX: principal factor of the three above variables

Unobserved job attributes? Tried his best in survey design...

Table 1: Summary statistics

Table 1 Definitions and Descriptive Statistics

Variable	Definition	*N*	Mean	Std. dev.
Job market experience				
# OFFERS RECVD	Number of offers received	164	2.88	1.00
ACCEPTED JOB	Accepted this job = 1, No = 0	164	0.30	0.49
Job offer cardinal record information				
JOB TYPE	1 = Established firm, 2 = Startup firm, 3 = Government, 4 = Medical school/center, 5 = University, 6 = Postdoc	164	See appendix	
Monetary compensation and career incentive measures				
SALARY	Annual starting salary (in US dollars)	121	62,263.95	31,553.04
STOCK_DUMMY	Job offer includes stock options = 1, No = 0	72	0.36	0.48
PROMOTION	Likert scale rating (1–5) of opportunities for internal promotion	111	3.49	1.29
Scientific orientation indicators				
PERMIT_PUB	Permission to publish in external journals = 1, No = 0	114	0.92	0.27
INCENT_PUB	Likert scale rating (1–5) of incentives to publish in refereed outside journals	104	3.89	1.12
CONTINUE RESEARCH	Job allows continuation of current research project = 1, No = 0	111	0.46	0.50
SCIENCE INDEX	First principal factor of PERMIT_PUB, INCENT_PUB and CONTINUE RESEARCH; see Hamilton (1992)	99	0.00	0.57
EQUIPMENT	Likert scale rating (1–5) of access to “cutting-edge” equipment	112	4.07	0.86
Job offer ordinal record data (1 = highest)				
MONETARY	Ranking of offer in terms of monetary compensation	134	1.96	0.99
RESEARCH QUALITY	Ranking of offer in terms of internal research environment	124	1.90	0.99
FLEXIBILITY	Ranking of offer in terms of flexibility to choose research projects	116	1.90	0.98
FUNDING	Ranking of offer in terms of availability of research funding	117	1.93	1.00
CAREER	Ranking of offer in terms of impact on career advancement	130	1.95	0.99
JOBFIT	Ranking of offer in terms of how well it “fits” with prior research experience	116	1.91	1.01

Table A1: Correlations

Measures of scientific orientation are correlated with each other; motivates composite index

Table A1 **Correlation of Job Offer Record Data**

	SALARY	PERMIT_ PUB	CONTINUE RESEARCH	INCENT_ PUB	EQUIPMENT	STOCK_ DUMMY	PROMOTION
SALARY	1.0000						
PERMIT_PUB	−0.0082	1.0000					
CONTINUE RESEARCH	−0.0728	0.0499	1.0000				
INCENT_PUB	**−0.2729**	**0.3204**	**0.2933**	1.0000			
EQUIPMENT	0.1047	−0.0318	−0.0398	0.1787	1.0000		
STOCK_ DUMMY	**0.4680**	−0.0757	**−0.3264**	**−0.3953**	0.0932	1.0000	
PROMOTION	**0.2173**	−0.0231	**0.2079**	0.0422	0.0532	**0.2742**	1.0000

Note. Significant (5%) coefficients are shown in bold.

Summary of main results

- Cross-section estimate "wrong-signed"
- With FE: Science-oriented offers associated with lower wages
  - Robust to controls for job types
    - How good are these controls?
  - Robust to restricting the sample to non-academic jobs
    - Important b/c academia is different on many dimensions
- Internal/external validity checks:
  - Accepted and rejected job offers are comparable
  - Single and multiple offer candidates look similar

Table 2: Descriptive evidence

Table 2 **Nonparametric Comparison of Deviations of Salary Means by Science Attributes**

	PERMIT_PUB (0 vs. 1)	CONTINUE RESEARCH (0 vs. 1)	INCENT_PUB ({1, 2, 3} vs. {4, 5})
Overall sample			
Average difference	14,200	16,809	6,694
	(7,241)	(5,189)	(2,678)
t-stat for means equality	1.961	3.239	2.500
Degrees of freedom	8	26	30
p-value	0.086	0.003	0.018
Nonacademic offers only			
Average difference	7,200	8,143	8,430
	(2,352)	(5,954)	(3,223)
t-stat for means equality	3.061	1.368	2.615
Degrees of freedom	8	12	18
p-value	0.016	0.197	0.18

Notes. Each "average difference" cell contains the difference in the average deviation in salary for a science characteristic, using the following procedure. For each science characteristic, we identified those individuals whose offers differed in terms of that characteristic. For these individuals, we then computed (a) the average salary offer for that individual by that specific characteristic and (b) the (weighted) average salary offer for each individual, where the weight associated with each value of the characteristic is equal to 0.5. Finally, to abstract away from differences in the level of salary across individuals, we subtracted (b) from (a). We then performed a *t*-test for the equality of the means based on these average salary deviations by scientific characteristic.

Though INCENT_PUB is a five-point Likert scale measure, we implemented the above procedure by grouping the INCENT_PUB responses into two groups ({1, 2, 3} versus {4, 5}).

Table 3: Estimates of equalizing wage differential

Table 3 **Hedonic Wage Regression: Overall Sample Dependent Variable = LN(SALARY), # of Observations = 121**

	Permission to publish			Combination model	Science index model	
	(3–1)	(3–2)	(3–3)	(3–4)	(3–5)	(3–6)
	Baseline (NO FE)	Baseline (w/FE)	Full model (w/FE)	Full model (w/FE)	Full Model (w/FE)	Full Model (w/FE)
PERMIT_PUB	0.027	**−0.266**	**−0.191**	−0.089		
	(0.186)	**(0.114)**	**(0.105)**	(0.103)		
CONTINUE RESEARCH				**−0.134**		
				(0.060)		
INCENT_PUB				−0.036		
				(0.028)		
SCIENCE INDEX					**−0.114**	−0.078
					(0.053)	(0.057)
EQUIPMENT				**0.063**	**0.057**	**0.053**
				(0.033)	**(0.030)**	**(0.031)**
CONTROLS						
PROMOTION			**0.041**	**0.046**	**0.042**	0.031
			(0.025)	**(0.021)**	**(0.021)**	(0.023)
STOCK_DUMMY			**0.196**	**0.234**	**0.260**	**0.190**
			(0.085)	**(0.074)**	**(0.067)**	**(0.077)**
ACCEPTED JOB			−0.013	0.002	−0.0001	−0.002
			(0.040)	(0.043)	(0.043)	(0.044)
JOBTYPE CONTROLS	no	no	yes (5; Sig.)	no	no	yes (5)
Individual fixed effects	no	yes (52; Sig.)	yes (52; Sig.)	yes (52; Sig.)	yes (52; Sig.)	yes (52; Sig.)
R-squared	0.001	0.915	0.955	0.958	0.954	0.958

Notes. Only persons with multiple job offers are included.
Standard errors are shown in parenthesis; significant coefficients (10%) are shown in bold.
Sig. stands for joint significance of fixed effects or job type controls (at 10% level).

Table 4: Estimates of equalizing wage differential
Sample limited to non-academic offers

Table 4 **Hedonic Wage Regression: Nonacademic Offers Dependent Variable = LN(SALARY), # of Observations = 71**

	Permission to publish	Factor model
	(4–1)	(4–2)
PERMIT_PUB	**−0.150**	
	(0.077)	
SCIENCE INDEX		**−0.109**
		(0.047)
EQUIPMENT		−0.015
		(0.038)
CONTROLS		
PROMOTION	**0.056**	**0.054**
	(0.029)	**(0.029)**
STOCK_DUMMY	0.092	0.105
	(0.066)	(0.065)
JOB ACCEPTED	−0.049	−0.021
	(0.047)	(0.048)
Individual Fixed Effects	yes (30; Sig.)	yes (30; Sig.)
R-squared	0.967	0.970

Notes. Only persons with multiple job offers are included.

Regressions exclude postdoctoral positions and job offers from universities.

Standard errors are shown in parenthesis; significant coefficients (10%) are shown in bold.

Sig. stands for joint significance of fixed effects (at 10% level).

Table 5: Relating salary to job amenities

Table 5 Regression: Job Offer Comparison Rankings Dependent Variable: Monetary

	(5–1)	(5–2)	(5–3)	(5–4)
Sample	All job types	Exclude academic job offers	All job types	Exclude academic job offers
RESEARCH QUALITY	**−0.34**	**−0.32**		
	(0.12)	**(0.16)**		
FLEXIBILITY			**−0.39**	−0.27
			(0.13)	(0.19)
JOBFIT	0.20	**0.29**	**0.32**	**0.35**
	(0.12)	**(0.16)**	**(0.12)**	**(0.17)**
CAREER	0.23	−0.04	**0.30**	0.04
	(0.12)	(0.16)	**(0.13)**	(0.18)
FUNDING	**0.34**	0.26	0.17	0.18
	(0.13)	(0.17)	(0.12)	(0.17)
Individual fixed effects	(51)	(28)	(51)	(28)
R-squared	0.48	0.41	0.48	0.38
# of observations	134	74	134	74

Notes. Only persons with multiple job offers are included.

Regressions (5–2) and (5–4) exclude postdoctoral positions and job offers from universities.

Standard errors are shown in parenthesis; significant coefficients (10%) are shown in bold.

Table 6a: Individuals receiving single vs. multiple offers

Could imagine doing more here

Table 6A Comparison of Single and Multiple Job Offers

	Single offers	Multiple offers
SALARY	58,074.01	61,958.85
	(26,859.57)	(31,394.96)
PERMIT_PUB	0.96	0.91
	(0.19)	(0.28)
CONTINUE RESEARCH	0.28	0.46
	(0.46)	(0.50)
INCENT_PUB	3.67	3.88
	(1.24)	(1.13)
EQUIPMENT	3.71	4.06
	(1.38)	(0.86)

Notes. Number of observations is different for every cell, depending on number of missing values.

Standard errors are shown in parenthesis.

Table 6b: Comparing accepted and rejected offers

More direct test than ACCEPTED regression control variable

Table 6B Comparison of Accepted and Rejected Offer Characteristics

	Rejected offers	Accepted offers
SALARY	60,925.06	64,782.93
	(32,647.24)	(29,602.07)
PERMIT_PUB	0.91	0.95
	(0.29)	(0.22)
CONTINUE RESEARCH	0.48	0.46
	(0.50)	(0.50)
INCENT_PUB	3.93	3.93
	(1.08)	(1.19)
EQUIPMENT	3.82	4.43
	(0.91)	(0.66)

Notes. Number of observations is different for every cell, depending on number of missing values.

Standard errors are shown in parenthesis.

Take-aways

- Scientists seem willing to pay to do science
- New methodology: has limitations, but very innovative
- Are there better/different ways to get at this idea?
- Substantively interesting context
- Economists? Doctors? Lawyers? Programmers?

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Linking back to theory

Aghion, Dewatripont, and Stein (2008) take Stern's compensating wage differential as a "fact" motivating a model clarifying the advantages and disadvantages of academic and private research

- "Usual" case for (government funding of) academic research: knowledge spillovers not fully appropriable $\Rightarrow$ underinvestment
  - Could solve that market failure with stronger property rights
- A-D-S: alternative reasoning generating a role for academia
  - Suggests stronger property rights may not be optimal

Academic vs. private-sector research

Key distinction emphasized between academia and private sector: tradeoff between creative control and focus

- Academia: scientists retain decision rights over what projects to take on, and what methods to use in tackling these projects
- Private sector: decision rights reside with owner/manager of the firm, who can (and will) largely dictate project choice and methods to individual scientists who work for the firm

If scientists value creative control (cite as evidence: Stern 2004), they will have to be paid a wage premium in order to give it up

Implications

- One advantage of academia: labor is cheaper
- One disadvantage of academia: scientists may work on projects they find interesting but which have little economic value; in contrast, given control rights firms can direct scientists to work on the most commercially valuable projects

In the A-D-S model, the resolution of this tradeoff depends on how far from commercialization a particular line of research is

Example

Line of biotech research with 10 stages which will yield a drug worth \$10 billion $\iff$ all ten stages are successfully completed

- Final stage. Moving project ahead: private directedness
- First stage. Expected payoff is smaller: cede creative control in order to economize on scientists' wages

These basic ideas clarify why it may be socially optimal to have early-stage, basic research occur in academia

(Most) interesting extension - "branching out": projects may be positive NPV at academic wages but not at private-sector wages $\Rightarrow$ under-investment in basic research

Technology

- I_0: initial idea (followed by $I_1, I_2, ...$: k stages)
- I_k: final idea, marketable product with value V
- Probability of success at stage i depends on:
  1. Number of active scientists at that stage (n)
  2. Research strategies they pursue:
     - ★ "Practical": maximizes probability that current idea I_{j-1} will be refined into I_j; if all n pursue "practical," probability is $\phi(n)$
     - ★ "Alternative": puzzle-solving (no immediate payoff)
- For practical strategy:
  - Main results assume $\phi(n) = p \ \forall n \geq 1$, $\phi(0) = 0$
  - Assumes all scientists pursuing practical have a perfectly correlated draw from same success distribution ($\Rightarrow n = 1$)
  - Also look at case where n is endogenous

Scientists' preferences

- Infinite pool of scientists: can research in academia or in firms
  - Can't be self-employed in science (fixed costs, no wealth)
- Outside option R (taxi-driving): sets wage floor
- Key assumption: scientists value creative independence
  - After seeing I_{j-1}, each scientist decides preferred strategy for I_j
  - α: *ex ante* probability scientist prefers practical strategy for I_j
    - ★ All scientists have the same preference at a given stage
    - ★ Can be relaxed
  - z: disutility from working on non-preferred strategy
  - *Ex ante* firm promise of preferred strategy: wage of R
  - *Ex ante* firm promise of non-preferred strategy: wage of $R + z$
  - Risk-neutral scientists: paid a proportional wage premium

Academia

- Precommitment to leave control over choice of research strategy in the hands of individual scientists
  - Why? Discuss non-profit structure, monitoring costs
- Characterization of outcome: n scientists at stage j
  - Scientists paid $w_a = R$, work on preferred strategy
  - With probability α, all n work on practical strategy
  - With probability $1 - \alpha$, all n work on alternative strategy
  - *Ex ante* probability of reaching I_{j+1}: $\alpha\phi(n)$

Private sector

- Entrepreneurs, not scientists, fund projects
  - Entrepreneurs care about profits, not research strategies
- *Ex post*, can force scientists to most profitable strategy
- Scientists demand wage of $w_p = R + (1 - \alpha)z$
  - $(1 - \alpha)z$: compensating differential

Single research line

Proposition 1. It cannot be value maximizing to have academia operate at later stages than the private sector.

Proposition 2. A research program with a sufficiently large number of stages won't be viable if located exclusively in the private sector.

Proposition 3. Holding fixed the number of stages, it is optimal to have the private sector transition occur earlier if (i) V is greater, or (ii) z is smaller.

Branching out

Modify the model to assume that the alternative strategy may yield new insights that may spawn wholly different lines of research

- Assume private sector never has any use for offspring lines because they are so early stage that they are negative NPV when evaluated at private-sector wages
- Assume offspring lines are viable if born in academia

Implies private sector ownership of an idea will not yield as diverse an array of useful next-generation ideas as would academia

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   - Stern (2004)
   - Linking back to theory: Aghion et al. (2008)
   - Linking back to empirics: Murray et al. (2012)

3. Looking ahead

How does openness affect diversity of research?

Murray *et al.* (2012) examine two shifts away from private-sector ownership for genetically engineered mice:

- Cre-lox: 1998
- Onco: 1999 (less dramatic)

1. Roy model (loosely defined!): Borjas-Doran (2012)

2. Compensating differentials
   - Stern (2004)
   - Linking back to theory: Aghion et al. (2008)
   - Linking back to empirics: Murray et al. (2012)

3. Looking ahead

Looking ahead

Discrimination: Theory

By Friday night: please comment on Goldin-Rouse (2000)

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Spring 2015