
Mechanism of Material Transfer in Different Scientific-field Environment

- Japanese Life Science and Material Science Fields -

2nd COMMUNIA Conference 2009

Global Science and the Economics of Knowledge-Sharing Institutions

29 June 2009

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Background of Material Transfer

■ Material transfer

- Unique form of cooperation in natural science
- Research output produced by academic scientists is a property of the academia (Norm of communism)

■ Transition of the academic norms

- Academic entrepreneurship
- Withholding by commercially-active scientists
- Increase in withholding of materials (10%=>20% in US)

■ How to maintain this crucial system of academic cooperation

Diapositiva 2

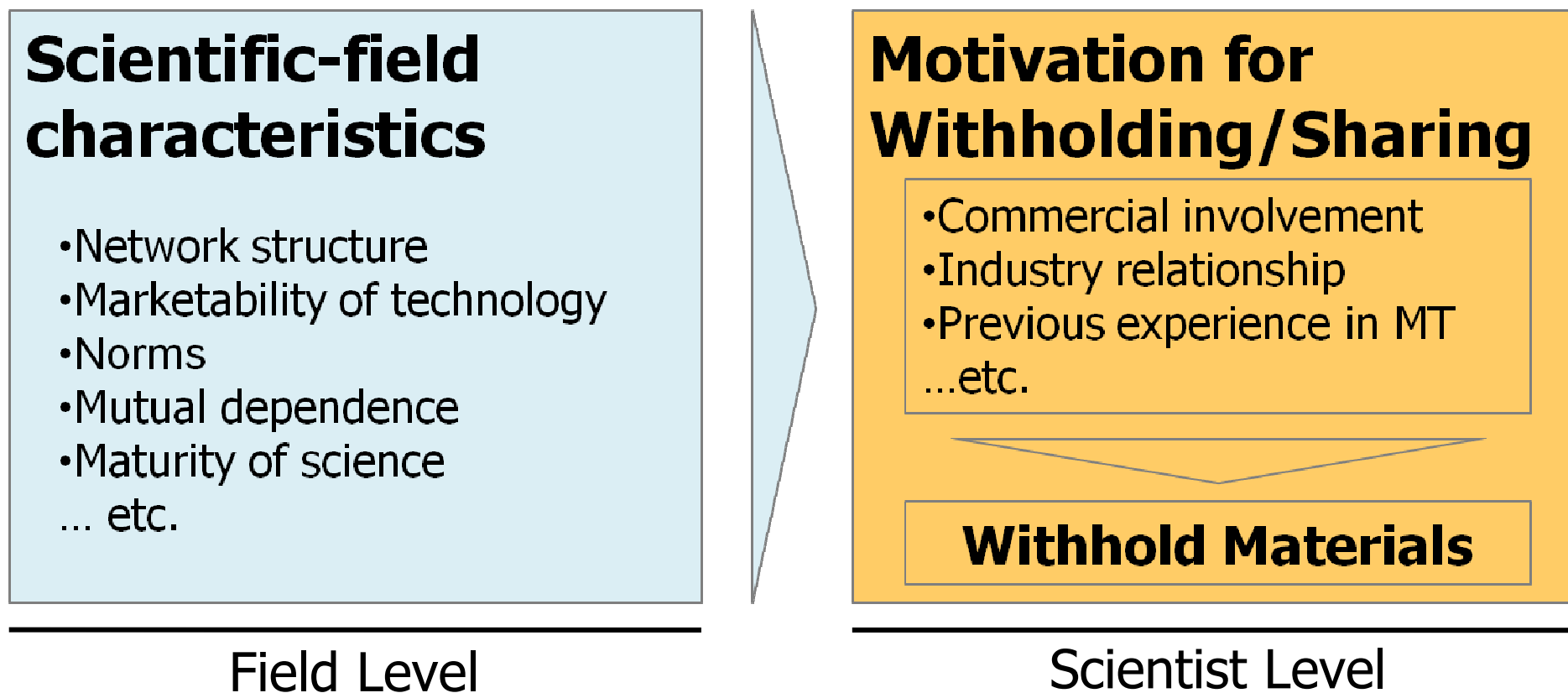
S34

2:00

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Purpose of This Study

- To examine motivations for material transfer with the influence of scientific-field characteristics



Diapositiva 3

S4

1:00

Concept name
"behavioral pattern"?

type of reasons not to comply
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S35 **Motivation for Withholding/Sharing
- Individual Scientist Level -**

Motivation Types	When scientists withhold materials	Mechanism
(A) Commercial based	<ul style="list-style-type: none"> • Involvement in commercial activities • Funded by industry 	<ul style="list-style-type: none"> • To protect commercial values • Pressure from industry partner
(B) Exchange based	<ul style="list-style-type: none"> • No expectation of supplier's benefit (e.g., coauthorship) 	<ul style="list-style-type: none"> • Desire to win academic recognition & opportunity • Material as a means to achieve personal goals
(C) Social network based	<ul style="list-style-type: none"> • Request from non-acquaintances • Request from outside community 	<ul style="list-style-type: none"> • High communication cost • Possible misuse, failure & harm to reputation

Diapositiva 4

S35

3:40

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Field Effect

Prevalence of commercialization

Extent to which scientists are involved in commercial activities



(B) Exchange based

Network intensity

Network density of collaborating scientists



(C) Social network based

Field Characteristic
(Field Level)

Motivation Type
(Scientist Level)

Diapositiva 5

S14 1:07

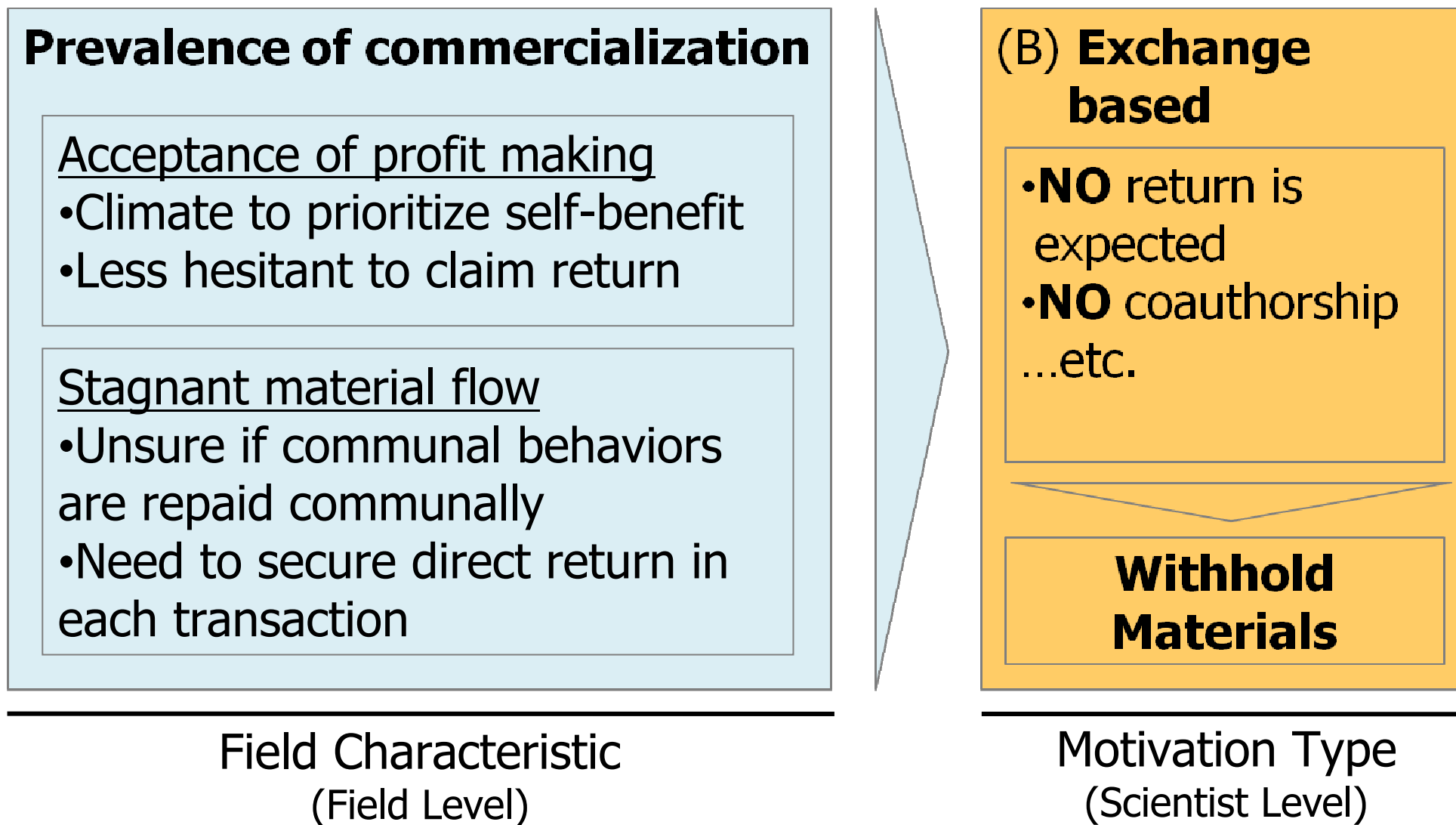
the transition from the prev. slide. why not for (A)
concept names

reciprocal climate
=> reciprocal exchange

laboratory network intensity
mobility
extent of inbreeding

= not conceptually interesting
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S30 **Field Effect (1): Prevalence of Commercialization Facilitates Exchange-Based Motivation**



Diapositiva 6

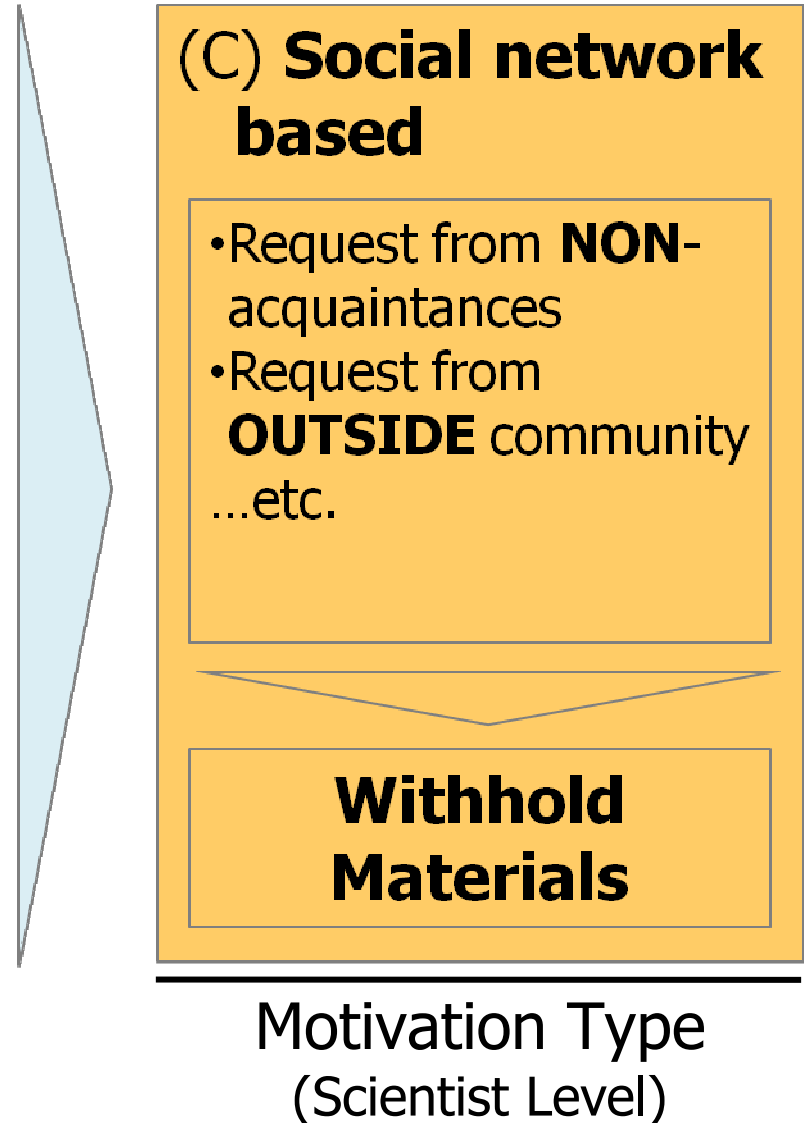
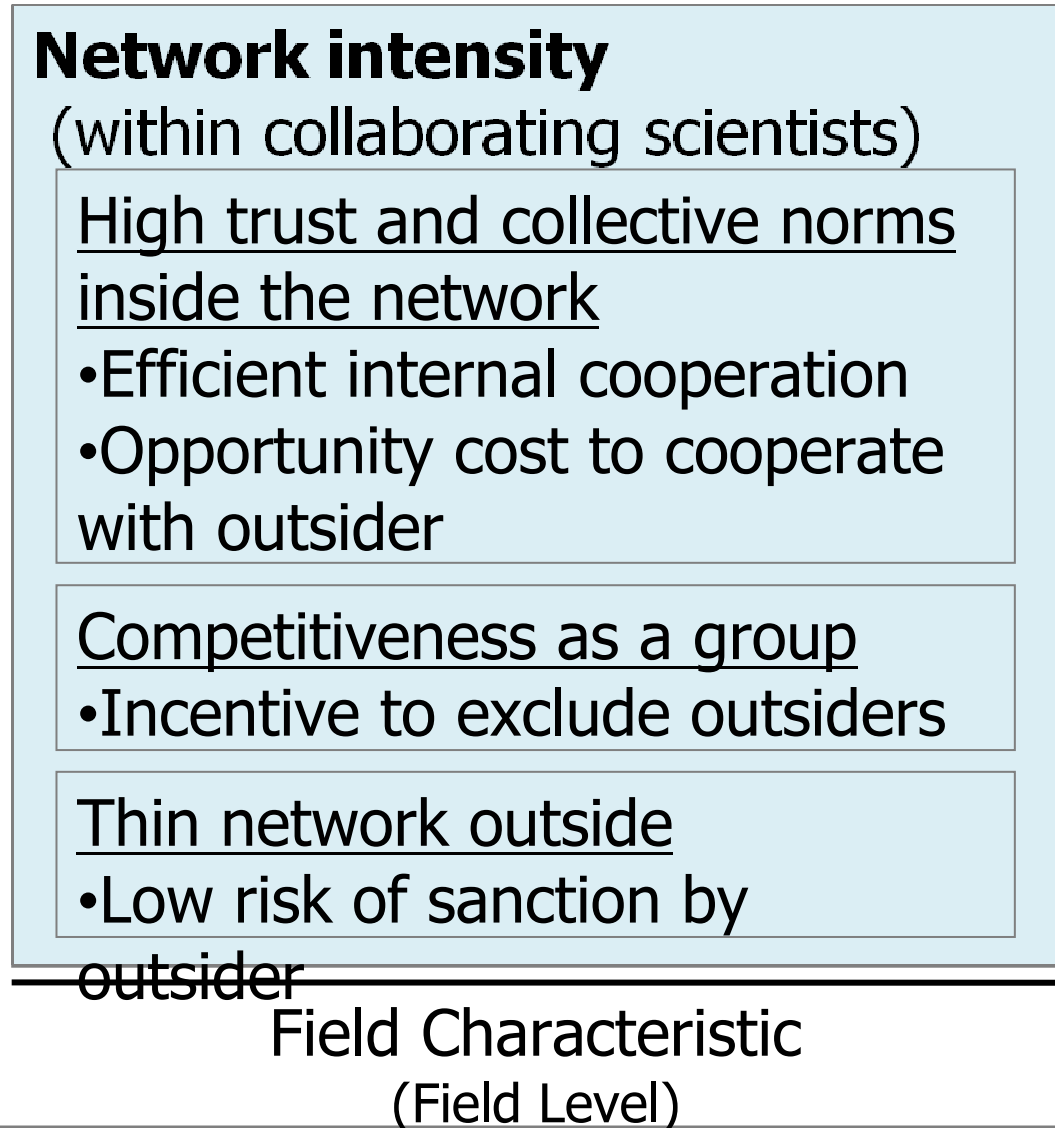
S30

2:36

confusing

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Field Effect (2): Network Intensity Facilitates Social Network Based Motivation



Diapositiva 7

S22

direct negative effect

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S36

2:17

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Data: Survey

- Random sample of 2,000 scientists
 - Japanese university & PRO
 - Life science & Material science (16 sub-fields)

- 838 responses (43% response ratio)

- Feb-Apr 2009

Diapositiva 8

S37

0:51

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Japanese Academia

■ Reform of academia

- Transition to academic entrepreneurship regime
- Japanese Bayh-Dole Act (1999)
- Incorporation of national universities (2004)

■ Job environment

- Low job mobility (2.3% in 2004)
- Inbreeding => high network intensity

Diapositiva 9

S11

1:14

funding is fixed, non-competitive

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Description: Material Transfer

	Supplier-side (When respondents <i>receive</i> requests)	Consumer-side (When respondents <i>make</i> requests)
%At least one request	59%	58%
#Request / year	2.8	1.4
% Withholding (Request denied)	8%	10%

*Material = reagents, cell lines, plasmids, chemical compounds, and model organisms

Diapositiva 10

S39

1:12

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S40 Bivariate Analysis

- Effects of Scientist-level Factors -

Conditions of material transfer	%Withhold (control)		T-test
(A) Commercial based			
Involvement in commercial activities	10%	(8%)	n.s.
(B) Exchange based			
NO expectation for coauthorship	17%	(5%)	***
(C) Social network based			
Request from NON -previous collaborator	12%	(2%)	***

*p<0.05, **p<0.01, ***p<0.001

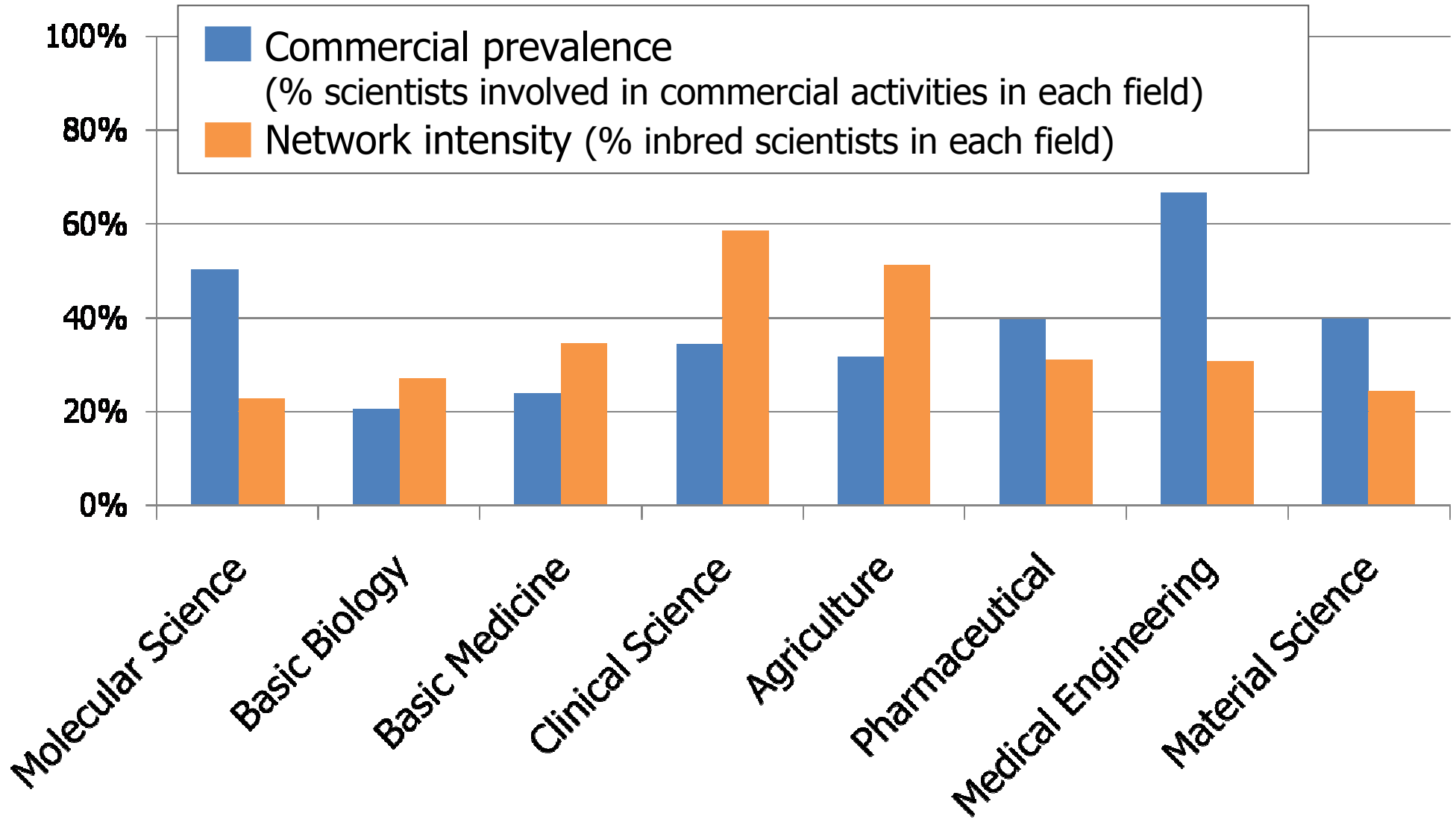
Diapositiva 11

S40

1:30

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S29 Description: Scientific-Field Characteristics



Diapositiva 12

S29

1:21

field level,
later used in regressions

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S41 Regression Analysis - Measures -

Dependent

Withheld a material for the latest request	1: Yes, 0: No
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Independent (Scientist level)

Involvement in commercial activities (A: Commercial based)	1: Commercially active 0: Non-active
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NO expectation for coauthorship (B: Exchange based)	1: NOT expected 0: Expected
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Request from NON -previous collaborator (C: Social network based)	1: NON-previous collaborator 0: Previous collaborator
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Independent (Field level) *Calculated for 16 subfields respectively

Prevalence of commercialization	% Involved in commercial activities
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Network intensity	% Inbred scientists in lab members
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Control

#publication, \$fund, organization type, demographic factors, etc.

Diapositiva 13

S41

3:00

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S42 Regression Analysis

- Effects of Scientist Level Factors -

Logit Regression

Dependent variable: Withheld a material for the latest request

Independent Variable	Coef. (s.e.)	Odds ratio
Involvement in commercial activities (A: Commercial based)	0.66 (0.47)	1.9
NO expectation for coauthorship (B: Exchange based)	1.09* (0.47)	3.0
Request from NON -previous collaborator (C: Social network based)	1.32* (0.64)	3.7

Other variables are omitted from the table.

* $p < 0.05$, ** $p < 0.01$.

Diapositiva 14

S42

1:50

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Regression Analysis - Field Effect (1) -

Prevalence of commercialization facilitates exchange-based motivation

Logit Regression

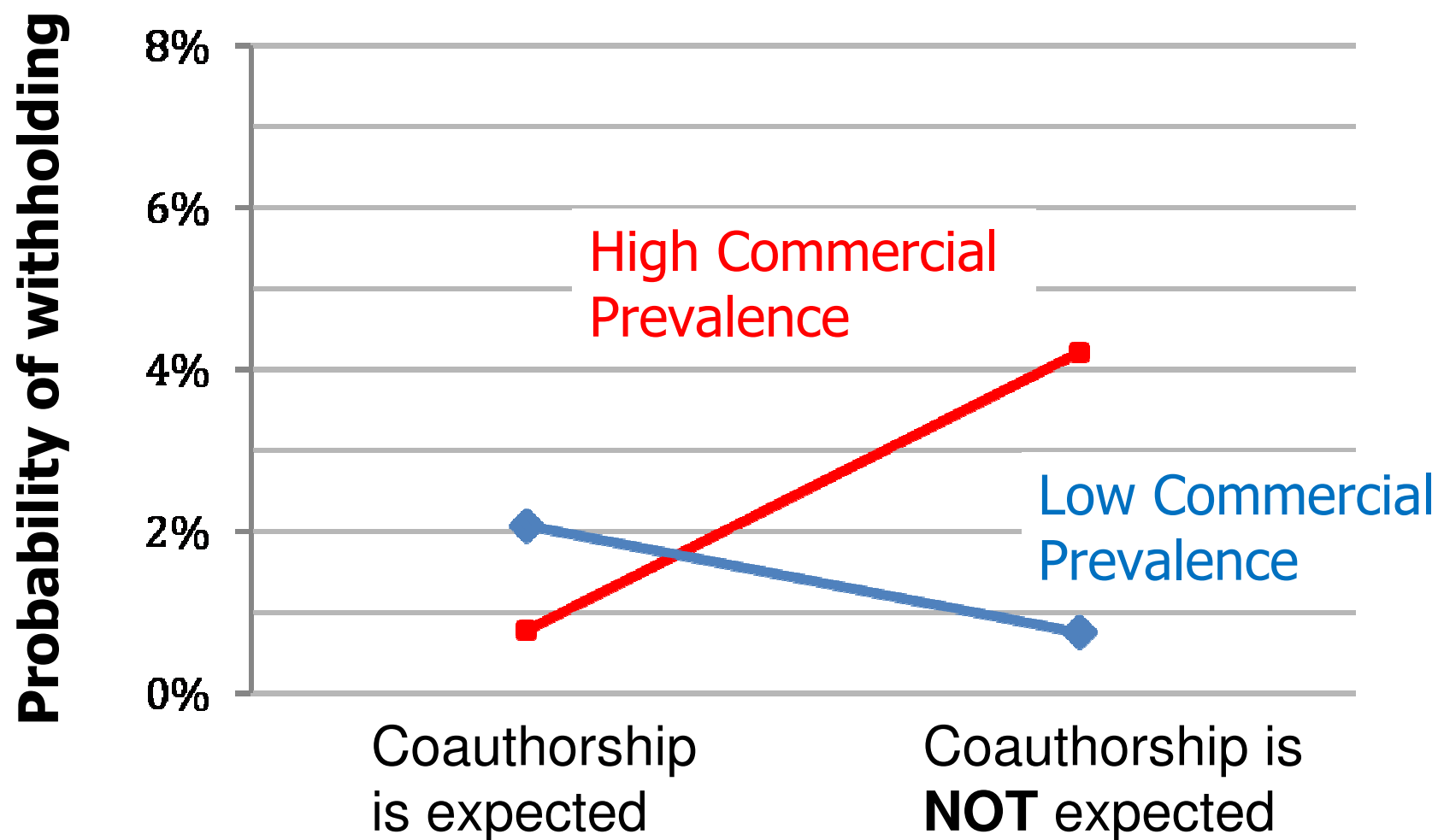
Dependent variable: Withheld a material for the latest request

Independent Variable	Coef. (s.e.)
(1) NO expectation for coauthorship (B: Exchange based)	0.97* (0.40)
(2) Prevalence of commercialization	2.78 (2.48)
(1) * (2)	7.52* (3.23)

Other variables are omitted from the table.

* $p < 0.05$, ** $p < 0.01$

Regression Analysis - Field Effect (1) - Prevalence of commercialization facilitates exchange-based motivation



Diapositiva 16

S44

2:05

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Regression Analysis - Field Effect (2) -

Network intensity facilitates social-network-based motivation

Logit Regression

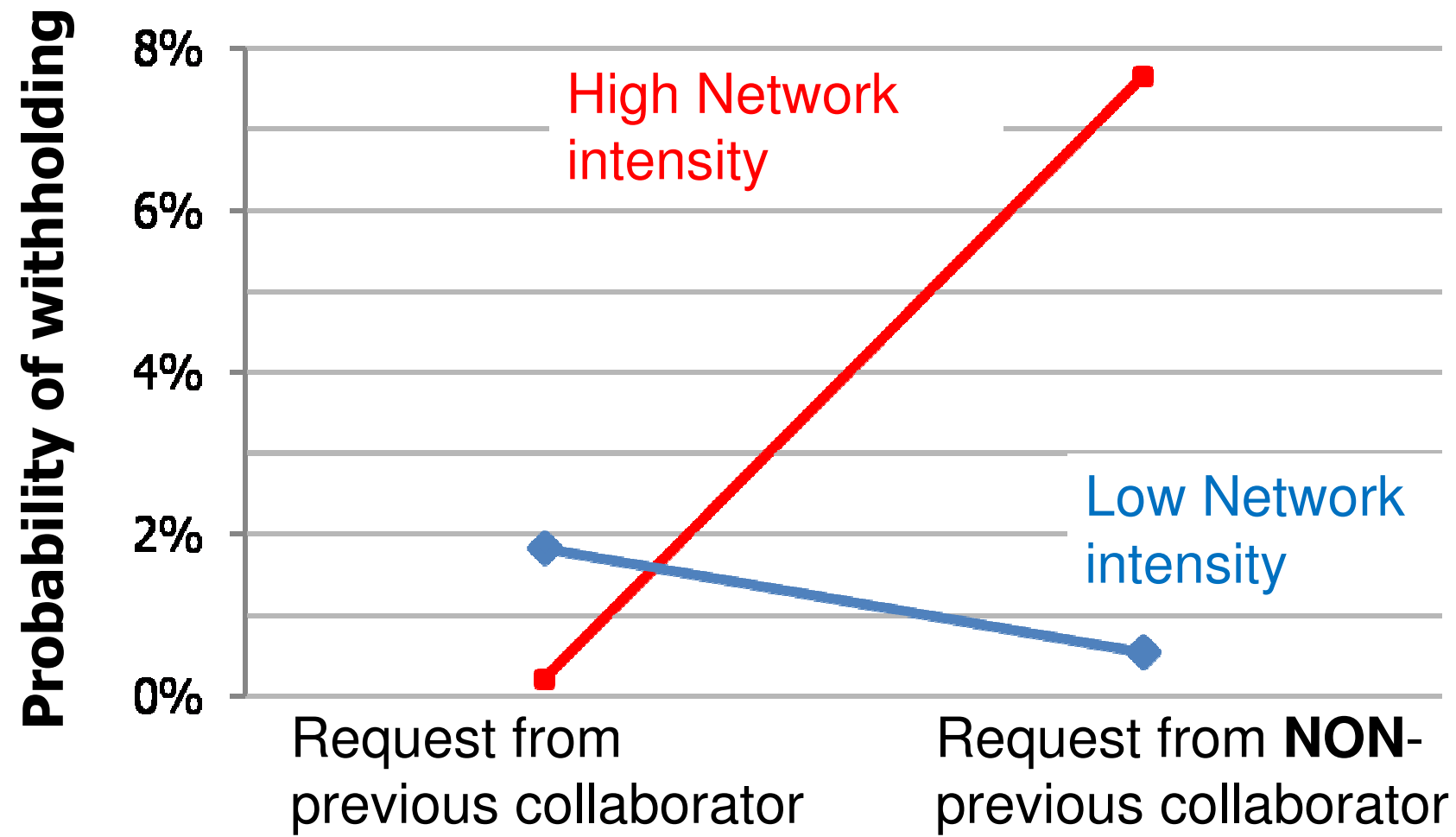
Dependent variable: Withheld a material for the latest request

Independent Variable	Coef. (s.e.)
(1) Request from NON -previous collaborator (C: Social network based)	2.36** (0.85)
(2) Network intensity	-8.42* (4.20)
(1) * (2)	9.94* (4.09)

Other variables are omitted from the table.

* $p < 0.05$, ** $p < 0.01$

Regression Analysis - Field Effect (2) - Network intensity facilitates social-network-based motivation



Diapositiva 18

S45

0:57

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Summary

■ Commercial based motivation

- Involvement in commercial activities: NOT clear effect

■ Exchange based motivation

- Greedy scientists deteriorate academic cooperation
- Facilitated by prevailing commercialization
- To reduce exchange-based motivation;
 - ◆ Disconnect reciprocal relationship; central material repository
 - ◆ Increase & standardize rewards for suppliers

■ Social network based motivation

- Research materials shared within restricted collaborators
- Facilitated by network intensity; fragmentation of science
- To bridge research groups; e.g., visiting positions

Diapositiva 19

S28

2:45

user of materials from repository are required to provide theirs when someone requires. and the repository facilitates the submission of materials on behalf of other scientists.

how do american universities distribute money?

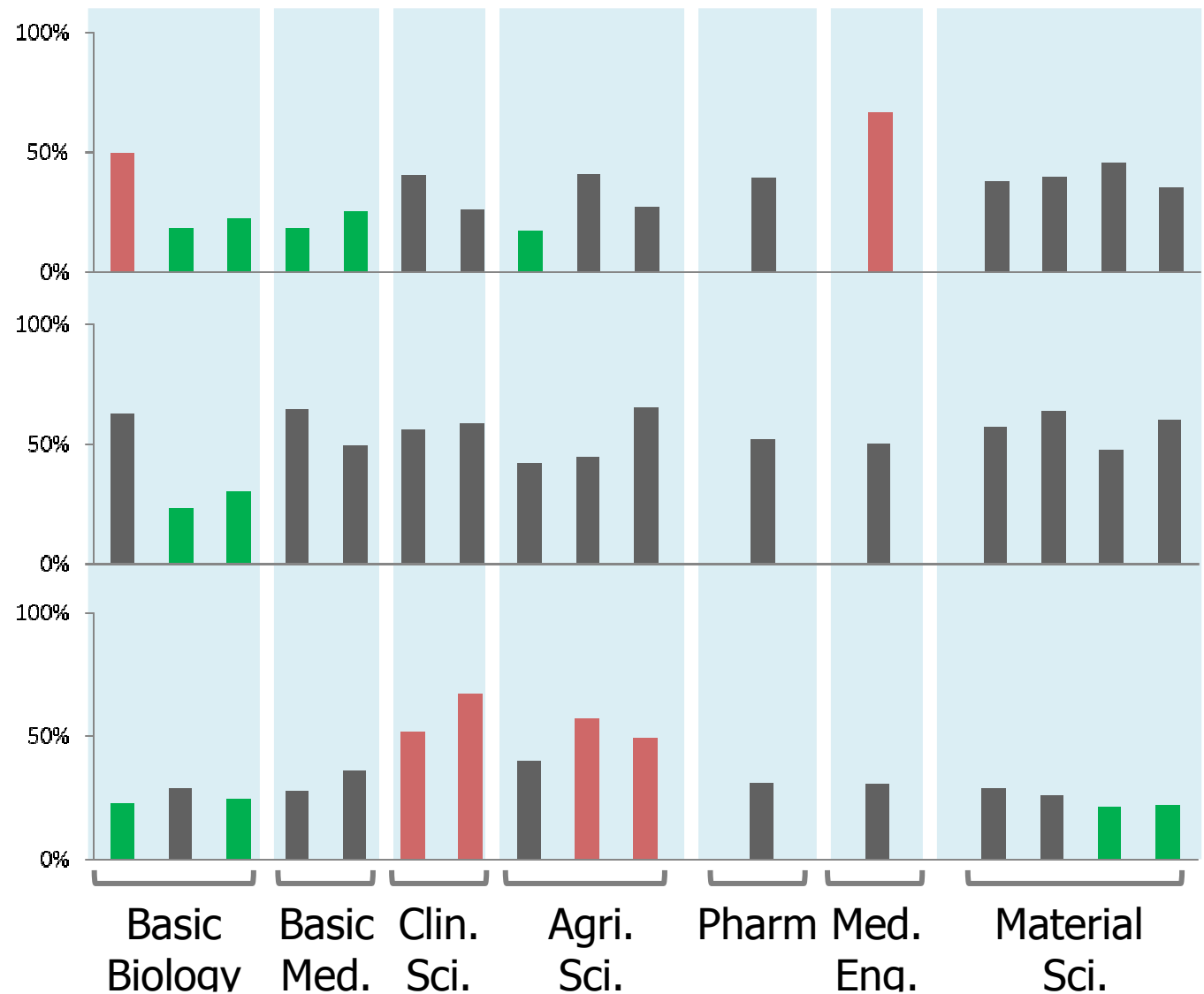
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Scientific-Field Characteristics

X) Prevalence of commercialization
(%involved in commercial activities)

Y) Reciprocal climate
(%coauthorship-based material requests)

Z) Laboratory network intensity
(%alumni in laboratory members)



Diapositiva 21

S10

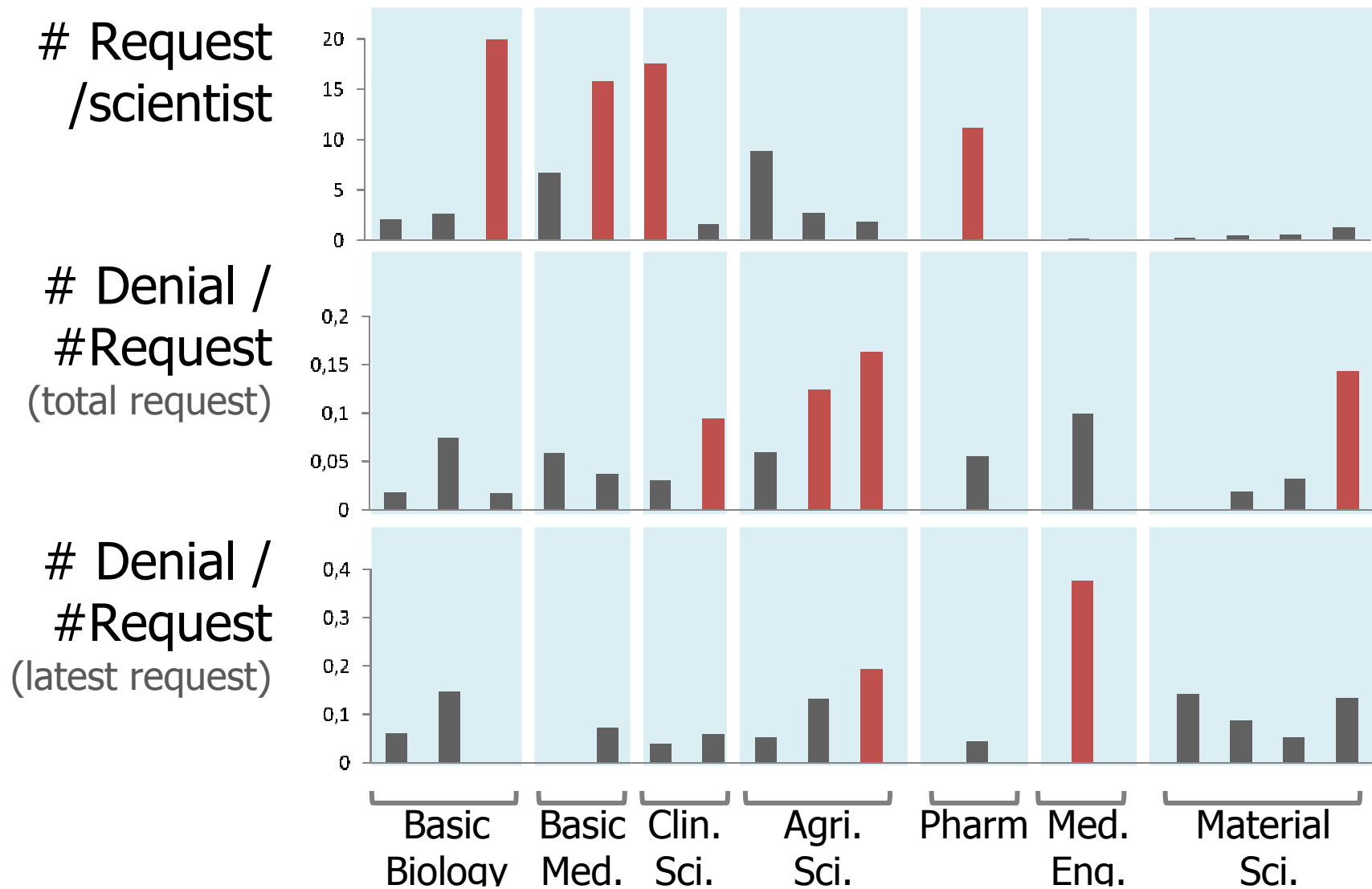
scale of vertical axes => OK

Horizontal axes: field name: high level => OK

c) delete => OK

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Frequency & Denial Ratio of Material Transfer



Field characteristics

	Comm ercial	Recip	Lab	Compli ance	
Basic biology	L	L	L	H	Traditional communism norms seem working
Basic medicine	L	M	M	M	
Clinical science	H	H	H	M	Closed network + exchange-based, denial for outsiders
Agricultural science	L	L	H	L	Closed network, inside free, deny outside
Pharmaceutical	H	M	M	M	Commercialized
Medical engineering	H	M	M	L	
Material science	H	H	L	M	Exchange based

Discussion

- Three types of motivations (Scientist level)
 - Commercial based
Commercial involvement: NOT clear effect
 - Exchange based
Greedy scientists deteriorate academic cooperation
 - Social network based
Material flow is restricted within limited collaborators

Diapositiva 24

S17 logic

user of materials from repository are required to provide theirs when someone requires. and the repository facilitates the submission of materials on behalf of other scientists.

how do american universities distribute money?

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Discussion

■ Field effect

● Prevailing commercialization

=> Exchange-based motivation

- ◆ To disconnect reciprocal relationship;
e.g., central repository, fund/journal rule & policing
- ◆ To standardize rewards & increase exposure;
e.g., compulsory citation, linking journal & repository

● High network intensity

=> Social-network-based motivation

- ◆ To bridge cliques; e.g., visiting positions
- ◆ To mandate sharing

Diapositiva 25

S46 logic

user of materials from repository are required to provide theirs when someone requires. and the repository facilitates the submission of materials on behalf of other scientists.

how do american universities distribute money?

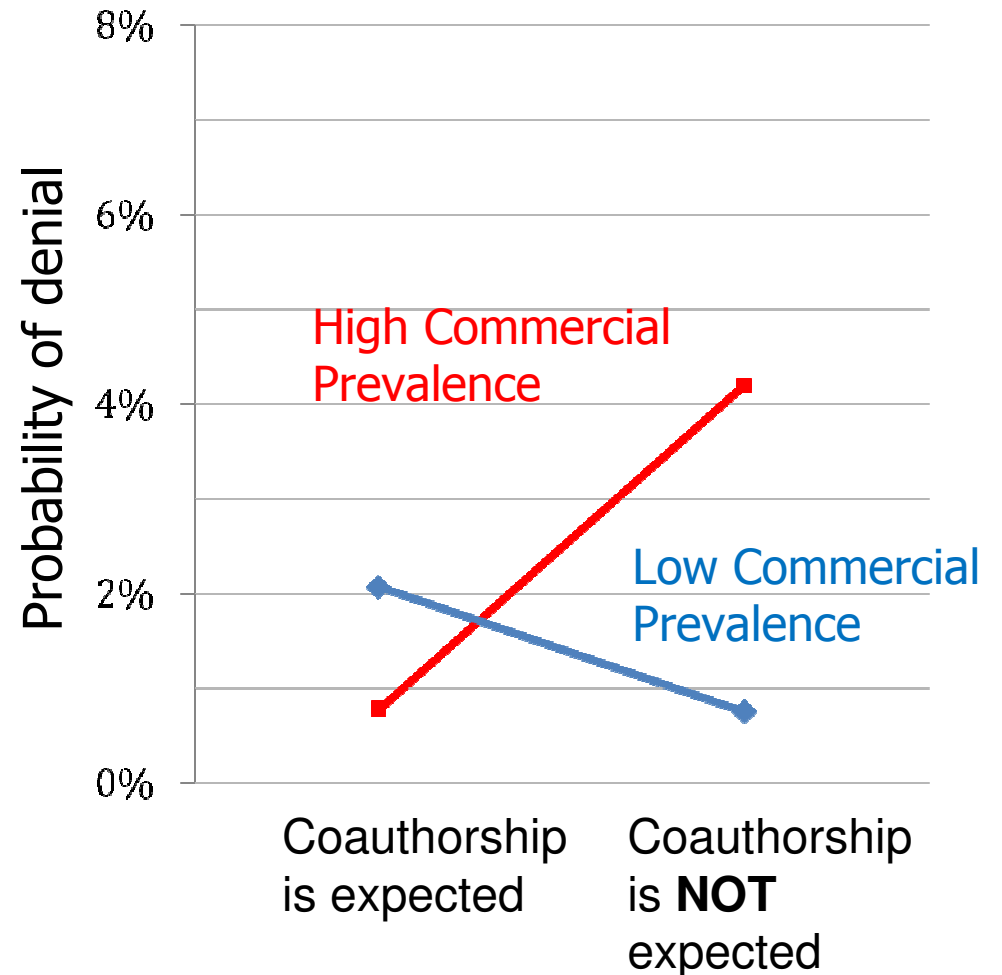
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Field difference

- Normative structure governing scientist behaviors can vary according to historical period, organizational context, changing institutional environment and scientific field (Hackett, 1990)
 - Field difference
 - ◆ Mutual dependence between scientists (Whitley, 1984)
 - ◆ Task uncertainty (Whitley, 1984)
 - ◆ scientific competition (Hagstrom, 1974)
 - ◆ Maturity of science (Crane, 1972)
 - ◆ Marketability of technologies
 - ◆ Size of research expenditure
 - ◆ Mobility of scientists
 - ...etc.

H1: Prevalence of commercialization accelerates Exchange-based behaviors

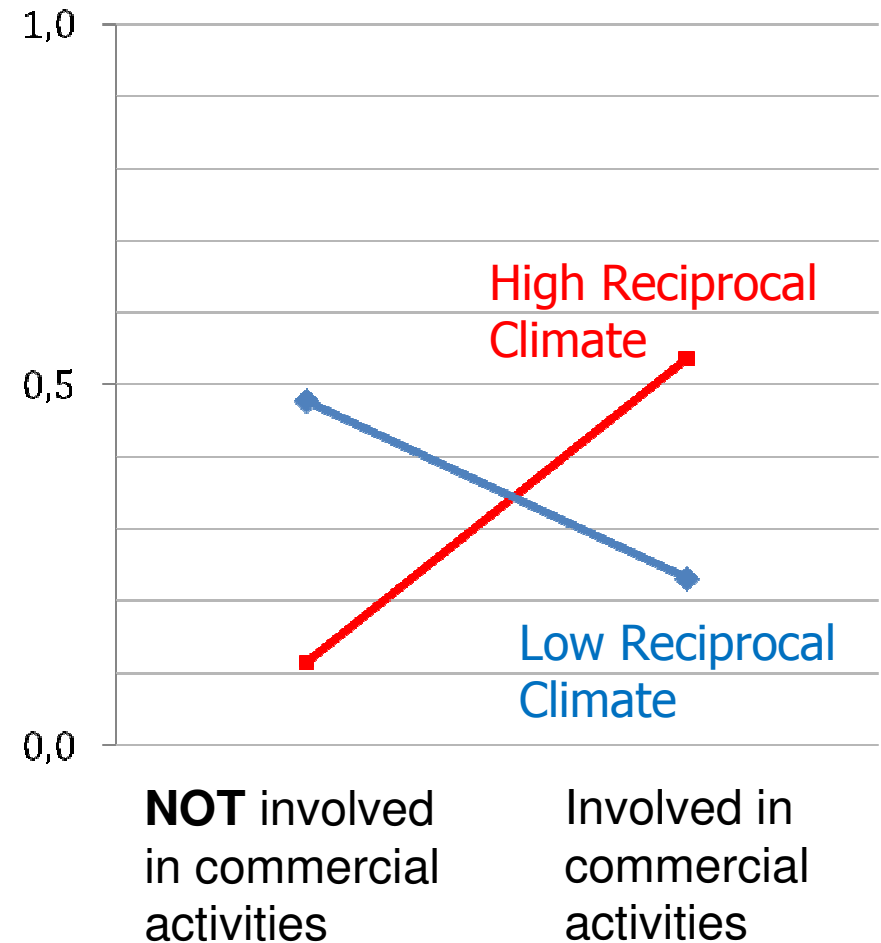
Independent Variable	Coef. (s.e.)
B) Exchange-based Coauthorship is NOT expected	0.97* (0.40)
X) Prevalence of commercialization	2.78 (2.48)
(B) * (X)	7.52* (3.23)



Other variables are omitted from the table. †p<0.1, *p<0.05, **p<0.01

H2: Reciprocal climate aggravate Monetary-value oriented behaviors

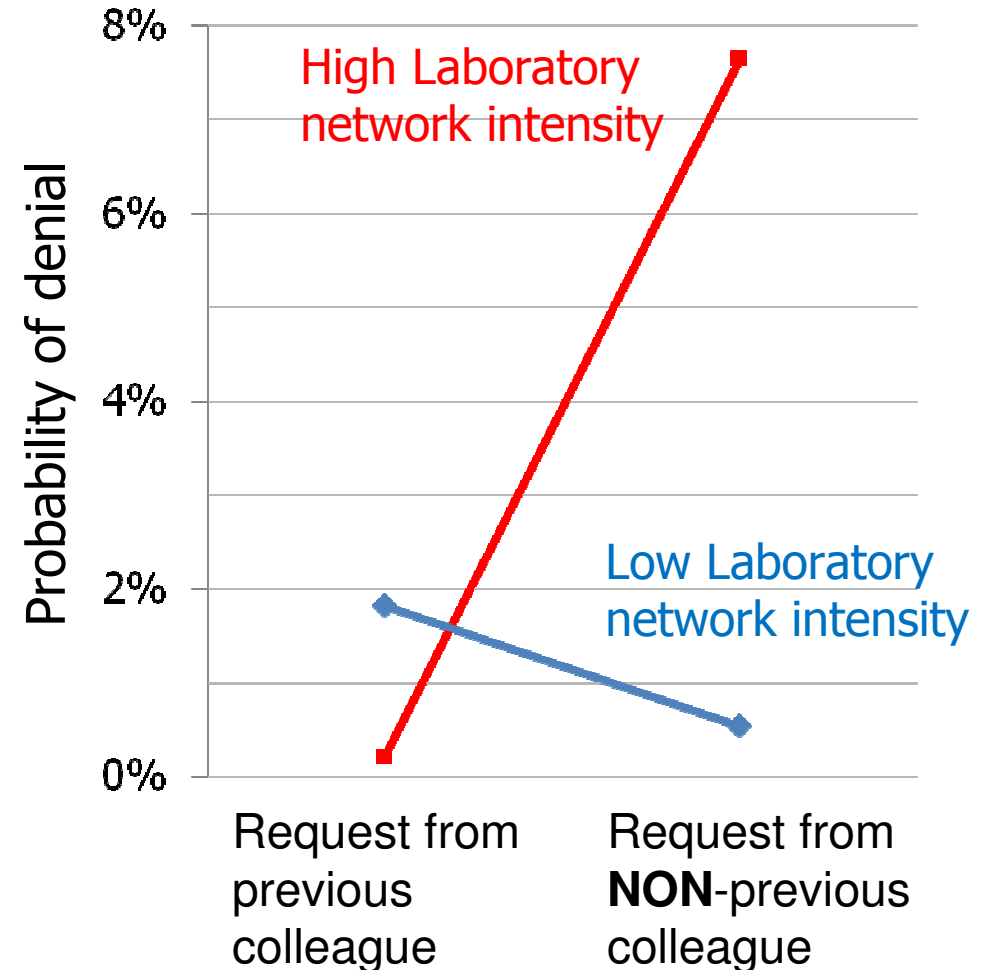
Independent Variable	Coef. (s.e.)
A) Monetary value Involved in commercial activities	0.25 (0.25)
Y) Reciprocal Climate	-0.99 (1.16)
(A) * (Y)	4.13[†] (2.24)



Other variables are omitted from the table. [†]p<0.1, *p<0.05, **p<0.01

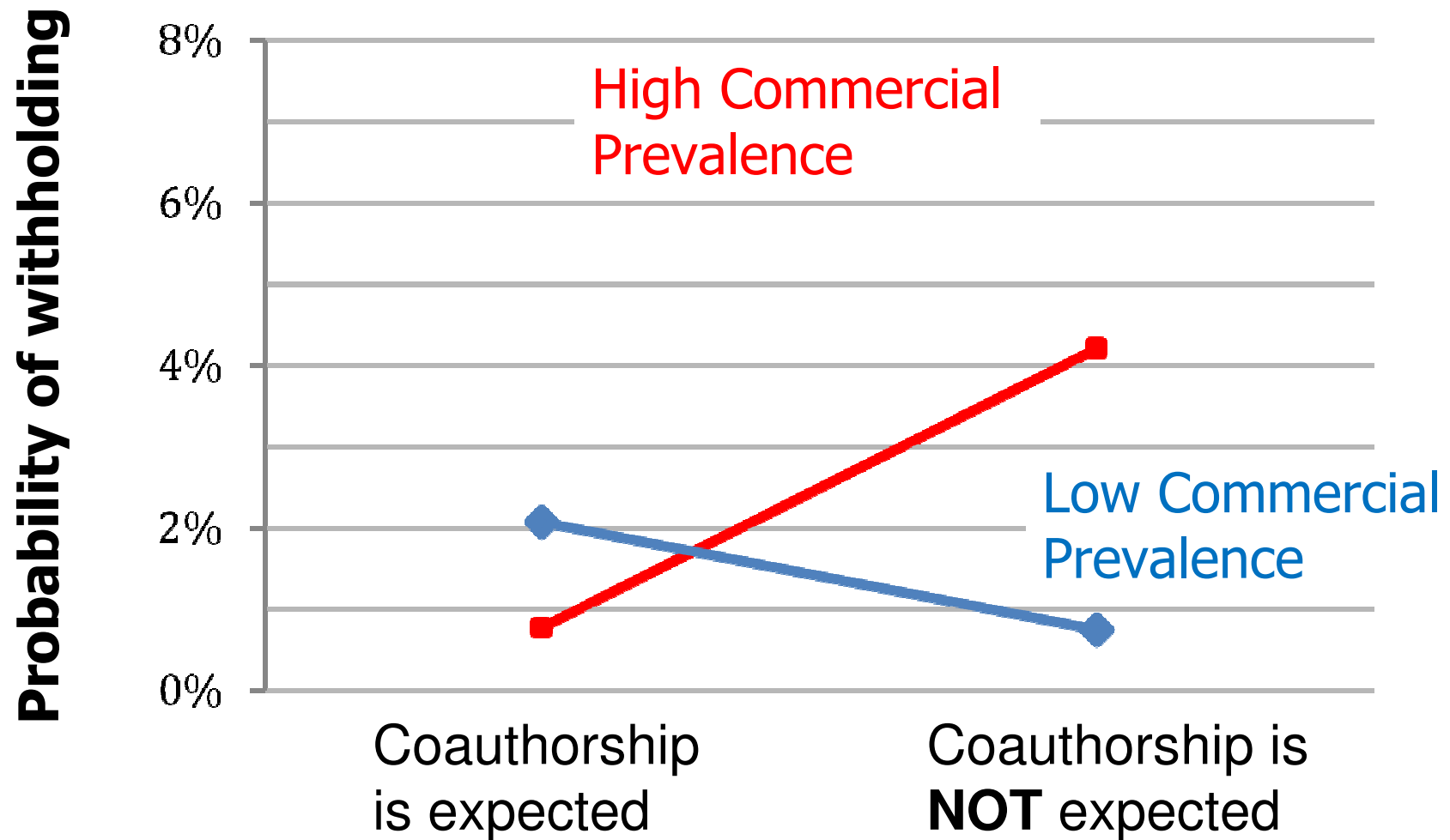
H3: Intense laboratory network restricts material flow in close collaborators

Independent Variable	Coef. (s.e.)
C) Social network Request from non-previous colleague	2.36** (0.85)
Z) Laboratory network intensity	-8.42* (4.20)
(C) * (Z)	9.94* (4.09)

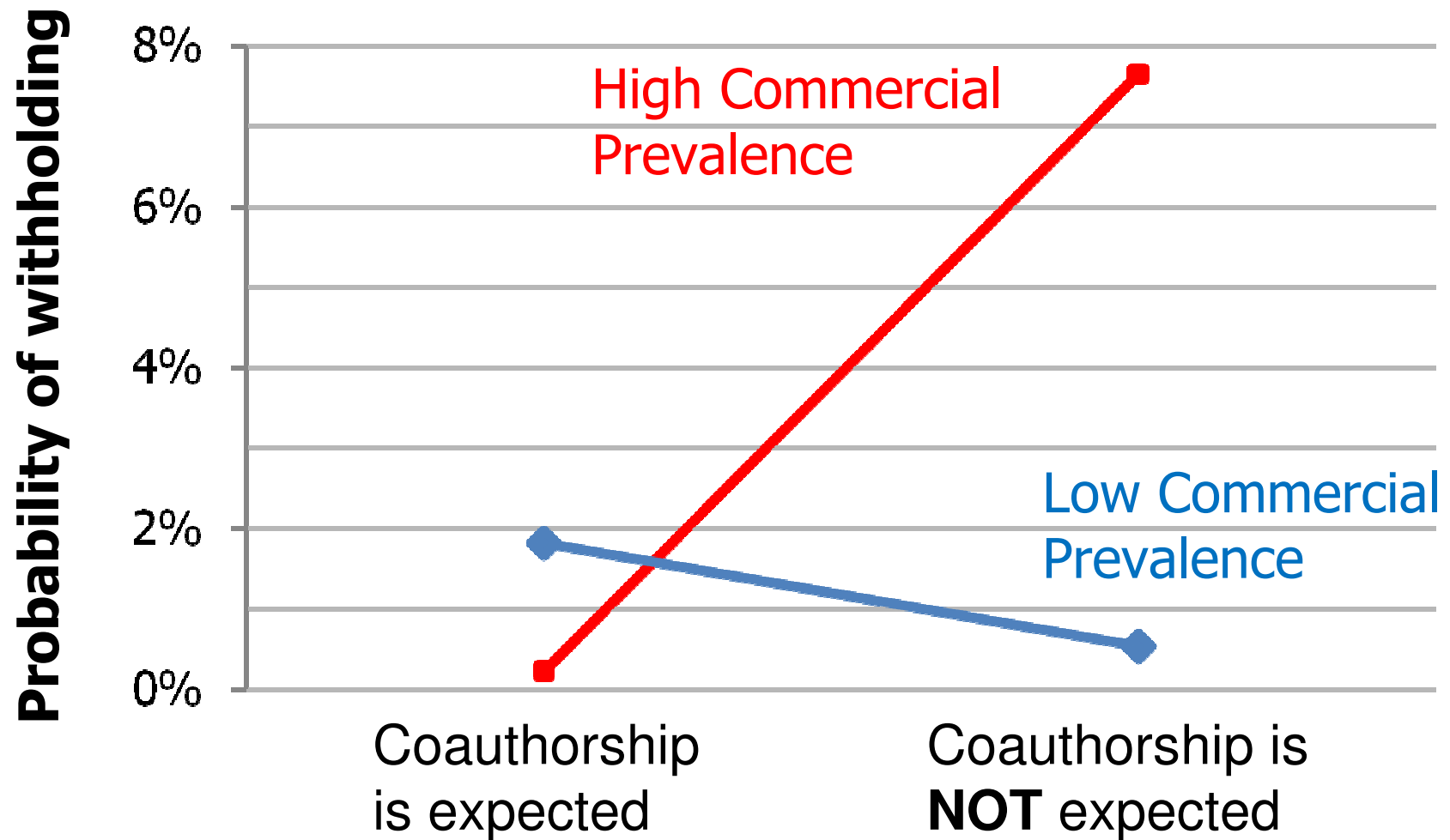


Other variables are omitted from the table. †p<0.1, *p<0.05, **p<0.01

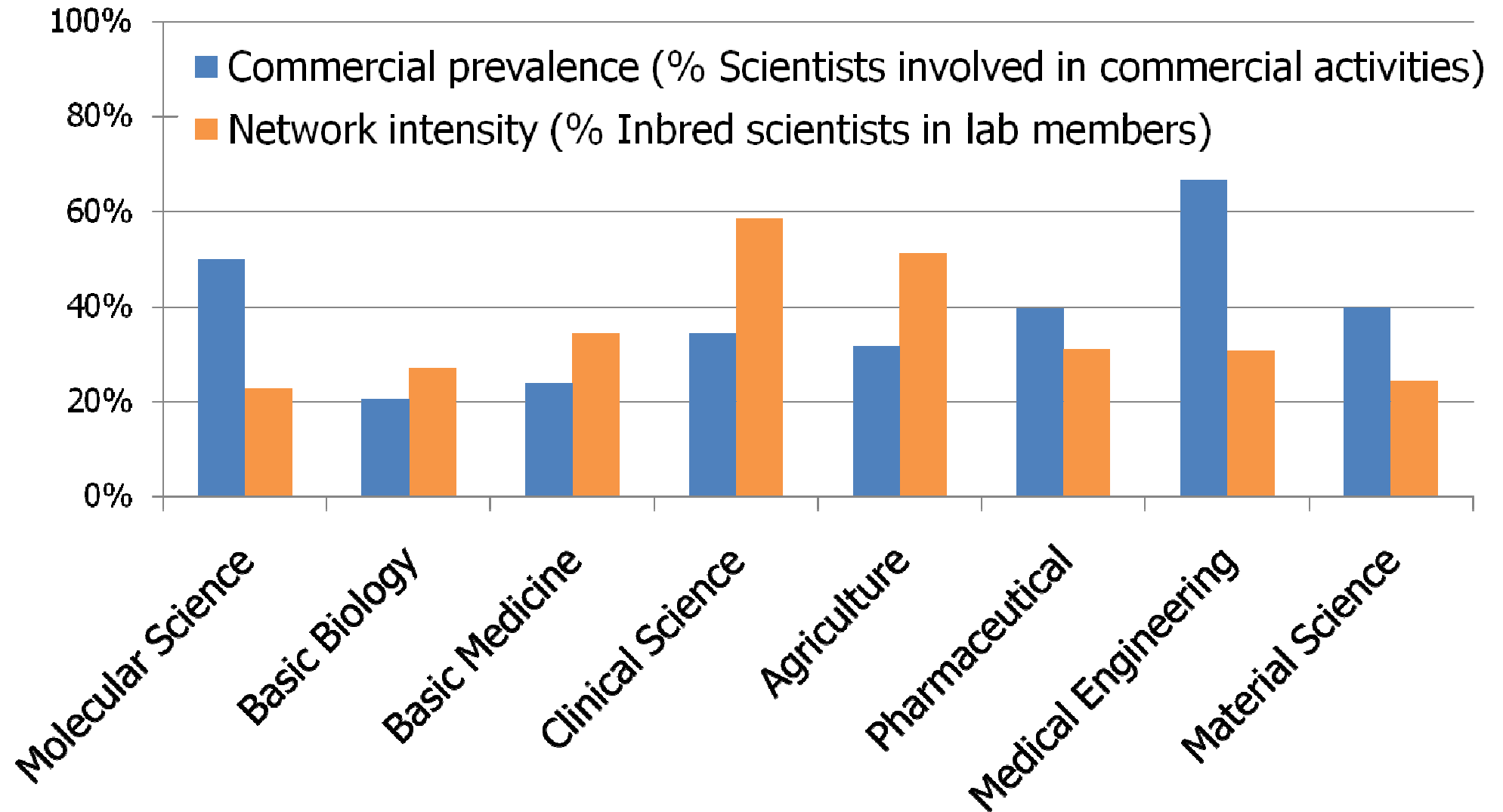
Regression Analysis - Field Effect (1) - Prevalence of Commercialization Facilitates Exchange-based motivation



Regression Analysis - Field Effect (2) - Laboratory network intensity facilitates social-network-based motivation



Scientific-Field Characteristics



Diapositiva 32

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field level,
later used in regressions
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Discussion

- Commercialization can accelerate exchange-based behaviors of non-commercial active scientists
 - Greedy demand in return for material transfer
 - Unreasonable demander, deteriorate material flow
 - Although academic entrepreneurship is a potential mechanism to expand practical application of academic research, it could deteriorate very basic cooperative relationship inside the academia.
 - Commercialization for communal purpose in Mat.Sci

- Reciprocal climate can aggravate Monetary-value-based behaviors
 - Imply difficulty of reward system
 - Control of financial income alleviates monetary-based behaviors
- Intense laboratory network restricts material flow in close collaborators
 - Policy for increasing mobility; visiting post, non-permanent post

- Conclusion
 - Facilitate scientist cooperation based on field characteristics