Sources and impacts of the research at Pasteur's quadrant

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Outline

I. Background and research questions

II. How important is “Pasteur's Quadrant”?

III. Funding sources of research in “Pasteur's Quadrant”

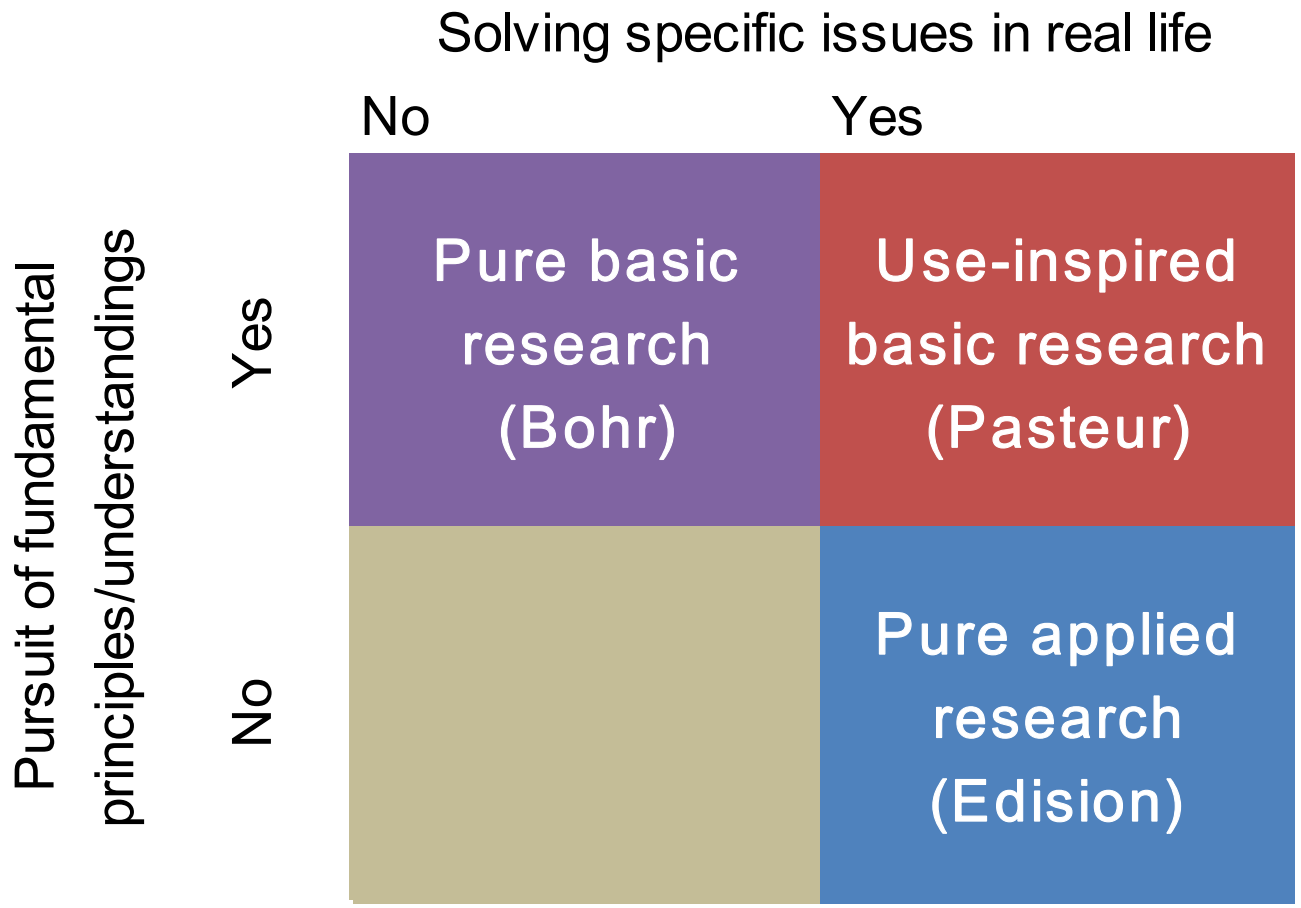
IV. Scientific and technological performance of research at Pasteur's Quadrants

I. Background and research questions

- **Definition of basic research** by Frascati manual 1993
  - "**Basic research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, *without any particular application or use in view*"
  - Basic research, Applied research, Experimental development

- Stokes(1997) points out the importance of "**Use-inspired basic research** "

Use-inspired basic research



Benefits of Pasteur's Quadrant research

- It strengthens the synergy between the science and technology.
  - Use-inspired basic research can help solving the bottleneck in the process of technological application of science (→ more technology).
  - Use-inspired basic research can help open a new area for science (→ more science).
- Thus, it increases the social return on investing in basic science (Stokes (1997)).

There are also concerns

- Concerns over potential crowding out of research at “Bohr’s Quadrant” :
  - “Applied research invariably drives out pure” if two are mixed (Bush (1945))
  - Goldfarb (2008) on the effects of mission-oriented funding
- Concern also over patenting basic science
  - Murray and Stern (2007) on the effects of patenting on access to research papers

Research questions

- How important is Pasteur's Quadrant ?
  - Linkage to the fields of science
- Which funding agencies support researches in “Pasteur's Quadrant”?
  - Is there a funding constraint on such research in size and in the funding criteria?
- Does research in “Pasteur’s Quadrant "perform well in scientific term and technological term?

Data used for analyzing these questions

- We use Hitotsubashi Univ-NISTEP-Georgia Tech scientists survey in Japan and the US.
- Basic findings are reported in the following working paper:
  - "Knowledge creation process in science: Key comparative findings from the Hitotsubashi-NISTEP-Georgia Tech scientists survey in Japan and the US" (http://www.iir.hit-u.ac.jp/iir-w3/file/WP11-09NagaokaIgamiWalshIjichi.pdf)

Hitotsubashi-NISTEP-Georgia Tech scientists survey

Population of the survey

- Articles and letters in the Science Citation Indexes-Expanded (Thomson Reuters)
- Time window: 2001 – 2006 (database year)
- 22 fields in the ESI
- The papers of multidisciplinary field were reclassified based on the backward citations.

Questionnaire

- Inputs
- Research team
- Motivation and process
- Knowledge source and management
- Research Environment
- Personal Environment
- Outputs
- Commercialization

Identification of possible focal papers

- Highly Cited Papers
  - Top 1% highly cited papers in each journal field and in each database year (approximately 3,000 in total).
- Normal Papers
  - Randomly selected papers in each journal field and in each database year from the population of the survey (approximately 7,000).

Response rate

Survey was conducted in JPN and USA

- JPN: 27.2% (2,081/7,652)
- USA: 26.3% (2,329/8,864)

Relation between the 22 ESI journal fields, 10 fields, and the large 3 fields

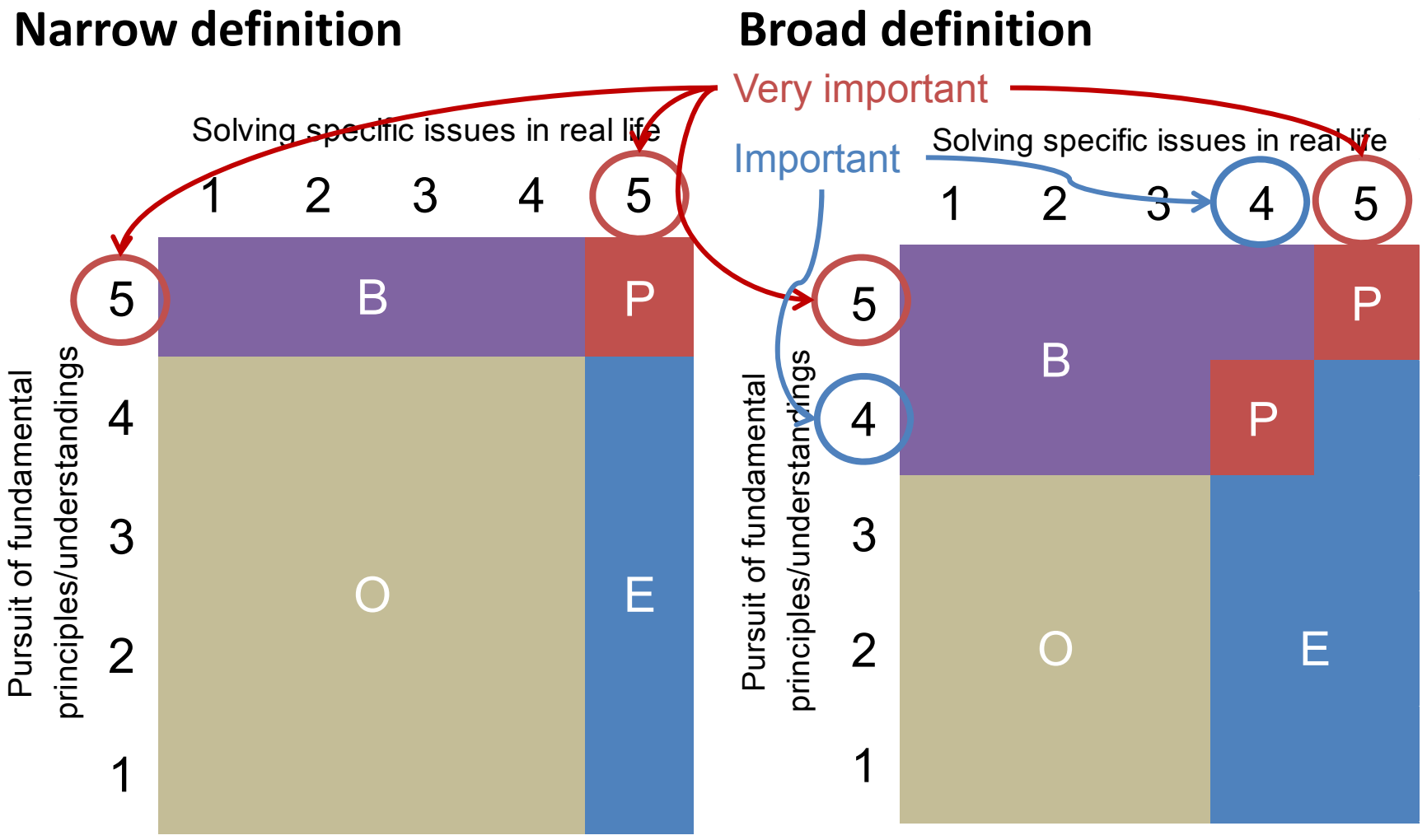
22 ESI journal fields	10 fields	large fields
Chemistry	1_Chemistry	Physical Sciences
Materials Science	2_Materials Science	
Physics	3_Physics&Space_Science	
Space Science		
Computer Science	4_Computer Science&Mathematics	
Mathematics		
Engineering	5_Engineering	
Environment/Ecology	6_Environment/Ecology&Geosciences	
Geosciences		
Clinical Medicine	7_Clinical Medicine&Psychiatry/Psychology	Medicine
Psychiatry/Psychology		
Agricultural Sciences	8.1_Agricultural Sciences&Plant & Animal Science	Life Sciences
Plant & Animal Science		
Biology & Biochemistry	8.2_Basic Life Sciences	
Immunology		
Microbiology		
Biology & Biochemistry		
Neuroscience & Behavior		
Pharmacology & Toxicology		
Multidisciplinary	Either of 22 ESI journal fields was assigned based on the analysis of the backward citations	Either of 22 ESI journal fields was assigned based on the analysis of the backward citations
Economics & Business	S_Social Sciences	
Social Sciences, general		

II. How important is “Pasteur's Quadrant”?

- We use the importance of the two basic motivations of the research project in order to determine where the project is located in the Stokes’ quadrant model of scientific research.

- Pursuit of fundamental principles/understandings
- Solving specific issues in real life

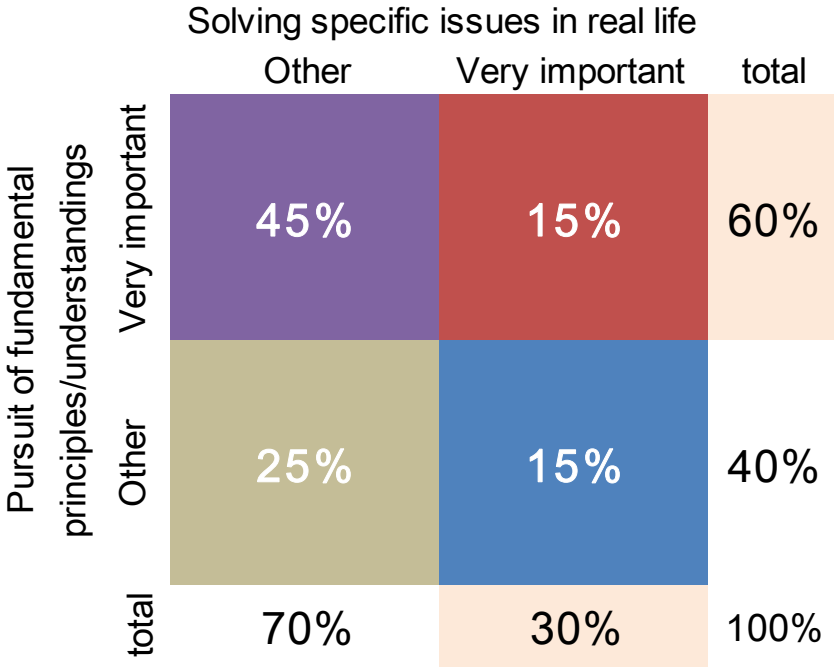
Mapping of research projects to quadrant



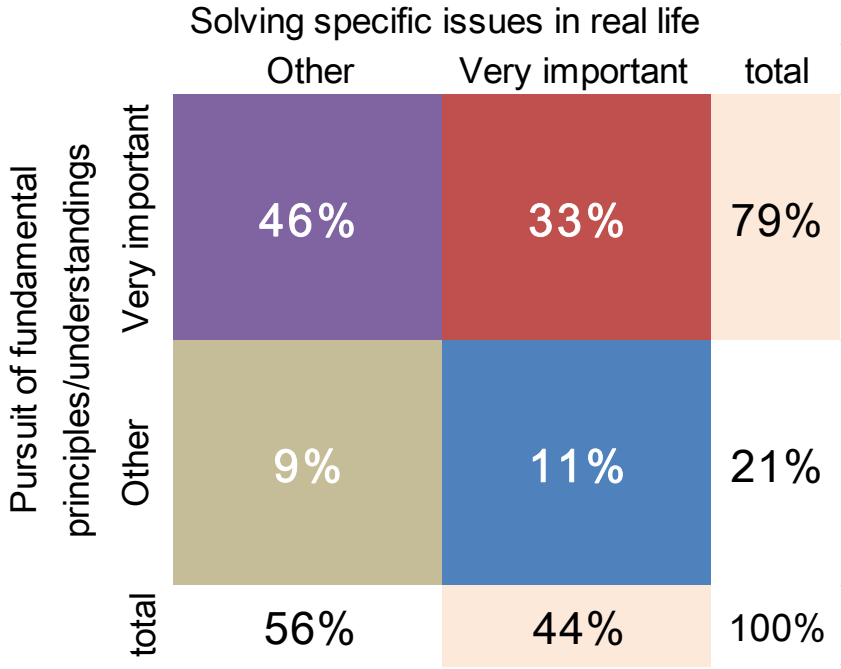
<How important is “Pasteur's Quadrant”>

Distribution of the H projects by quadrant (JP vs. US), narrow definition

(a) Japan



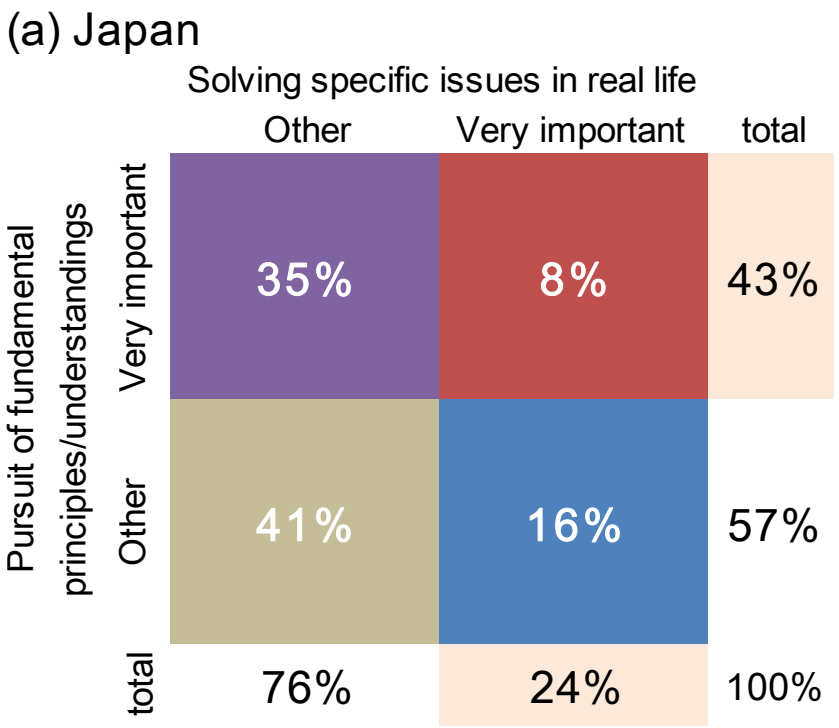
(b) USA

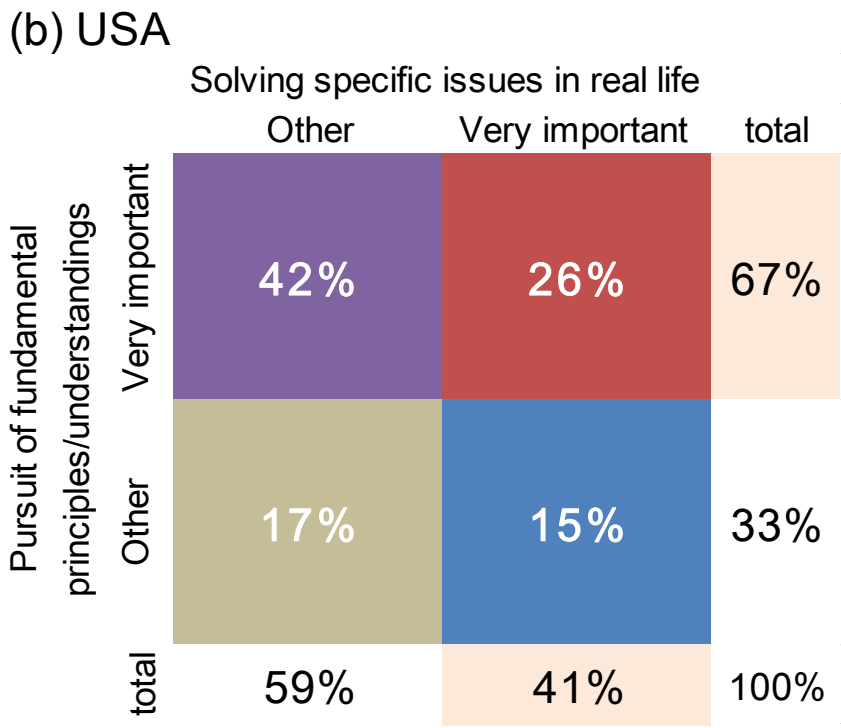


Note: Results weighted by field.

<How important is “Pasteur's Quadrant”>

Distribution of the N projects by quadrant (JP vs. US), narrow definition





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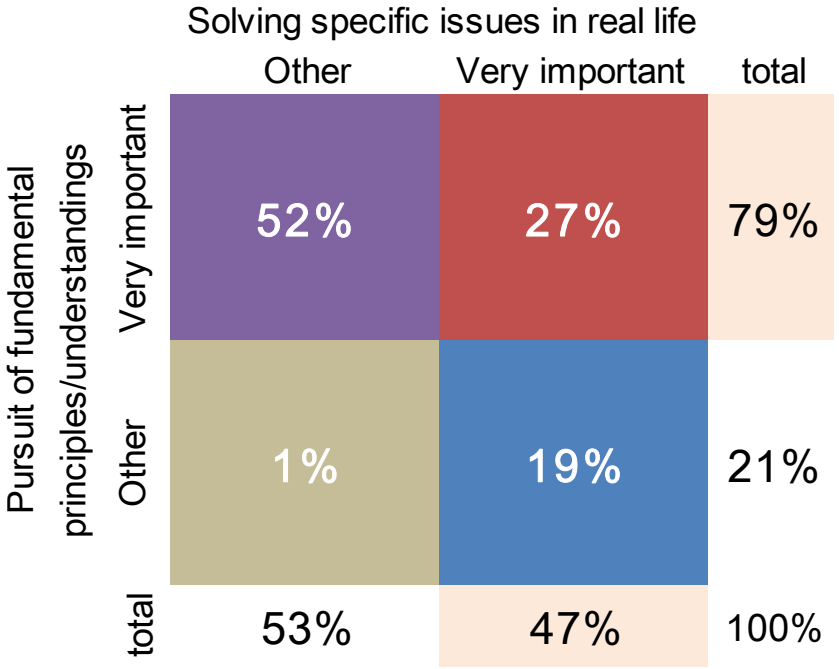
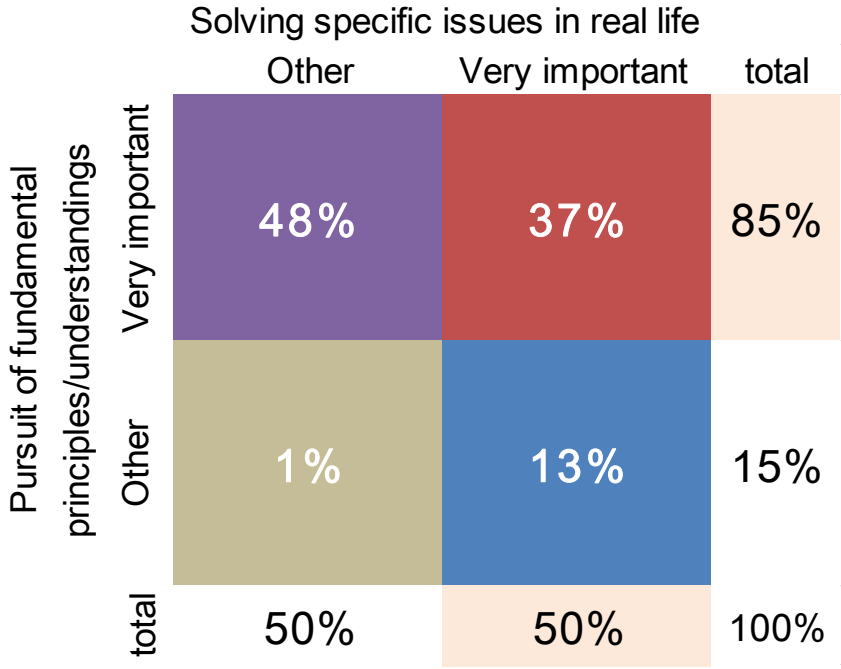
<How important is “Pasteur's Quadrant”>

Distribution of the H projects by quadrant (JP vs. US), broad definition

(a) Japan



(b) USA



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Distribution of the N projects by quadrant (JP vs. US), broad definition

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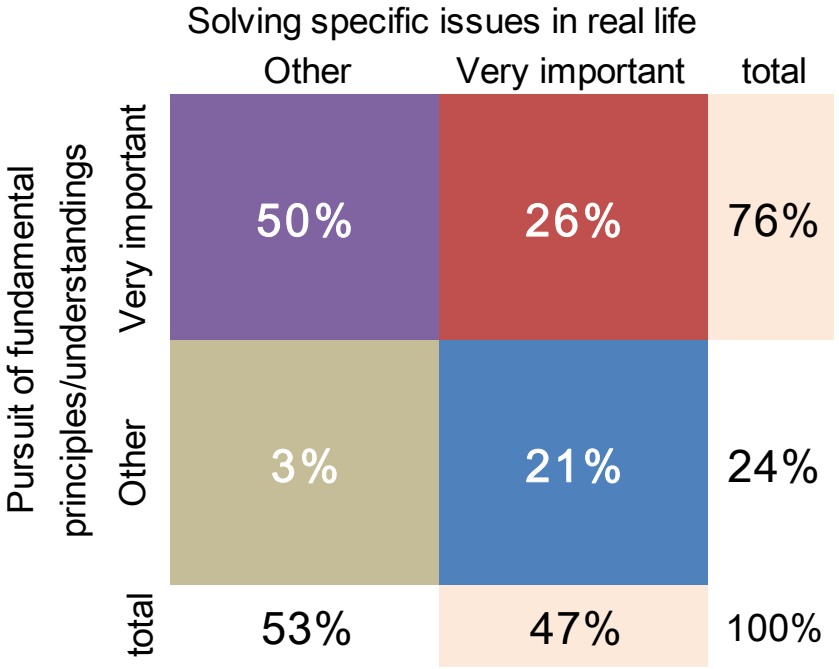
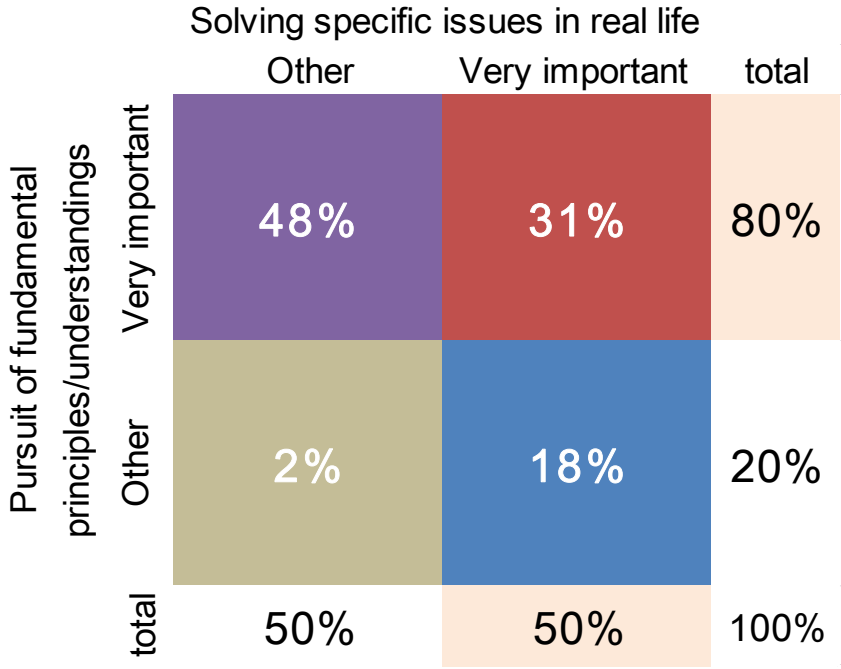


(b) USA

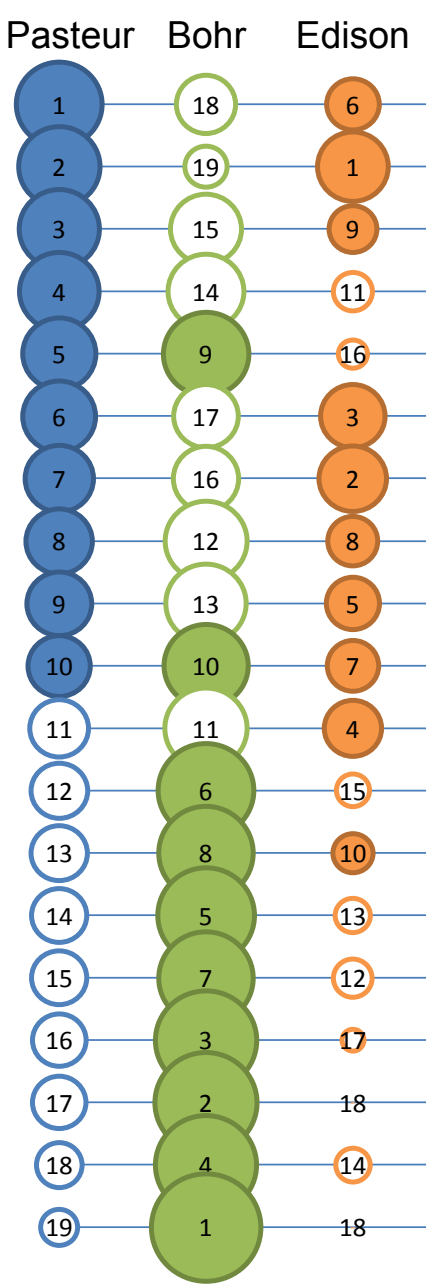


Note: Results weighted by field.

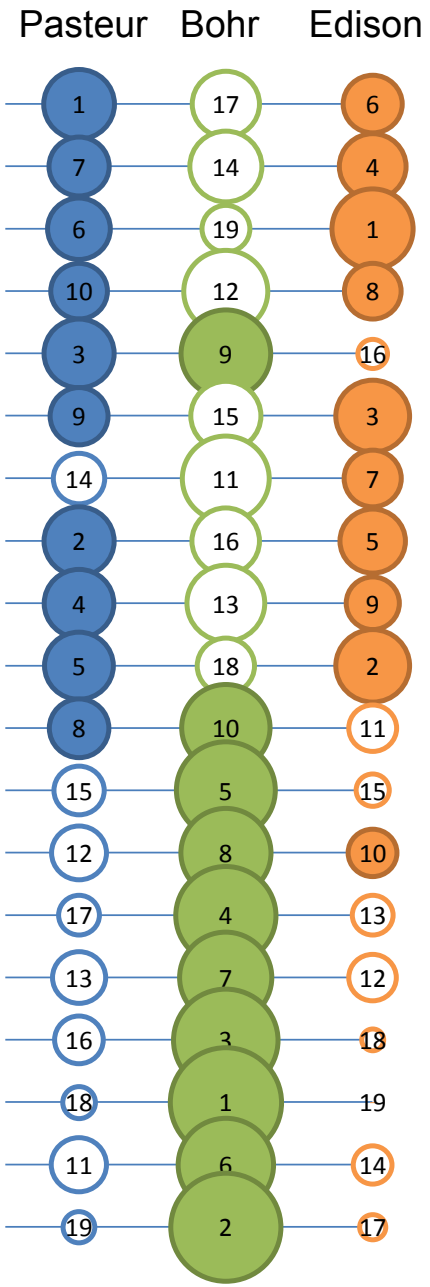
<How important is “Pasteur's Quadrant”>

Quadrant by field (Broad definition, H+N)

USA



7_1_Clinical Medicine
8_1_Agricultural Sciences
8_7_Pharmacology & Toxicology
8_4_Microbiology
8_3_Immunology
5_Engineering
6_1_Environment/Ecology
2_Materials Science
7_2_Psychiatry/Psychology
4_1_Computer Science
8_8_Plant & Animal Science
8_2_Biology & Biochemistry
1_Chemistry
8_6_Neuroscience & Behavior
6_2_Geosciences
8_5_Molecular Biology & Genetics
4_2_Mathematics
3_1_Physics
3_2_Space Science



JPN

Findings

- In both countries, Bohr’s quadrant is the most important and accounts for a similar share.
- Pasteur’s quadrant comes next in both countries. It is more important in the US than in Japan under broad definition, even controlling for the propensity to say “important” or “very important.”
  - This US-Japan difference is due to more choice of “very important” category by the US scientists for the two objectives.
  - However, Pasteur’s quadrant remains more important in the US when we replace “very important” threshold by the threshold of “very important” or “important.”
- Edison’s quadrant is equally important (or less important) than Pasteur’s quadrant.
- Bohr’s quadrant and Pasteur’s quadrant are more important in H projects than in N projects.

Findings, cont.

- Strong linkage between fields of science and quadrant model.
- The balance of Pasteur’s quadrant is relatively high in Clinical Medicine & Psychiatry/Psychol (both Japan and the US), Agricultural Sciences (the US), and Materials Science (Japan).
- Bohr’s and Pasteur’s quadrants are equally important in Immunology.
- The balance of quadrants in Japan and the US shows remarkable differences in some fields.
  - Environment/Ecology (Smaller share of Pasteur’s quadrant in Japan)
  - Computer Science (Smaller share of Bohr’s quadrant in Japan)

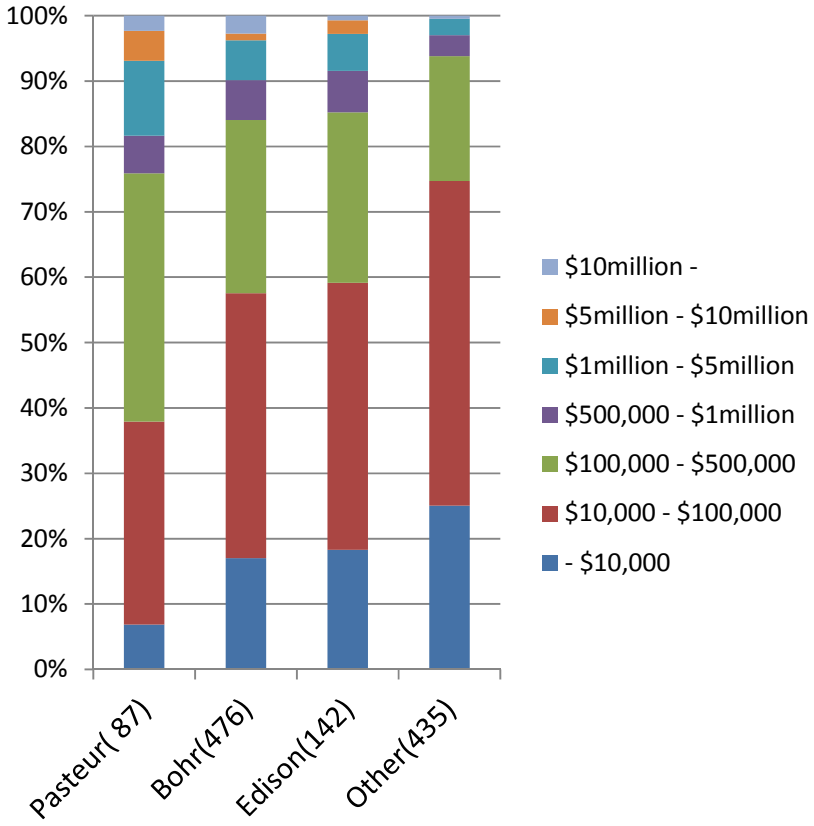
III. Funding sources of research in “Pasteur’s Quadrant” by university scientists

- Is there a funding constraint on such research in size and in the funding criteria?
  - Research in Pasteur’s Quadrant may require a larger scale of research funding.
  - The scientists may have to combine different sources for funding in implementing such research, if funding agencies are specialized for Bohr and for Edison.

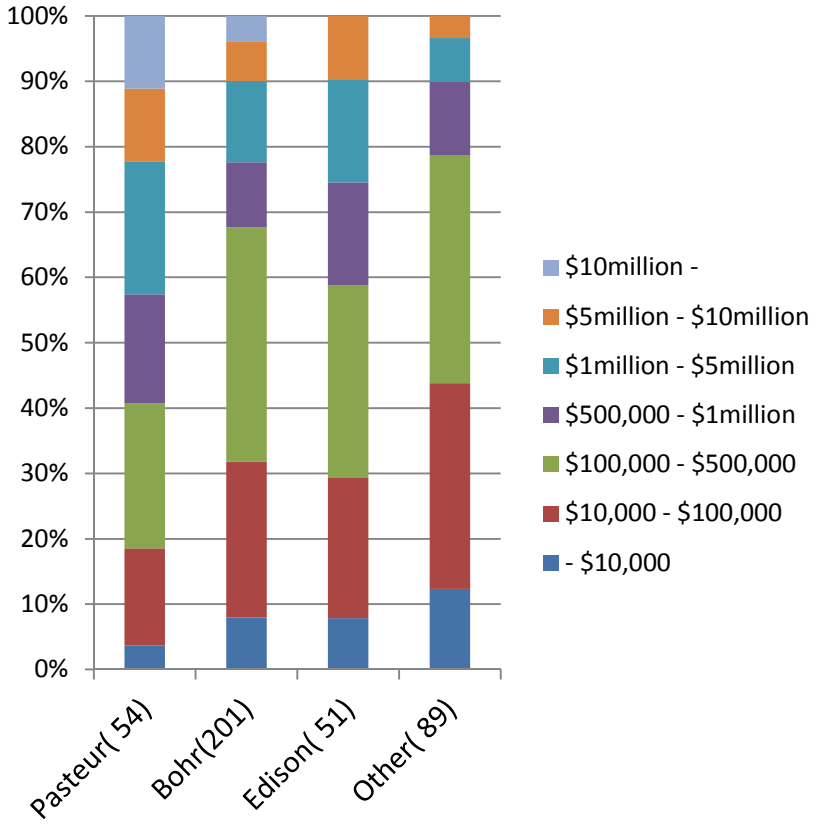
<Funding sources of research in “Pasteur’s Quadrant”>

Amount of research fund by quadrant (JPN, Univ.)

JPN, N projects

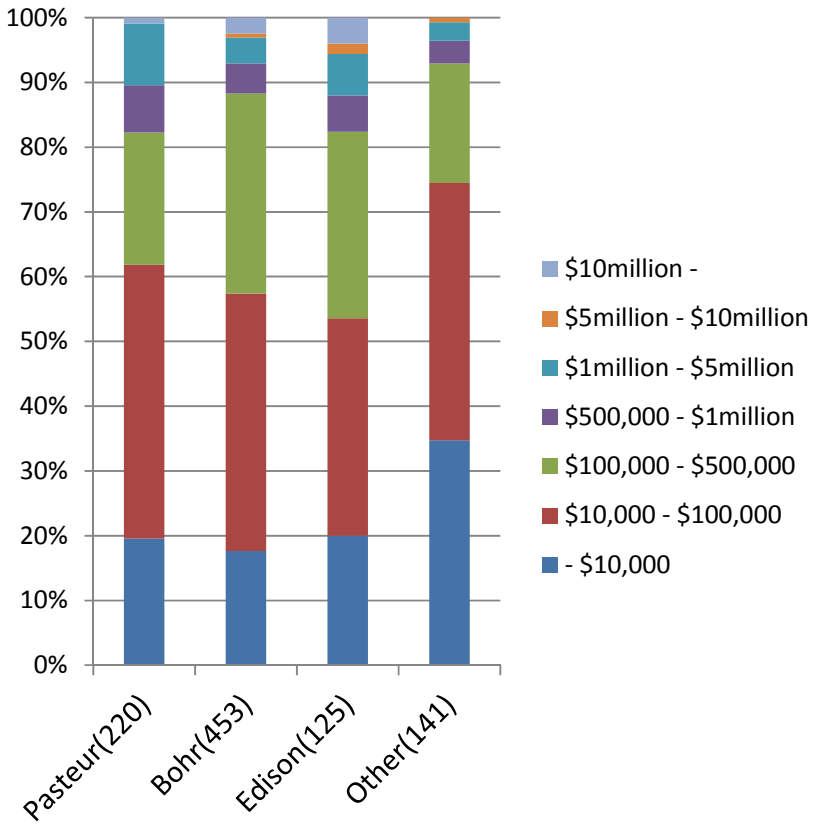


JPN, H projects

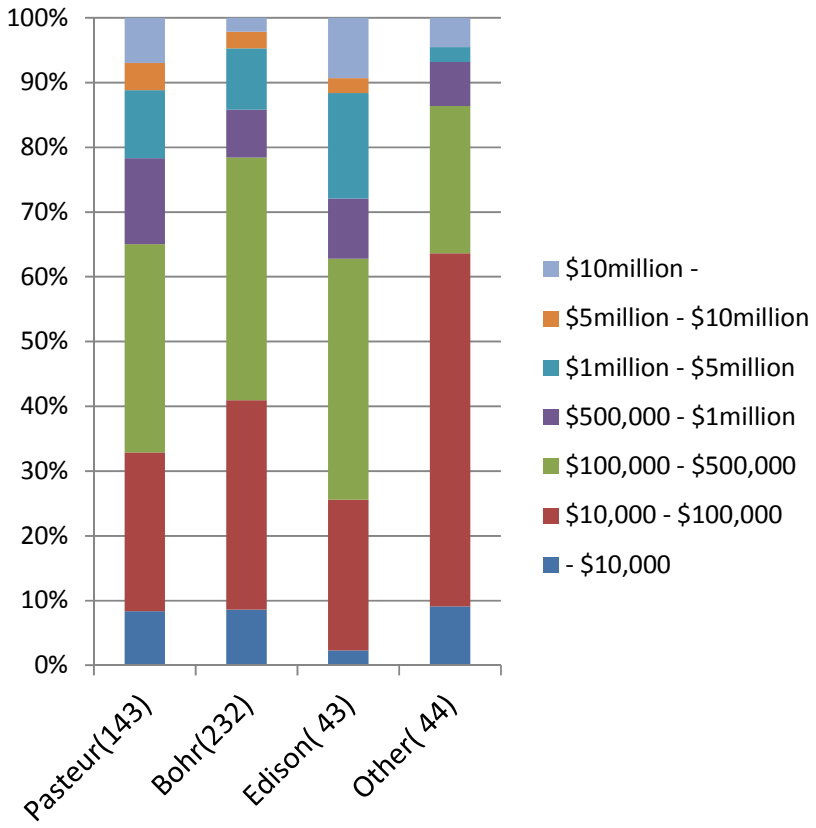


Amount of research fund by quadrant (USA, Univ.)

USA, N projects



USA, H projects



Relative Size
(Log, relative to the other quadrant)

	JPN		USA	
	N projects	H projects	N projects	H projects
Pasteur	1.48	1.76	0.72	0.93
Bohr	0.62	0.48	0.72	0.58
Edison	0.65	0.70	0.99	1.32

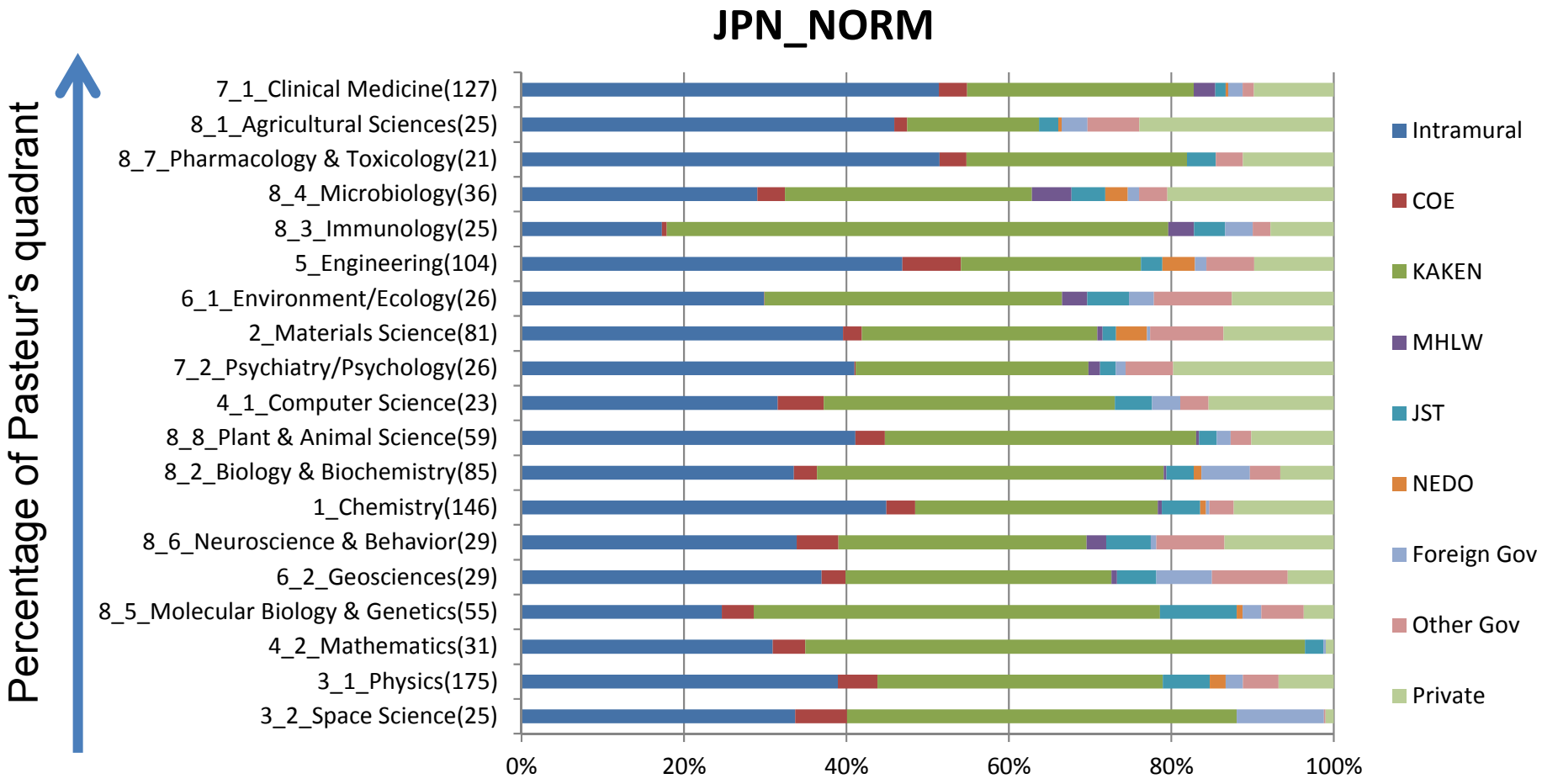
10 fields dummy controlled.

$$\ln(\text{Pasteur}) = \ln(\text{Other}) + \Delta$$

If $\Delta = 0.72$, Pasteur ~ $2 \times$ Other

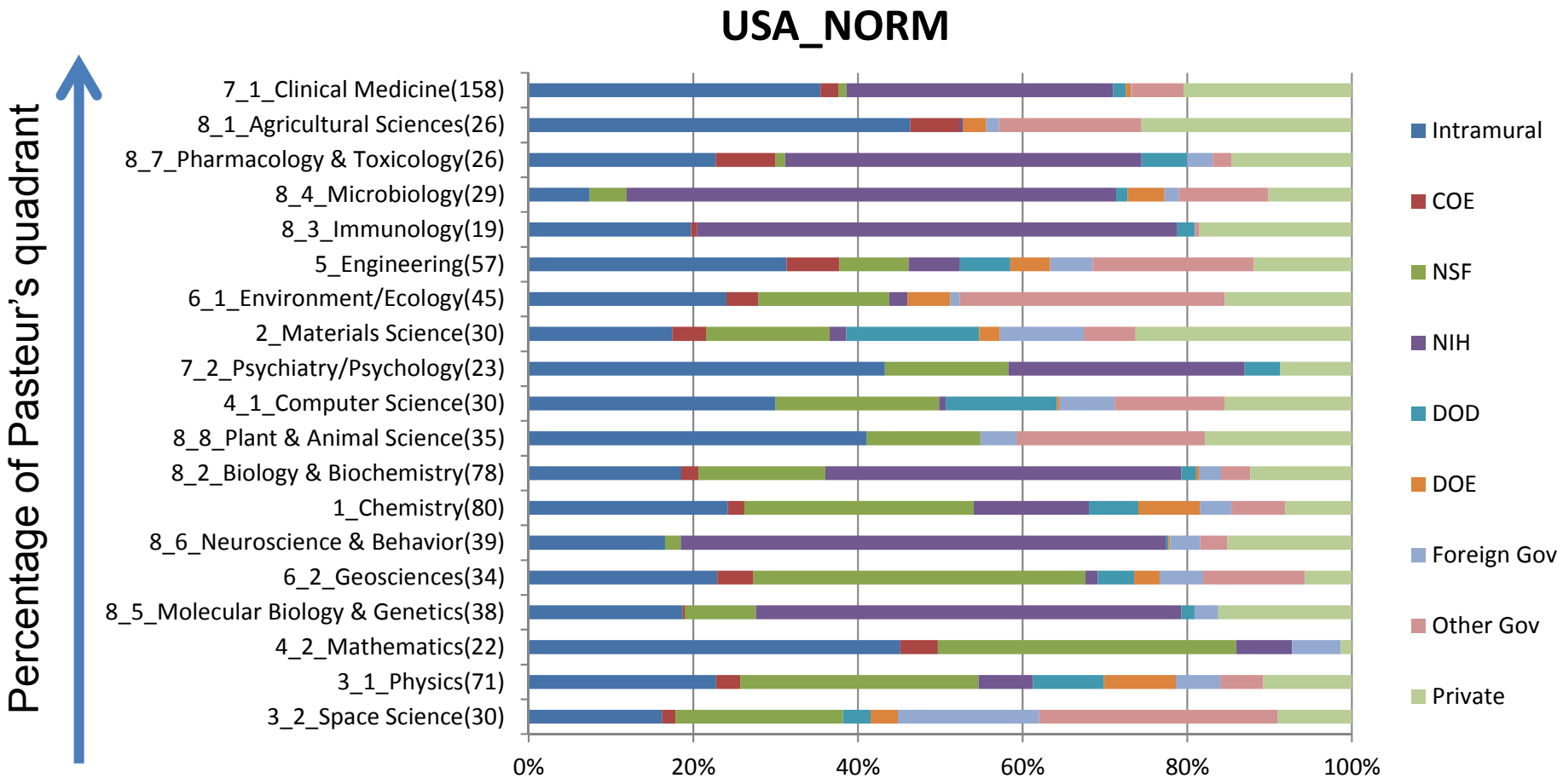
<Funding sources of research in “Pasteur’s Quadrant”>

Fields of science vs. funding source, (JPN, Univ.)



<Funding sources of research in “Pasteur’s Quadrant”>

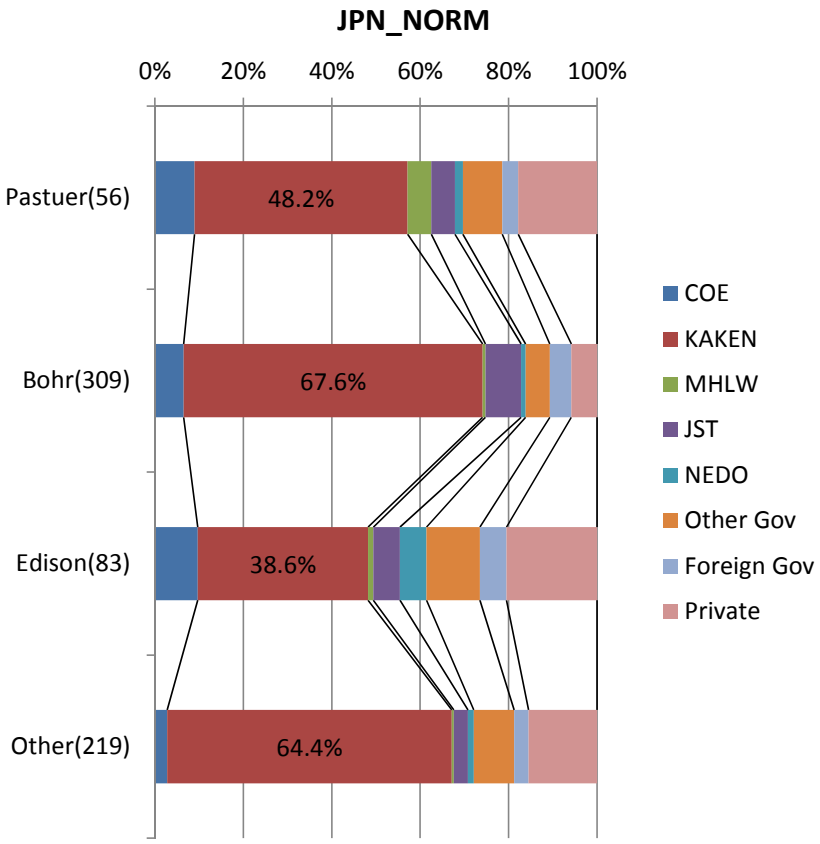
Fields of science vs. funding source, (USA, Univ.)



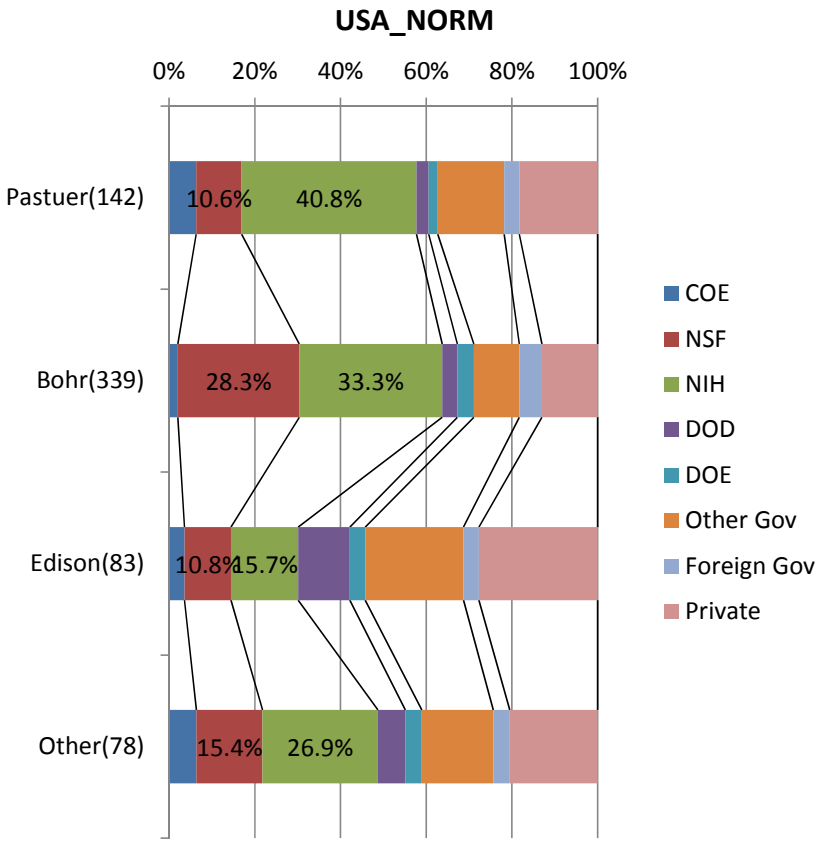
<Funding sources of research in “Pasteur’s Quadrant”>

Composition of the largest external fund used in projects by quadrant

JPN



USA

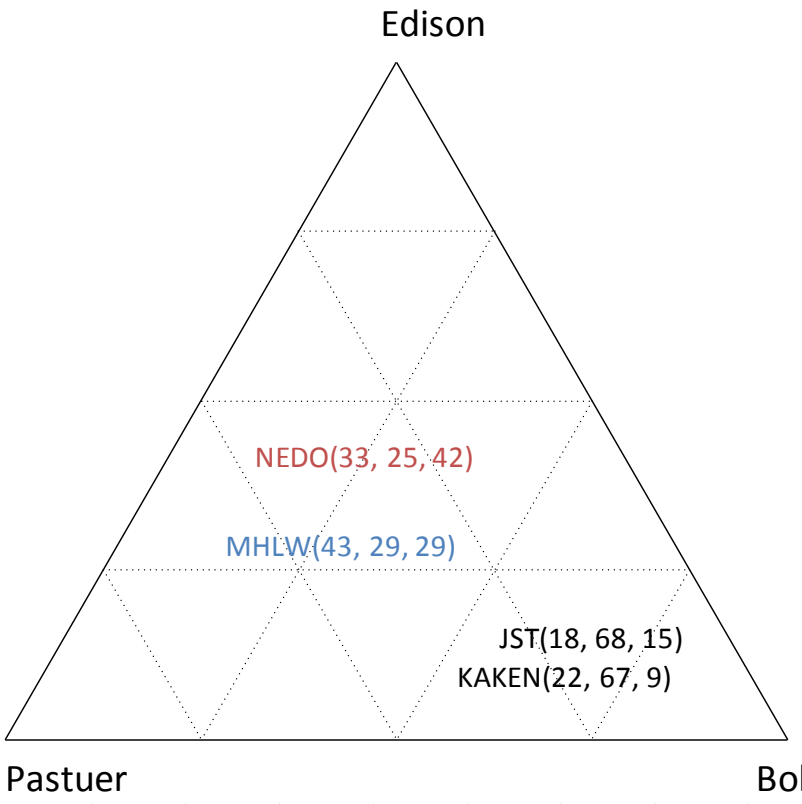


Note: Research projects whose largest funding source is intramural fund are excluded.

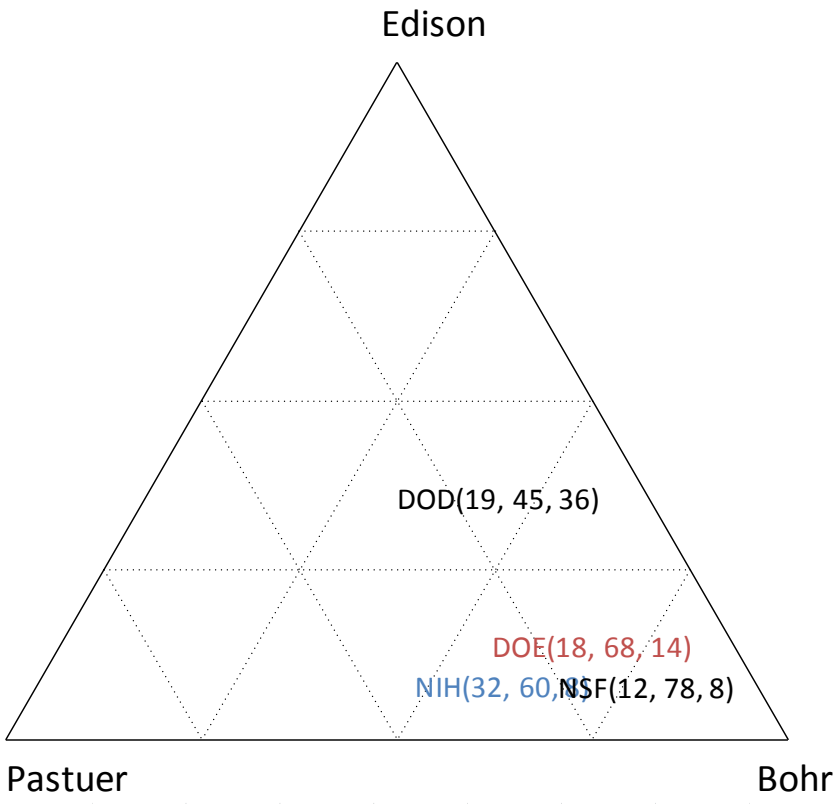
<Funding sources of research in “Pasteur’s Quadrant”>

Characterization of funding agency by quadrant model

JPN



USA



Funding agency (%Pasteur, %Bohr, %Edison)

Note: Mapping of funding agency is based on the broad definition of quadrants.
The number of samples of NEDO, MHLW, and DOE is less than 20.

<Funding sources of research in "Pasteur's Quadrant">

Quadrant and funding sources, university projects, Multinomial logistic reg., JPN

		JPN					
		Pasteur		Bohr		Edison	
Number of external funds		0.333***	(2.62)	0.128	(1.35)	0.137	(1.05)
Largest external funding source	COE	0.234	(0.35)	1.362***	(2.68)	0.532	(0.91)
	KAKEN	-0.611*	(-1.66)	0.745**	(2.47)	-0.821**	(-2.41)
	MHLW	0.974	(0.96)	0.438	(0.44)	-0.299	(-0.23)
	JST	-0.395	(-0.75)	0.691*	(1.69)	-0.042	(-0.08)
	NEDO	-0.703	(-0.82)	-0.001	(-0.00)	0.783	(1.19)
	Other Gov	-0.422	(-0.80)	0.480	(1.17)	0.086	(0.19)
	Foreign Gov	-0.296	(-0.39)	1.193**	(2.38)	0.191	(0.31)
	Private	-	-	-	-	-	-
Type of project (0: N, 1: H)		0.900***	(3.37)	0.645***	(3.44)	0.146	(0.55)
Duration of the project		0.062***	(2.73)	0.020	(1.18)	0.027	(1.17)
Field dummy		YES		YES		YES	
Constant		-1.880***	(-3.61)	-0.600	(-1.50)	-1.384***	(-2.59)
N		950					
r2_ct		0.552					
r2_ctadj		0.122					
aic0		2.291					
aic_n		2176.4					

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Note: Research projects whose largest funding source is intramural fund are excluded.

<Funding sources of research in "Pasteur's Quadrant">

Quadrant and funding sources, university projects, Multinomial logistic reg., USA

		USA					
		Pasteur		Bohr		Edison	
Number of external funds		0.323	(1.48)	0.305	(1.47)	0.172	(0.69)
Largest external funding source	COE	-1.052*	(-1.71)	-0.880	(-1.52)	-0.978	(-1.43)
	NSF	0.135	(0.27)	0.836*	(1.81)	-0.739	(-1.21)
	NIH	0.032	(0.08)	0.297	(0.74)	-0.467	(-0.97)
	DOD	-0.324	(-0.51)	-0.232	(-0.40)	0.269	(0.41)
	DOE	-0.800	(-0.91)	0.237	(0.35)	-0.286	(-0.33)
	Other Gov	0.094	(0.19)	-0.017	(-0.04)	0.008	(0.01)
	Foreign Gov	-0.177	(-0.22)	0.402	(0.55)	-0.384	(-0.41)
	Private	-	-	-	-	-	-
Type of project (0: N, 1: H)		0.637**	(2.21)	0.279	(1.03)	0.190	(0.56)
Duration of the project		0.051	(1.56)	0.026	(0.83)	0.037	(0.99)
Field dummy		YES		YES		YES	
Constant		0.0904	(0.13)	1.432**	(2.21)	-0.454	(-0.53)
N		862					
r2_ct		0.579					
r2_ctadj		0.0879					
aic0		2.221					
aic_n		1914.4					

t statistics in parentheses

* p<0.1, ** p<0.05, *** p<0.01

Note: Research projects whose largest funding source is intramural fund are excluded.

Findings

- Size of research fund by types of the projects
  - highly skewed nature of the size of the fund (log normal distribution)
  - Pasteur > Edison > Bohr in Japan (both in N and H projects) and Edison > Pasteur > Bohr in the US (in H projects) on the average (logarithmic scale)

- KAKEN is the major external funding source in Japan in almost all fields of science.
- Major funding sources vary across fields of science in the US.
  - Physical sciences: NSF
  - Life sciences: NIH

Findings, cont.

(Japan)

- KAKEN is the major external funding source in Japan for research projects in Bohr’s quadrant. The share of funding agencies other than MEXT is very small in Bohr’s quadrant.
- Quadrant portfolio of “KAKEN and JST” and “NEDO and MHLW” are different.
- Number of external funding is positively correlated with the likelihood to be the Pasteur’s quadrant.

- Bridging of different funding agency is crucial to foster researches in Pasteur’s quadrant in Japan.

Findings, cont.

(USA)

- Funding agencies (departments) in the US have similar quadrant portfolio. Each funding agency (department) has substantial weight in Bohr’s quadrant.

- NSF accounts for only 28.3% of research projects in Bohr’s quadrant.
- NIH supports large portion of research projects in Bohr’s quadrant (33.3%). It is also the largest funding agency of Pasteur’s quadrant.
- Other agencies (departments) also likely support research projects in Bohr’s quadrant.

IV. Scientific and technological performance of research at Pasteur's Quadrant

- Is research in the Pasteur's Quadrant more productive?
  - Scientific performance
  - Technological performance (commercialization of research outcome)

- Use may inspire research on the fundamental issues from an new angle ("technology is the inspiration of science")
- Basic research may provide an effective solution to a real world problem when guided by use consideration.

Controlling inputs

- We control for
  - 10 technology fields
  - Publication years
  - Project size (number of authors and size of research fund)
  - Type of the project (when output referrers to that of the project) as well as the calendar length of the project

- Base for the estimation is the other quadrant.
- We focus on university projects, i.e. those projects for which the corresponding author belongs to a university.

Scientific and technological performance

- Pasteur's quadrant is scientifically productive?
  - Comparison with Bohr's quadrant
  - Forward citations of the focal paper
- Pasteur's quadrant is technologically productive?
  - Comparison with Edison's quadrant
  - Patent application (the number of domestic applications)

Forward citations, university projects, OLS

	JPN		USA	
	Forward citations in 2009 (log)		Forward citations in 2009 (log)	
Pasteur	0.787*** 0.145	0.291** 0.141	0.463*** 0.12	0.276** 0.11
Bohr	0.733*** 0.088	0.564*** 0.084	0.389*** 0.108	0.356*** 0.101
Edison	0.393*** 0.132	0.204* 0.12	0.000 0.146	-0.195 0.131
Authors (log)		0.557*** 0.06		0.775*** 0.054
Research funding (log)		0.202*** 0.019		0.133*** 0.019
Observations	1574	1515	1592	1553
R-squared	0.14	0.29	0.15	0.30

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Base for these etimation is the other quadrant.
Publication year dummies and 10 field dummies introduced as controls.

Number of domestic patent applications, university project , OLS

	JPN		USA	
	Number of patent applications, domestic (log)		Number of patent applications, domestic (log)	
Pasteur	0.549***	0.402***	0.079***	0.067**
	0.088	0.085	0.023	0.031
Bohr	-0.014	-0.068*	0.001	-0.009
	0.035	0.035	0.016	0.022
Edison	0.214***	0.161***	0.066***	0.058*
	0.059	0.058	0.025	0.034
Type of project	0.267***	0.171***	0.074***	0.065***
1: H project, 0: N project	0.045	0.045	0.018	0.024
Authors (log)		-0.061**		-0.005
		0.027		0.018
Research funding (log)		0.095***		0.026***
		0.011		0.006
Duration (log)		0.03		0.035***
		0.027		0.013
Observations	1564	1458	1582	986
R-squared	0.17	0.25	0.06	0.10

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Base for these etimation is the other quadrant.
Publication year dummies and 10 field dummies introduced as controls.

Findings

- Forward citation of the paper:
  - Controlling for publication and fields of science, a research project at Pasteur's quadrant is more or as frequently cited as that at Bohr quadrant.
  - Controlling for project size, it is less cited both in Japan and the US.

- Patent applications
  - Larger number of domestic patents, controlling for research inputs in Japan and as large as those from Edison quadrant in the US
  - Larger number of foreign patents in Japan , controlling for research inputs

V. Conclusions (Tentative)

- Pasteur's quadrant accounts for an important share of research projects in both US and Japan.

- Strong linkage between fields of science and quadrant model.
- The percentage of Pasteur's quadrant is relatively high in Clinical Medicine & Psychiatry/Psychol (both Japan and the US), Agricultural Sciences (the US), and Materials Science (Japan).

Conclusion, cont.

- Funding system of Japan and the US is quite different!

- KAKEN is the major external funding source in Japan for research projects in Bohr's quadrant. The share of funding agencies other than MEXT is very small.
- Bridging of different funding agency is crucial to foster researches in Pasteur's quadrant in Japan.

- Funding agencies (departments) in the US have similar quadrant portfolio. Each funding agency (department) has substantial weight in Bohr's quadrant.

Conclusion, cont.

- Research at Pasteur's Quadrant is scientifically as productive as that at Bohr quadrant, controlling for the project size.

- Furthermore, research at Pasteur's Quadrant is technologically as productive as that at Edison quadrant, controlling for the project size.

Key References

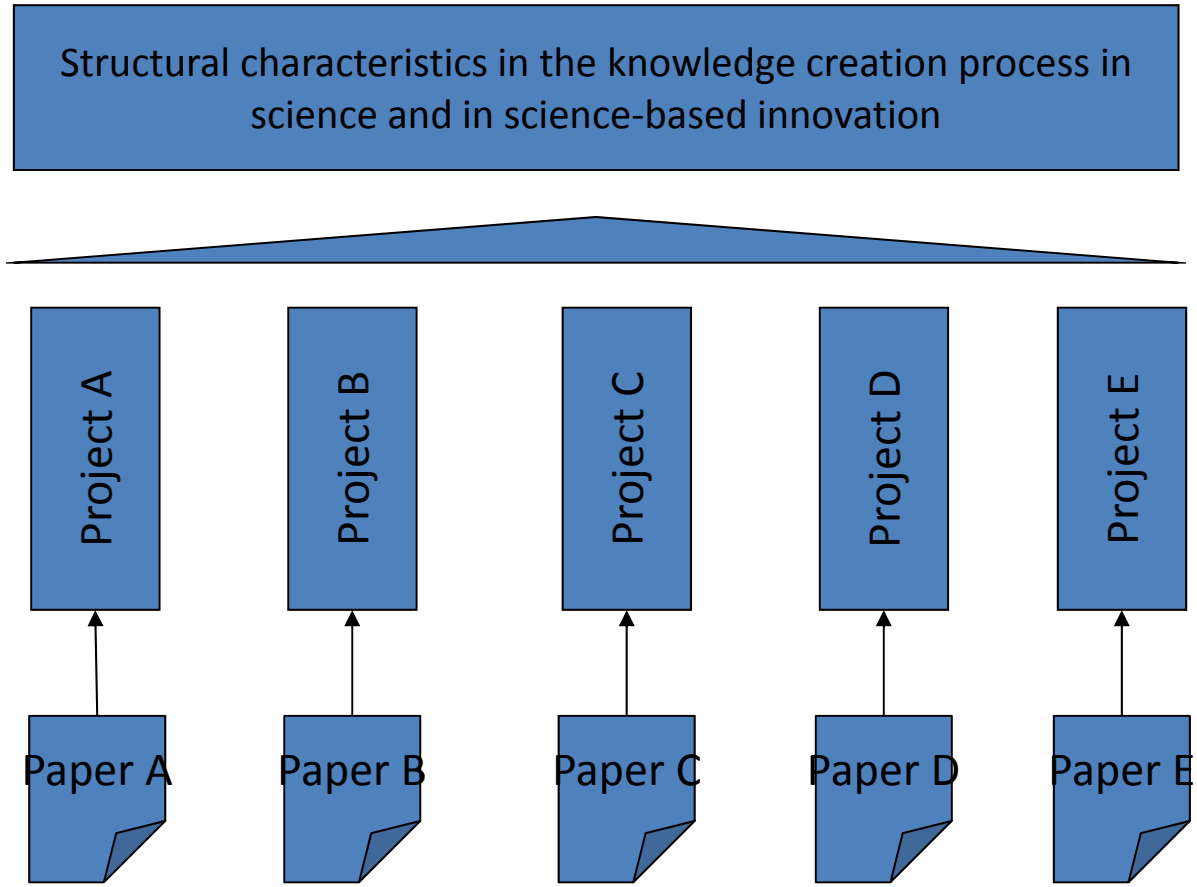
- Bush Vannevar, 1945 " Science The Endless Frontier :A Report to the President", (http://www.nsf.gov/od/lpa/nsf50/vbush1945.htm)
- Nagaoka, S, M. Igami, J. Walsh and T. Ijichi "Knowledge creation process in science: Key comparative findings from the Hitotsubashi-NISTEP-Georgia Tech scientists' survey in Japan and the US"
- Stephan, P., 2010, "The Economics of Science," in Hall, B.H. and N. Rosenberg (eds.), Handbook of The Economics of Innovation, Elsevier.
- Stokes, D.E., 1997, Pasteur's Quadrant: Basic Science and Technological Innovation, Brooking Institution Press.

Supplemental

Purpose of the research

- Developing systematic and objective data on the knowledge creation process in science at the project level (JPN and USA).
  - Motivations of the research projects
  - Knowledge sources that inspired the project
  - Uncertainty in the knowledge creation process
  - Research competition
  - Composition of the research team
  - Sources of funds
  - Research outputs, e.g., research papers, students, patents, etc.

Bottom-up approach to explore structural characteristics in the knowledge creation process



(3) Analyze the characteristics of the research projects.

(2) Collect the profiles of research through a comprehensive questionnaire survey of researchers.

(1) Select research papers in all fields of science.

Organization of the questionnaire

<Inputs>

- History of the Research Project
- Total research man-months expended on the Research Project
- Research funds
- Sources of Research Funds

<Research team>

- Composition of the authors
- Number of collaborating researchers, students and technicians who are not coauthors on the paper
- The number of R&D personnel specifically hired for this project

<Motivation and process>

- Motivation for the Research Project that yielded the focal paper
- Research process for the Focal Paper
- Research method of the research project that yielded the paper

<Knowledge source and management>

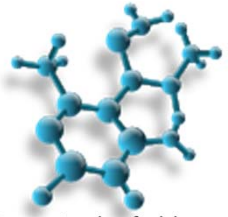
- External knowledge sources that inspired the Research Project
- Research management

<Research Environment>

- Use of advanced research facilities, databases, and the Internet
- Research competition
- Threat from competition

<Personal Environment>

- Your roles in the Research Project
- Family situation
- Educational background
- Research career
- Publication of refereed papers



<Outputs>

- Importance of the Focal Paper in the field
- Importance of the Focal Paper among all the outputs of the Research Project
- Types of outputs from the Focal Paper
- Number of papers produced by the Research Project
- Training of researchers
- Follow-up research
- Projects in collaboration with an external organization
- Other outputs: research tools

<Commercialization>

- Patent applications
- Internal commercialization
- Licensing or sales
- Start-up companies
- Standards
- Effects on industries and on society

The population of the survey

- Articles and letters in the Science Citation Indexes-Expanded (Thomson Reuters)
- Time window: 2001 – 2006 (database year)
- Forward citation counts were retrieved on December 31, 2006
- 22 fields in the ESI were adopted

Identification of possible focal papers

- Highly Cited Papers (Highly cited papers)
  - Top 1% highly cited papers in each journal field (22 fields in total) and in each database year; at least one organization of authors should be located in the target country (approximately 3,000 in total).
- Normal Papers (Normal papers)
  - Randomly selected papers in each journal field and in each database year from the population of the survey, excluding the above highly cited papers; at least one organization of authors should be located in the target country (approximately 7,000).

Highly cited group and normal group

- The project is defined as a series of research activities in which the specified focal paper and the other closely related research outcomes were produced.
- Highly cited group
  - Research projects from which the highly cited papers were produced.
- Normal group
  - Research projects from which the normal papers were produced.

Implementation of the survey

- Survey was conducted on the Web.

Japanese survey

- Survey launch: December 21, 2009
- Initial due date: February 9, 2010
- Reminders were sent twice (mid of Jan., mid of Feb.)
- Final due date: April 11, 2010

US survey

- Initial mail-outs: September – November, 2010
- Reminder emails: November – December, 2010
- Second (final) reminders: January, 2011

Response rate, JPN

	All Focal Papers			H papers			N papers			
	Survey targets	Responded	Response rate	Survey targets	Responded	Response rate(A)	Survey targets	Responded	Response rate(B)	(A) - (B)
1_Chemistry	837	257	30.7%	208	71	34.1%	629	186	29.6%	4.6%
2_Materials Science	472	142	30.1%	127	43	33.9%	345	99	28.7%	5.2%
3_Physics&Space_Science	1407	380	27.0%	400	127	31.8%	1007	253	25.1%	6.6%
4_Computer Science&Mathematics	323	77	23.8%	66	16	24.2%	257	61	23.7%	0.5%
5_Engineering	707	206	29.1%	197	68	34.5%	510	138	27.1%	7.5%
6_Environment/Ecology&Geosciences	361	115	31.9%	81	30	37.0%	280	85	30.4%	6.7%
7_Clinical Medicine&Psychiatry/Psycholog	1278	264	20.7%	325	66	20.3%	953	198	20.8%	-0.5%
8.1_Agricultural Sciences&Plant & Animal Science	597	192	32.2%	165	60	36.4%	432	132	30.6%	5.8%
8.2_Basic Life Sciences	1504	404	26.9%	351	83	23.6%	1153	321	27.8%	-4.2%
9_Multidisciplinary(*)	13	2	15.4%	0	0	-	13	2	15.4%	-
S_Social Sciences	153	42	27.5%	12	2	16.7%	141	40	28.4%	-11.7%
Total	**7,652**	**2,081**	**27.2%**	**1,932**	**566**	**29.3%**	**5,720**	**1,515**	**26.5%**	**2.8%**

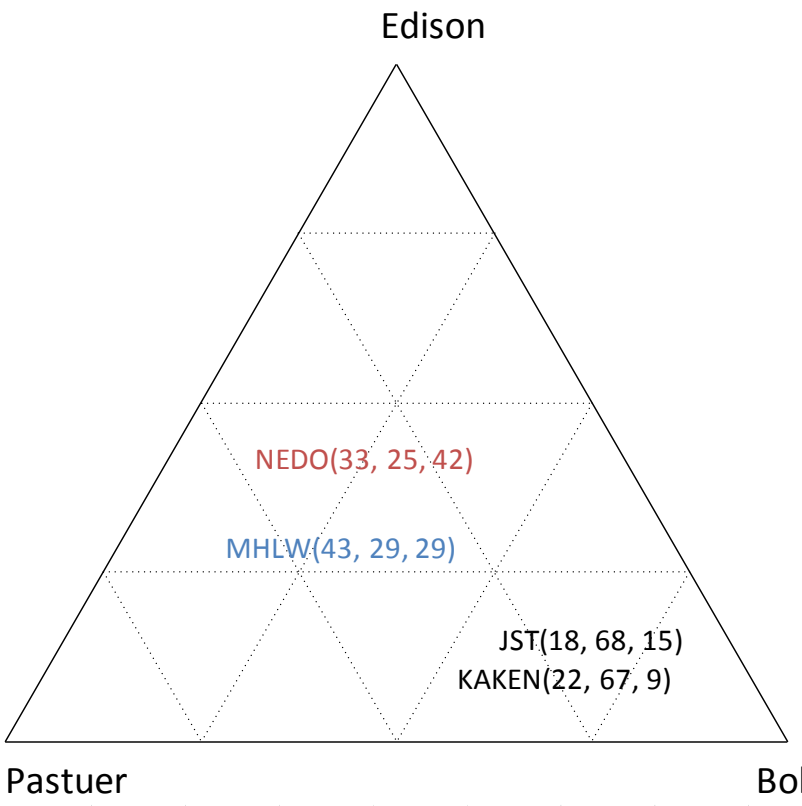
Response rate, USA

	All Focal Papers			H papers			N papers			
	Survey targets	Responded	Response rate	Survey targets	Responded	Response rate(A)	Survey targets	Responded	Response rate(B)	(A) - (B)
1_Chemistry	663	184	27.8%	204	66	32.4%	459	118	25.7%	6.6%
2_Materials Science	261	72	27.6%	82	22	26.8%	179	50	27.9%	-1.1%
3_Physics&Space_Science	993	259	26.1%	347	96	27.7%	646	163	25.2%	2.4%
4_Computer Science&Mathematics	508	131	25.8%	165	39	23.6%	343	92	26.8%	-3.2%
5_Engineering	571	162	28.4%	186	57	30.6%	385	105	27.3%	3.4%
6_Environment/Ecology&Geosciences	522	193	37.0%	183	68	37.2%	339	125	36.9%	0.3%
7_Clinical Medicine&Psychiatry/Psycholog	2165	446	20.6%	718	155	21.6%	1447	290	20.0%	1.5%
8.1_Agricultural Sciences&Plant & Animal Science	508	157	30.9%	181	60	33.1%	327	97	29.7%	3.5%
8.2_Basic Life Sciences	1954	506	25.9%	602	159	26.4%	1352	348	25.7%	0.7%
9_Multidisciplinary(*)	78	11	14.1%	2	0	0.0%	76	11	14.5%	-14.5%
S_Social Sciences	641	208	32.4%	212	76	35.8%	429	132	30.8%	5.1%
Total	**8,864**	**2,329**	**26.3%**	**2,882**	**798**	**27.7%**	**5,982**	**1,531**	**25.6%**	**2.1%**

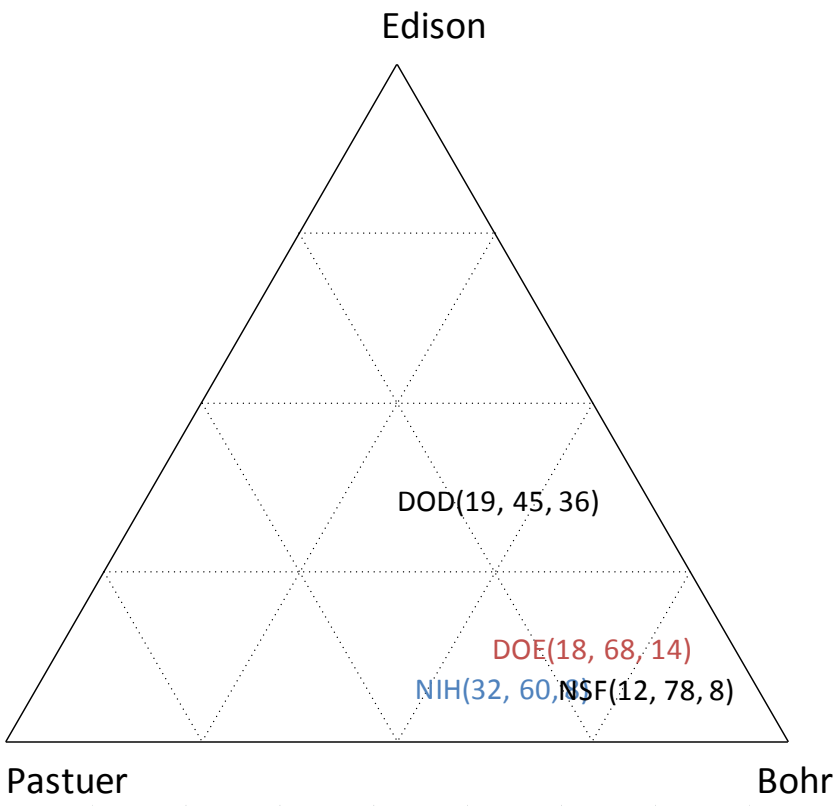
<Funding sources of research in “Pasteur’s Quadrant”>

Characterization of funding agency by quadrant model

JPN



USA



Funding agency (%Pasteur, %Bohr, %Edison)

Note: Mapping of funding agency is based on the broad definition of quadrants.
The number of samples of NEDO, MHLW, and DOE is less than 20.