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Use and Non-use of Patents in the US and Japan: Evidence from the RIETI/GT Inventor Survey

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Based on work in collaboration with Sadao Nagaoka (Hitotsubashi University) and Taehyun Jung (Hanyang University).

Understanding Strategic Patenting

Patents designed to promote science and useful arts by giving owner exclusive rights (to exclude) for a limited period of time (U.S. Const. I:8).

- Firms can exercise this right by using the technology in their own products and using the patent to enforce market exclusivity, and/or through licensing the patent to others to manufacture in exchange for a share of the rents.
- However, we have seen a growth in patenting and increasing emphasis on "strategic" uses of patents (Cohen et al., 2002; Cohen, et al. 2000; Blind, et al., 2006; Hall and Ziedonis, 2004; Giuri, et al., 2007; Ziedonis, 2004; Nagaoka and Walsh, 2009; Reitzig, 2004)
  - including using patents defensively (prevention of suits)
  - to build fences around a technology
  - block others from patenting (to ensure freedom of operation and for use in cross-licensing).

What drives strategic patenting?

Theory and Hypotheses

Technology cycle: uncertainty v. maturity of technology

- Bargaining failure (Merges 94)
  - Blocking patents as a result of bargaining failure (TCE)
  - Novel technologies harder to evaluate (for licensing contract)
- Also, which of set of related pathways are most promising is uncertain (hedging) (Mazzoleni and Nelson, 1998)
  - Early automobiles
- Technology cycle:
  - The lower technological uncertainty, the more incremental innovation
  - Shift of competition from innovation to production capability
    - Lower protective efficiency of patents

Hypothesis 1. Technological maturity (lower uncertainty) leads to less strategic patenting

Firm assets and strategic patenting

The more fixed assets to protect, the higher the propensity of strategic patenting

- **Capital asset**-protective roles of patents (Hall & Ziedonis 2000; Ziedonis, 2004; Ceccagnoli 2009)
  - Threat of injunction
  - e.g. Polaroid v. Kodak (instant camera); RIM v. NTP (BlackBerry mobile email)
- Also, reluctance to cannibalize existing competences related to scale of production): **inertia**
  - Threat of losing the existing competitive advantages
  - Switching costs
- **Technological assets** similarly generate need for protection (fence, player) and inertia

Hypothesis 2a. Capital intensive firms have greater strategic patenting

Hypothesis 2b. Firms with larger patent stocks have greater strategic patenting

Effectiveness of Patent Protection-I

- Greater effectiveness reduces uncertainty involved in markets for technology (Gans, et al., 2006; Arora and Ceccagnoli, 2006) and hence more licensing (so lower rate of strategic patents).
- Similarly, should reduce the need for fences (since the single patent should work)

Hypothesis 3a. More effective patents associated with less strategic patenting (*uncertainty and markets for technology argument)*

Effectiveness of Patent Protection-II

- Stronger patents make rivals' patents more dangerous, and increase the need for building defensive portfolio (Ziedonis, 2004).
- Might also encourage fence building, since more effective at preventing inventing around.
- And, stronger fences may need stronger player patents to break them down and ensure freedom to operate.
  - Accelerating the arms race? Rivals propagate patent portfolios to build fences and ensure FTO for themselves.

Hypothesis 3b. More effective patents associated with more strategic patenting (*greater effectiveness of fences, greater need for FTO and possible arms race)*

Data & Measures

I. Design of Inventor Surveys

- **Pioneered by PATVAL, followed by RIETI, GT/RIETI**
- **Survey inventors (rather than R&D managers) for specific R&D projects**
- **Large sample, broad technology/industry coverage**
- **Comparative (JP-US, also Europe)**
- **Measures**
  - Invention Process, Collaboration
  - Inventor Career, Mobility, Background, and Inventor Motivations
  - Business objective of R&D, R&D strategy and performance
  - Uses of the Patent, Commercialization

Primary Sampling Frame – OECD Triadic Patent Families

- **Triadic Patent Families**
  - Compiled by OECD
  - Sharing, either directly or indirectly, at least one priority patent applications in three patent offices
  - Filed in EPO and JPO and granted in USPTO
- **Advantage of using the TPF**
  - Reduce home country bias
  - Focus on economically important patents (Random sampling would result in targeting most questionnaires to economically unimportant patents. Filing in multiple jurisdictions works as a threshold)
- **Disadvantage of using the TPF**
  - **Select subset of inventions, and even of patented inventions. Likely to be biased toward commercialized inventions**
  - Perhaps, bias against nonprofit, small, and/or independent inventors?

Data

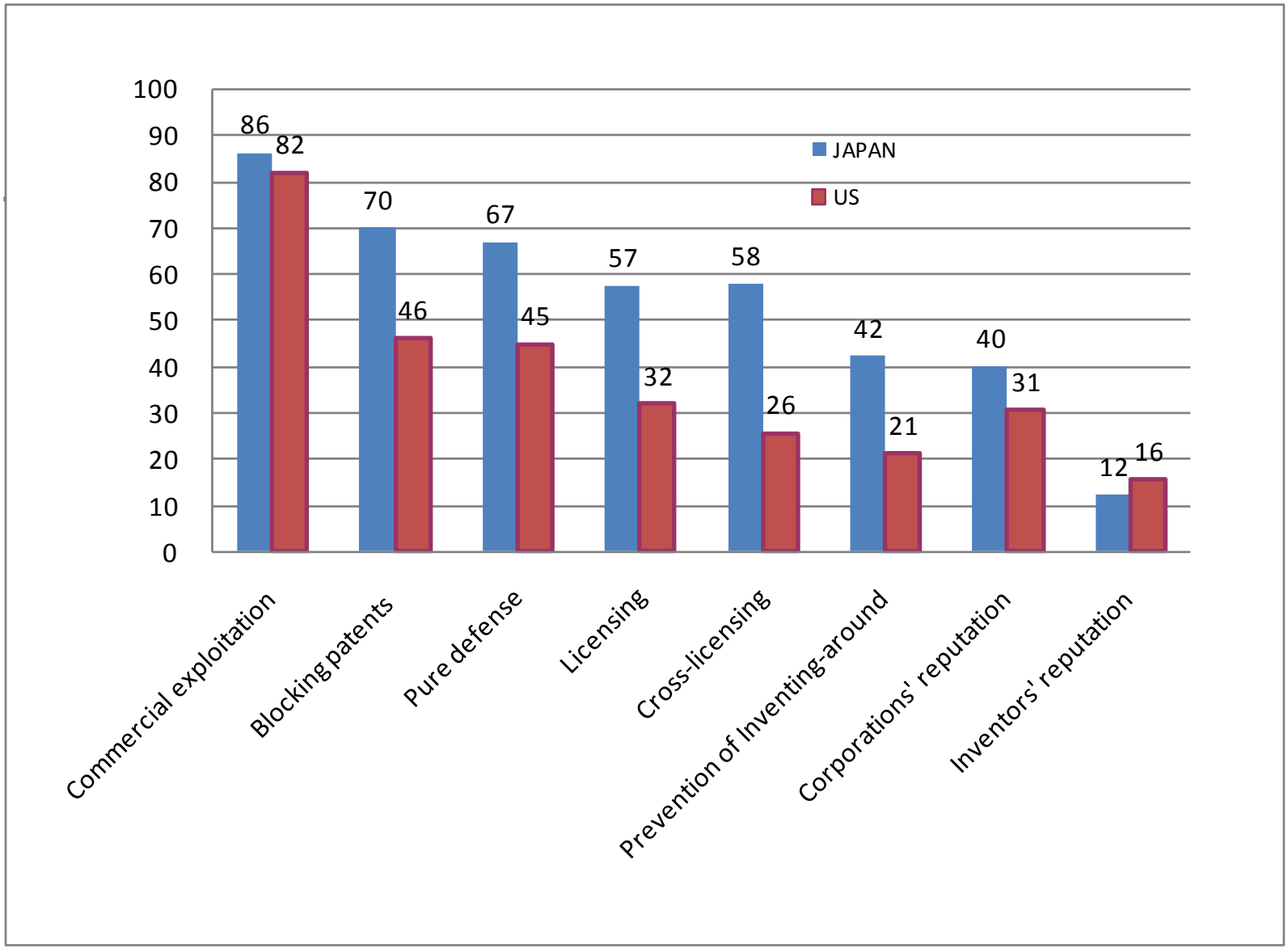
- **Japan: 5,300 responses**
  - 20.6% response rate (27.1% adjusted for undelivered, ineligible, etc.)
  - triadic patents: approximately 70%
  - non-triadic patents: approximately 30%
  - very important patents (selected from the JPO reports and the essential patents of standards): roughly 120 patents
- **US: 1,900 (all triadic)**
  - 24.1% response rate (31.8% adjusted)
- **Comparisons based on triadic patent samples**
- **Created country-technology weights to adjust for different composition across technology in each country**
  - Effects of the weighting quite small.

Survey Results

I) US-Japan comparison

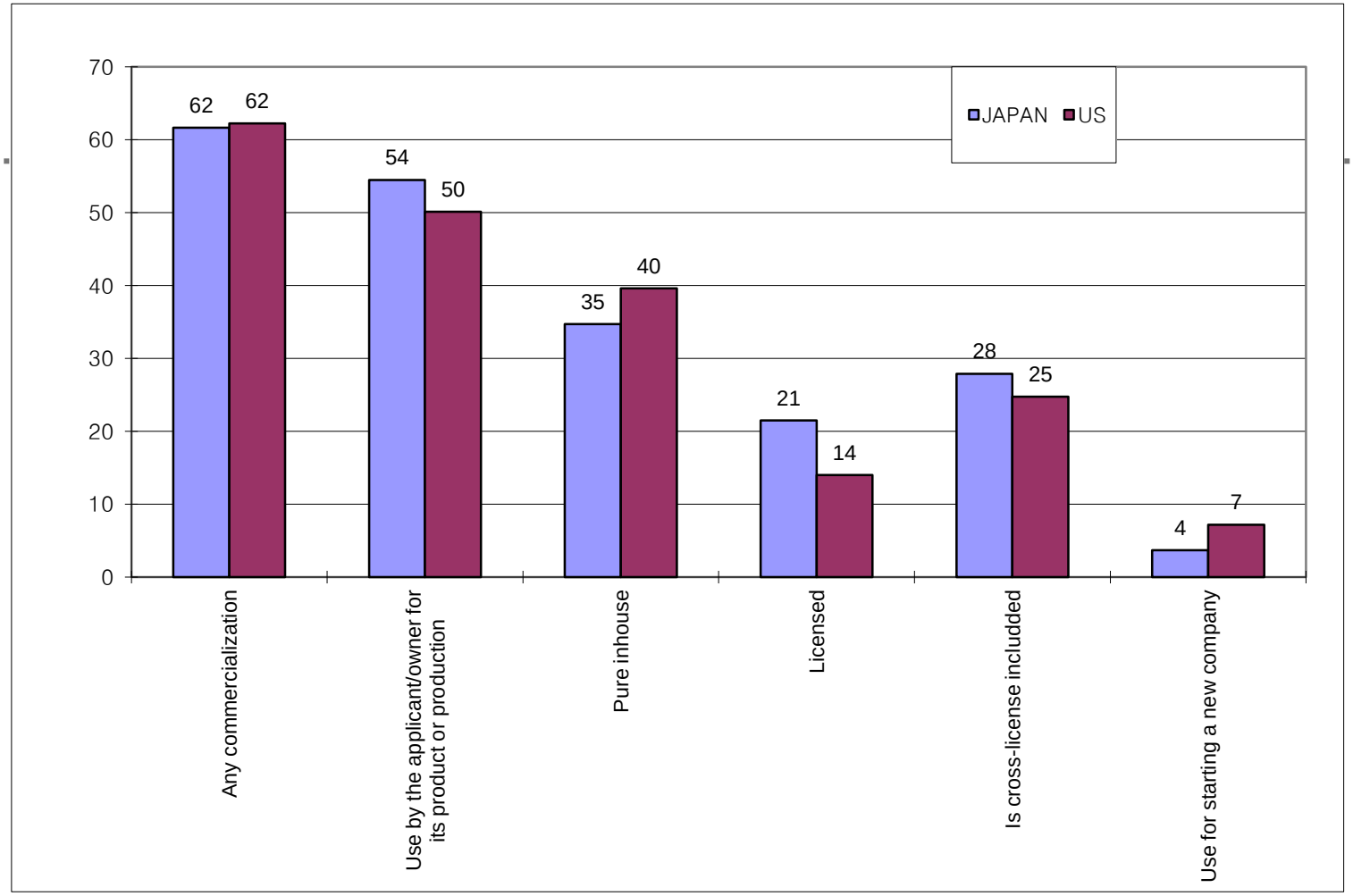
II) Explaining strategic patents (US)

Figure13. Reasons for patenting (%high)



Note: Based on common technology class weight

Figure 1. Commercialization of the inventions



Note. pure in-house= used by the applicant/owner only for its internal use (neither license nor the use through a startup), based on common technolog class weight

Figure 3. Proportion of the inventions internally commercialized by organization type (%)

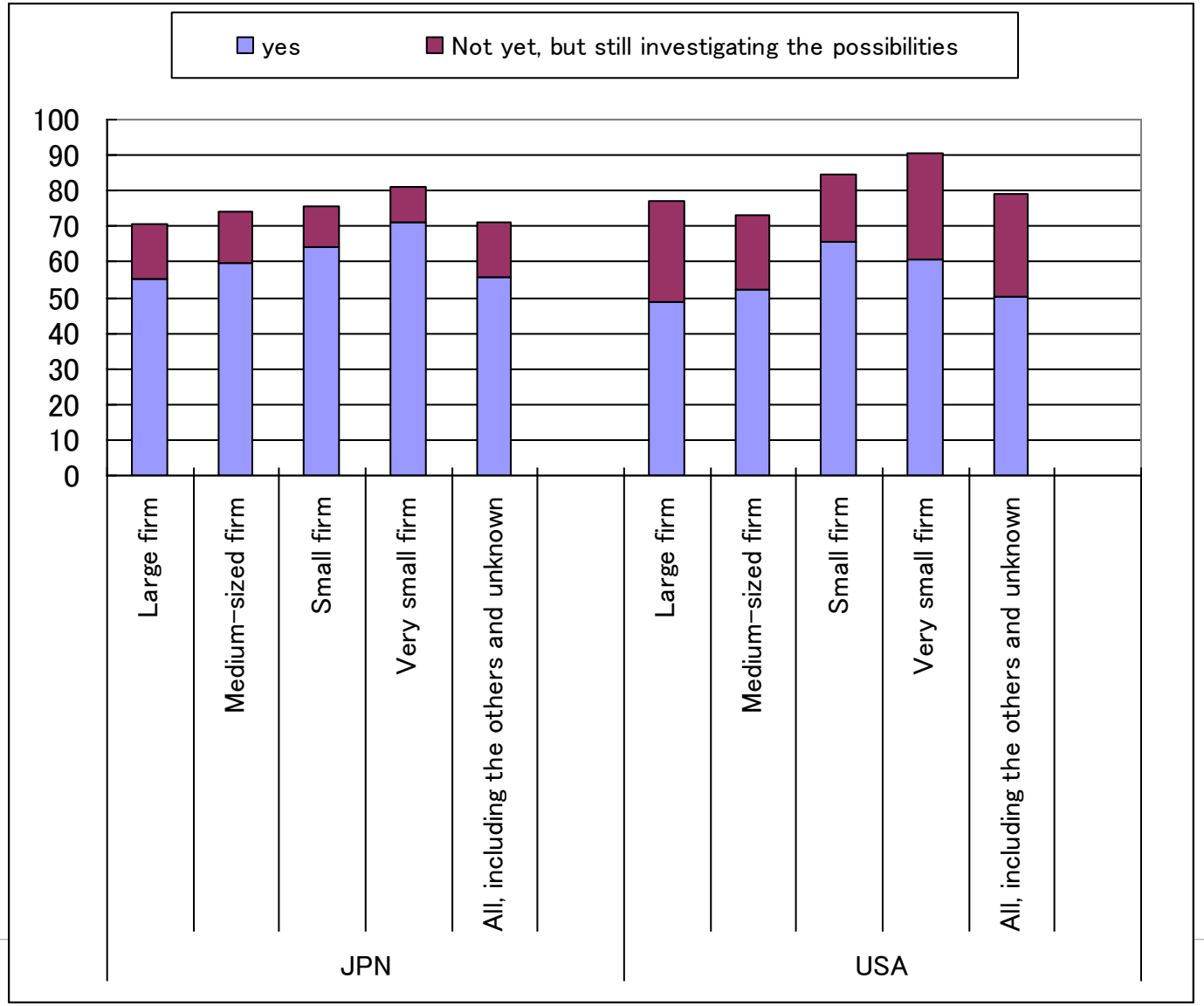


Figure 4. Licensing rate by organization type

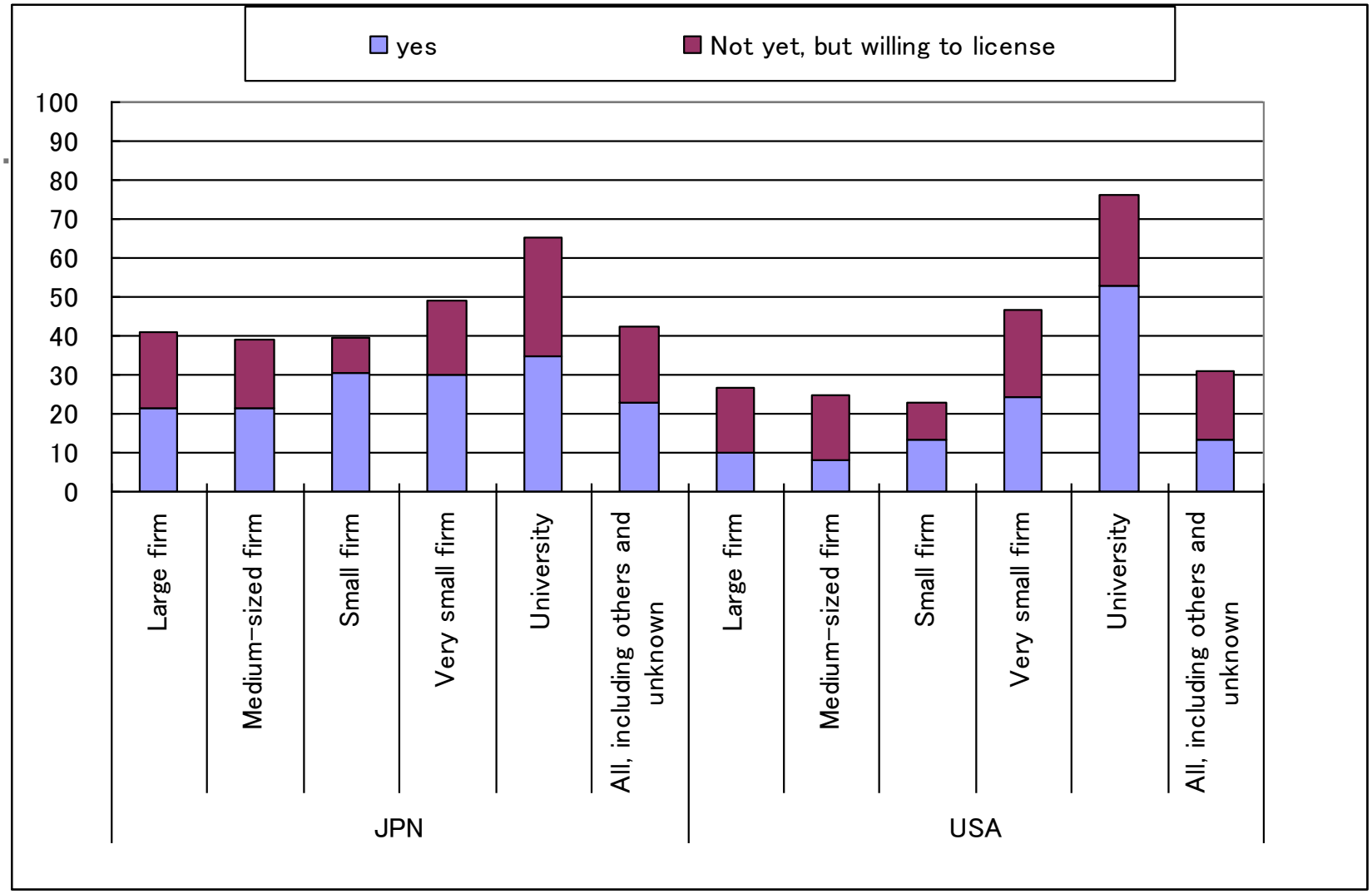
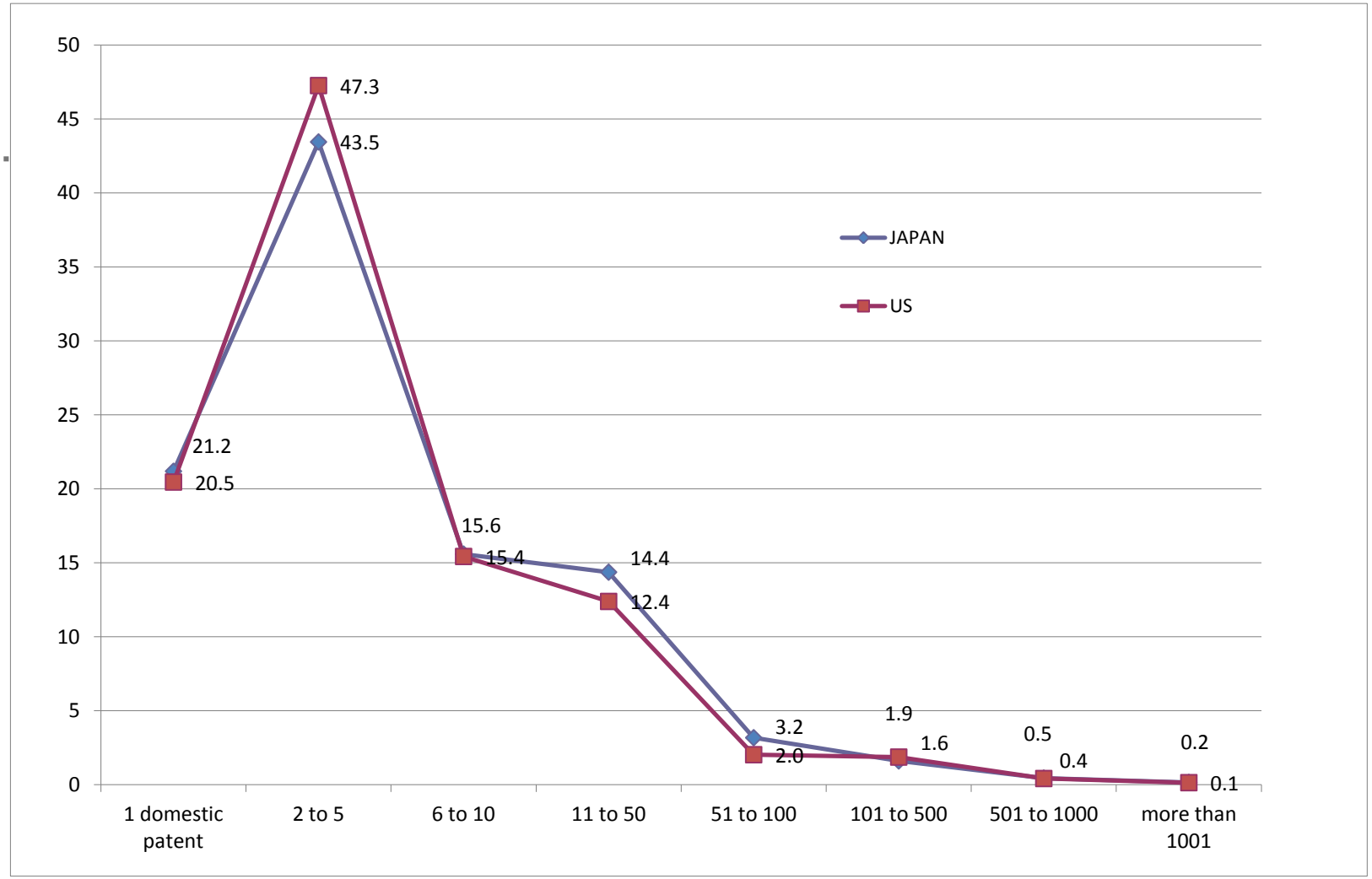


Figure 9. Estimated Number of Patents jointly used in Commercializing the Invention (own and others)



Note: based on common technology class weight

Figure 10A. Size of the bundle of the patents jointly used and the licensing patterns, Japan

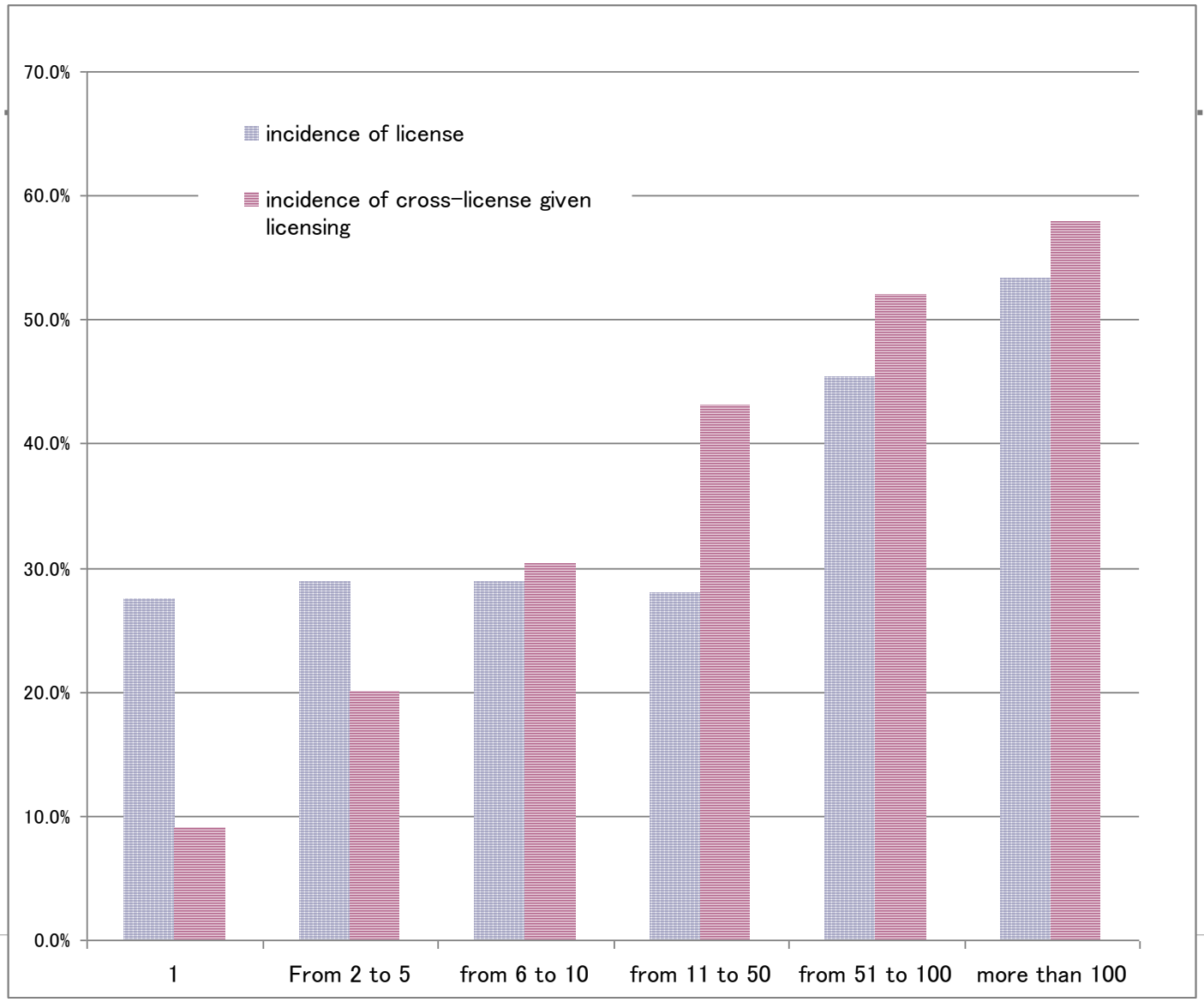
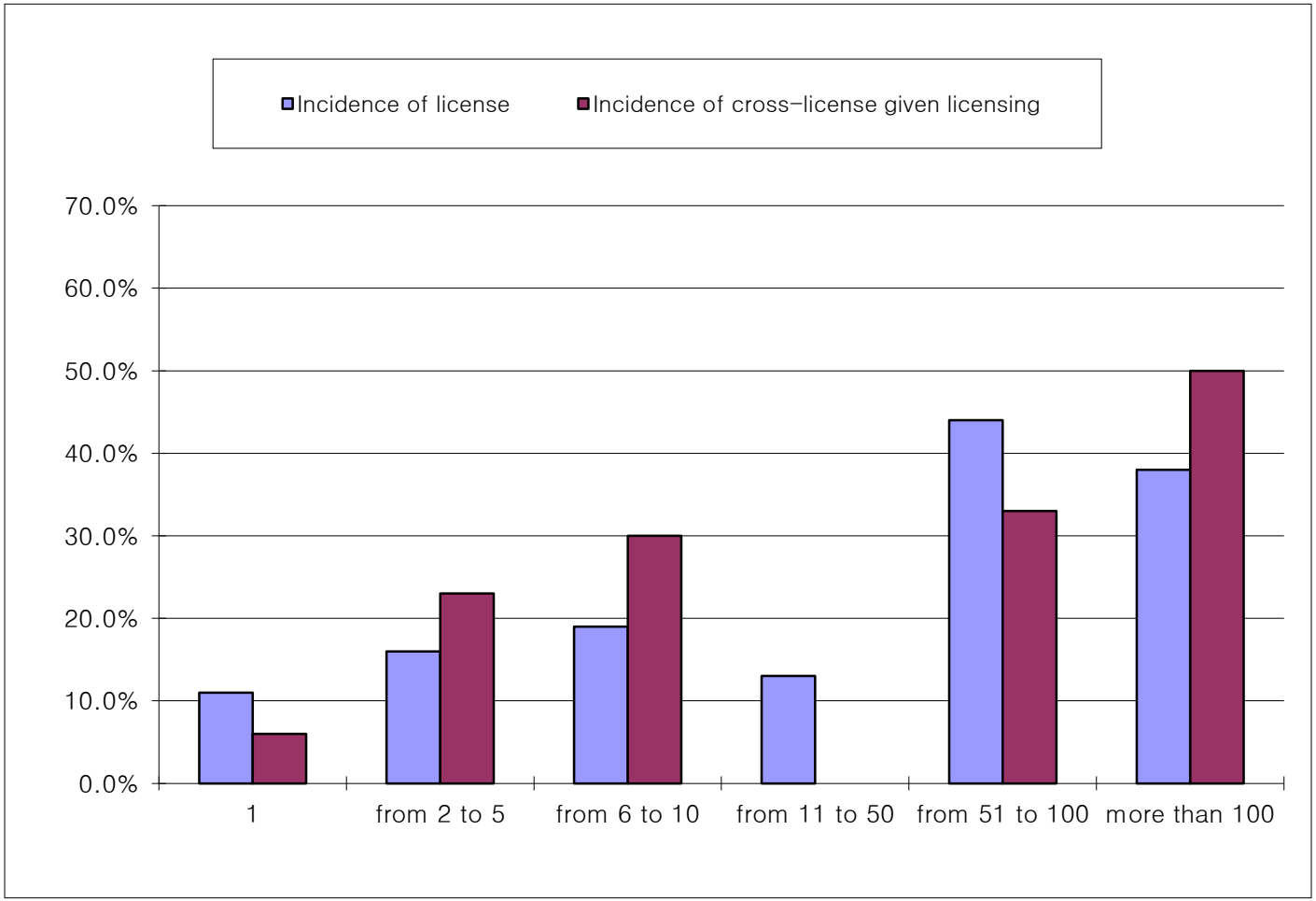
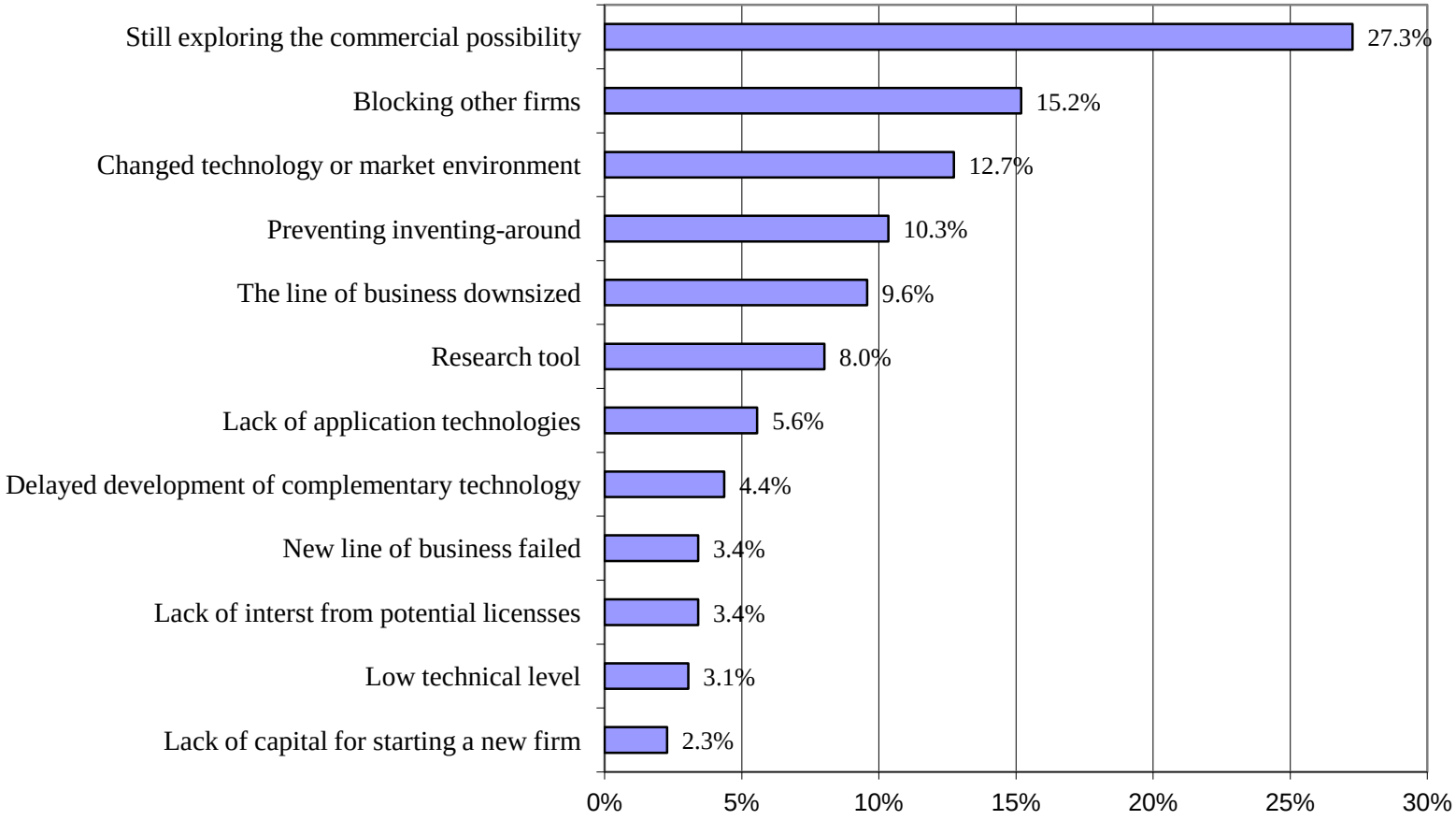


Figure 10B. Size of the bundle of the patents jointly used and the licensing patterns, US



Reasons for nonuse (US, N=1672)

% Yes (over all patents)



Types of nonuse (US)

- Still exploring commercial possibilities: 27%
- Strategic nonuse [Blocking] (preventing others from patenting or preventing inventing around) 17%
- Obsolete patents (technology or market shift, business downsized or failed line of business) 19%
- Lack of sponsors to commercialize the technology (licensees or financiers) [orphaned patents] 5%
- Other technological problems (low technical level, delay in developing complementary technologies, or lack of technologies for application) 12%

Predicting Strategic Nonuse

Dependent variable

- Strategic nonuse (1/0)
  - –Narrow*: Reason for Non-use* is "blocking other firms" or "preventing inventing around"
    - 17% of all (38% of nonuse)
  - –Broad: either of above or still exploring commercial use but *filed* for blocking or preventing (closer to Giuri, et al., Blind, et al.)
    - 26% of all patents
  - –These estimates are similar to Giuri, et al. for Europe (19%) and Nagaoka and Walsh (2009) for Japan (15%)

Predicting Strategic Non-Use

Independent variables

- Tech familiarity (component familiarity) (USPTO)
  - # patents filed in the same tech subclass with the focal patent following Fleming (2001)
- Firm assets (COMPUSTAT, PATSTAT)
  - Capital intensity
  - Patent stock
- Patent effectiveness
  - patent effectiveness measure provided by the Carnegie Mellon survey (Cohen et al., 2000)

Predicting Strategic Use (Probit)

	1	2	3
	Main	Broad definition	Firm fixed effects
Component familiarity	-1.171***	-1.528***	-1.365***
	(0.426)	(0.463)	(0.428)
Capital intensity	0.986**	0.966**	1.180**
	(0.472)	(0.491)	(0.506)
Ln(patent stock)	0.065**	0.042*	0.037
	(0.025)	(0.023)	(0.035)
Patent effectiveness	0.019**	0.013	0.013
	(0.009)	(0.008)	(0.012)

Results qualitatively robust to restricting to complete data

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

Summary of the results

- Strategic nonuse is common, even among triadic patents (17-26%)
  - Similar to Japan and Europe
- Also significant heterogeneity in these strategic uses
- In particular, like earlier work, we find that industry and technology characteristics distinguish which strategic use will dominate
  - player strategy (emphasizes FTO) more common in complex product industries
  - fence strategy (emphasizing exclusivity) more common in discrete product industries.
- Also large firms are more likely to generate strategic patents

Discussion and Conclusion

Implications for the debates on patent reforms: patent quality

- Results support the importance of higher quality patents for innovation.
  - The higher technological quality of patents, the more likely that they will be commercialized and the less likely strategic nonuse (e.g., blocking)
- Patent reform proposals that increase the patenting threshold should reduce the rate of strategic patents.
- However, two cautions.
  - First, we find even triadic patents (high threshold) are often strategic patents.
  - Second, do not know if the accumulation of strategic patents provide important incentives and protections for firm innovation.
- This is an area where further research is needed.

Discussion and Conclusion

Implications for the debates on patent reforms: patent strength

- Changes over time in patent law to strengthen patents in US and elsewhere and current debates about patent reform
- One concern is stronger patents may encourage more strategic patenting, creating thickets of non-commercialized but potentially dangerous patents raising barriers to innovation.
- Others see strategic patenting as a second-best solution to a weak patent system, arguing that if we could make patents sufficiently strong, we would not need to generate numerous patents to protect innovations.

Discussion and Conclusion

Implications for the debates on patent reforms: Patent strength

- We find that stronger patents associated with greater rates of strategic patenting
  - suggesting that reforms designed to strengthen patents may have encouraged firms to patent more of their inventions and to stockpile patents in case they are needed (either for defense or to collect rents from rivals' innovations).
- Thus, some evidence that the concerns raised by the skeptics of the strong patent system may be valid.
- However, additional research is needed to see if a higher rate of strategic patenting retards the pace of innovation (accounting for incentive effects of strategic patents)

Discussion and Conclusion

- Finally, one of the key findings from this study is that as technology matures and becomes more familiar, the propensity of strategic nonuse decreases
  - because of increased propensity of commercial use, especially licensing
  - Although also plain non-use: surprising finding
- Technology evolution may naturally dampen stacking-up of non-practicing strategic patents
- On the other hand, emerging technologies will suffer more from stacking non-practicing strategic patents
  - Could be a serious problem because competitions for design play a bigger role in emerging technologies than in mature technologies (Utterback 1994).

Discussion and Conclusion

- May be one justification for putting early stage research results (especially publicly funded and/or conducted by PROs) into the public domain, while the diversity of technology options is large and the most promising paths are still being explored (Mazzoleni and Nelson, 1998).
- This lifecycle analysis may be key to understanding the uses of patents
  - Relative importance of trajectory uncertainty, bargaining failure and composition of innovations?
- Detailed studies of how strategic patents are used as the commercial potential of the technology unfolds may be critical for understanding the managerial and policy implications of strategic patenting.

Discussion and Conclusion

Methodological Implications

- Our results also add to discussion on the validity of using patents as a proxy for innovativeness
- A majority of triadic patented inventions are used for innovation (about 60% of triadic patents)
- But a significant portion used for strategic purposes
- And many are not used at all
- Moreover, the more patents a firm has, the greater the likelihood that a given patent is a strategically unused patent.
- This implies that it would be misleading to measure innovativeness using the number of patents, without accounting for the likelihood that the patents are commercialized versus being unused, either for strategic purposes or as sleeping patents

Thank You
Questions, Comments, Suggestions?

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Backup

Sample characteristics

Uses of patents; Don't Know

Mode	Valid Resp	Item missing	
	% (of all pats)	Large firm	SME
Any commercialization	53.2	6.2	3.4
Only internal commercialization	38.7	11.8	4.4*
Any external commercialization	14.5	6.2	3.4
-Licensed	10.1	26.2	9.8*
○Cross-license	2.3	18.1	11.1
-New firm	5.8	10.7	7.8
UNUSED PATENTS	46.8	5.4	4.8

Results excluding missing

VARIABLES	(4) Strategic Narrow	(6) Strategic Narrow	(7) Strategic (Broad)	(9) Strategic (Broad)
CMS Pat Eff	0.016**	0.024***	0.012*	0.021***
	(0.008)	(0.008)	(0.007)	(0.008)
CMS missing	-0.248		-0.113	
	(0.161)		(0.139)	
CI	0.409	0.202	0.567*	0.465
	(0.329)	(0.388)	(0.307)	(0.361)
CI missing	0.181		0.109	
	(0.160)		(0.144)	
LN(Pat Stock)	0.059**	0.074***	0.041*	0.056**
	(0.024)	(0.028)	(0.022)	(0.026)
Tech familiarity	-1.108***	-0.967**	-1.203***	-1.191***
	(0.413)	(0.415)	(0.428)	(0.438)

Marginal effects

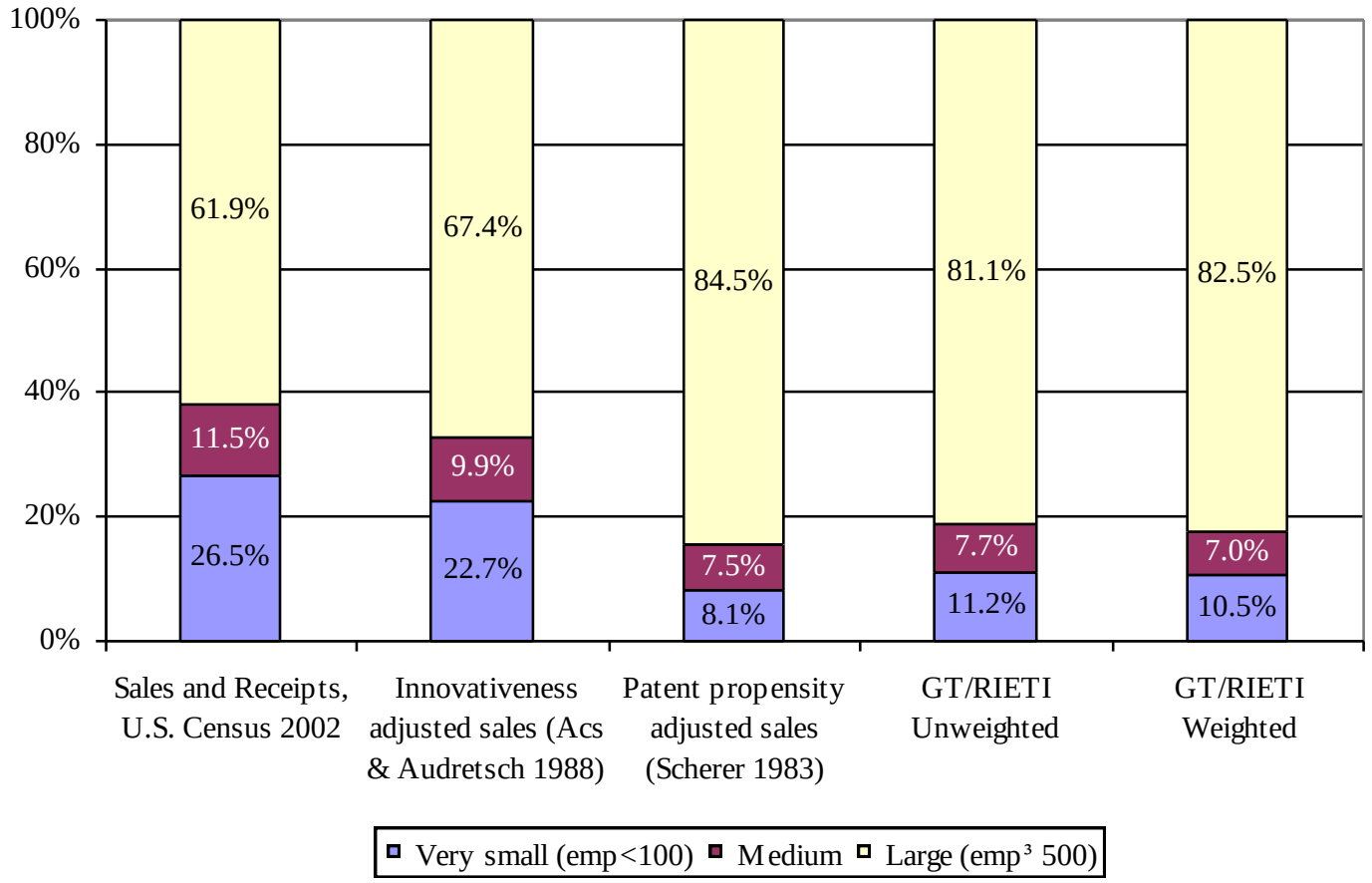
- Capital intensity: $1M/ee increase results in 16.2 percent point increase in probability of strategic patent
- Technology assets: 1% increase in (depreciated) patent stock results in 1.2 percent point increase in the probability of strategic patent
- Technology familiarity: 1000 (present value) increase in patents in the class results in 34.4% decrease in the probability of strategic patent
- Patent strength: 1% increase in use of patents unit results in 0.3% increase in the probability of strategic patent

Value of nonuse patents

	Economic value		Technological value	
Mode of (non)use	N	Mean	N	Mean
Still exploring commercial use	748	60.02	757	65.49
Strategic nonuse	225	44.86	236	52.49
Strategic nonuse (broad)	337	46.09	359	53.50
Lack of sponsors	71	45.70	76	53.03
Obsolete patents	259	40.97	276	49.54
Low tech	42	32.08	45	34.06
Total	1339	53.71	1388	60.32

Sample characteristics

Sample composition of firms by size is similar with patent propensity adjusted composition of population



Sample characteristics

Non-response bias tests: comparing analysis sample and survey population

- No difference
  - measures of collaboration
    - solo inventions: 26.3% for the sample, 26.8% for the rest, p=0.69
    - average number of inventors: 2.80 for the analysis sample, 2.74 for the rest, p=0.34
  - technological breadth of invention
    - number of different US Patent Classes: 4.44 for the analysis sample, 4.61 for the rest, p=0.14
    - number of different International Patent Classes: 4.77 for the sample, 4.85 for the rest, p=0.44
  - scope of invention (the number of claims: 3.44 for the analysis sample, 3.59 for the rest, p=0.06)
  - measures of patent value (Log(forward citations), 0.97 for the sample, 0.99 for the rest, p=0.43)
- Significant difference
  - smaller number of patents for which we only had a company address, instead of home address (4.2% of the sample had only a company address v. 5.8% for the rest, p<.01).
  - The linkage to universities or science is lower in our sample (mean of the number of "Other References": 4.07 for the analysis sample, 4.96 for the rest, p<0.05).

Sample Statistics – Key Variables

Variable	Mean	Std. Dev.	Min	Max	Data source
Strategic nonuse (narrow)	0.174	0.379	0	1	Survey
Strategic nonuse (broad)	0.261	0.439	0	1	Survey
Explanatory variables					
Patent effectiveness (CMS)	32.877	7.266	16.400	50.200	CMS
Missing patent effectiveness	0.157	0.364	0	1	CMS
Strength of appropriability of patents	3.748	0.294	2.875	4.222	Survey
Capital intensity (M$/employee)	0.076	0.131	0	1.908	COMPUSTAT
Dummy for missing capital intensity	0.259	0.438	0	1	COMPUSTAT
Ln(patent stock)	5.473	2.740	0	9.865	PATSTAT
Component familiarity (/1000)	0.085	0.154	0.000	2.489	USPTO

Sample Statistics - Controls

Variable	Mean	Std. Dev.	Min	Max	Data source
Fragmentation index	0.678	0.283	0	0.979	PATSTAT
Large firm (employees >500)	0.861	0.347	0	1	Survey & Patent
Inventor in manufacturing unit	0.084	0.277	0	1	Survey
Competence-destroying invention	0.573	0.495	0	1	Survey
Complexity of product technology	0.584	0.493	0	1	Survey
Breadth of openness	4.666	2.899	0	10	Survey
Diversity index of collaboration	0.434	0.863	0	8	Survey
Technological value	2.218	1.068	1	4	Survey
No immediate demand	0.222	0.416	0	1	Survey
% Basic R&D (/100)	0.079	0.172	0	1	Survey
Product invention	0.510	0.500	0	1	Survey
Man-month (normalized)	0.182	0.229	0.005	1	Survey

Sample Statistics - Controls

Variable	Mean	Std. Dev.	Min	Max	Data source
Number of inventors	2.797	1.916	1	16	Patent
Complexity of technology (# USPC)	4.452	3.538	1	30	Patent
Number of citations to the U.S. patents	17.697	24.478	0	399	Patent
Number of claims	22.922	15.585	1	181	Patent
Age of invention (months)	68.874	12.002	37	92	Patent
Semiconductor industry	0.069	0.254	0	1	COMPUSTAT
Electrical engineering	0.257	0.437	0	1	Patent
Chemistry, pharmaceuticals	0.239	0.427	0	1	Patent
Process eng, special equipment	0.135	0.342	0	1	Patent
Mechanical eng, machinery	0.132	0.339	0	1	Patent
Consumer goods & Construction	0.028	0.166	0	1	Patent

Reasons for patenting

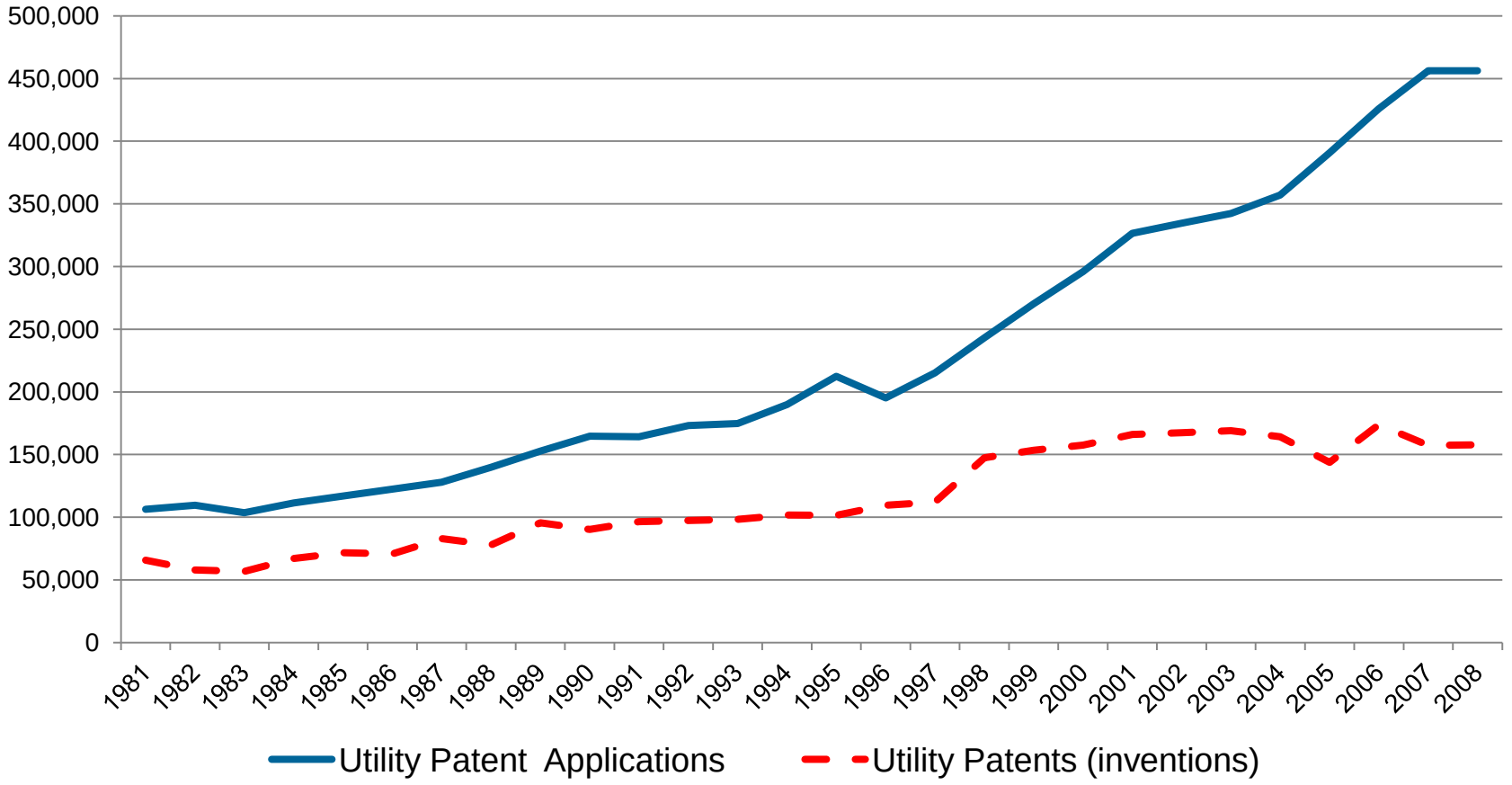
Small & medium; large	Discrete		Complex			All
	all	Pharma & Polymer	all	Bio	EE	
Licensing	>***	>***	>***	>	>	>***
Fence strategy	<*	<	<	<	>*	<*
Player strategy	>	>***	<***	>	<***	<*

Types of Strategic Patenting?

	Values/ benefits accruing to the inventor organization	Examples
Blocking	Increasing competitors' innovation costs Preventing competitors from further innovation	"Fleming valve" (radio)
Player strategy	Better bargaining position "freedom of operation"	S3 (graphic chip) v. Intel
Fence strategy (preventing invention around)	Securing the rent from the core inventions Heightening entry barriers	"Fan" patent (color proofing) Polaroid v. Kodak

Motivation

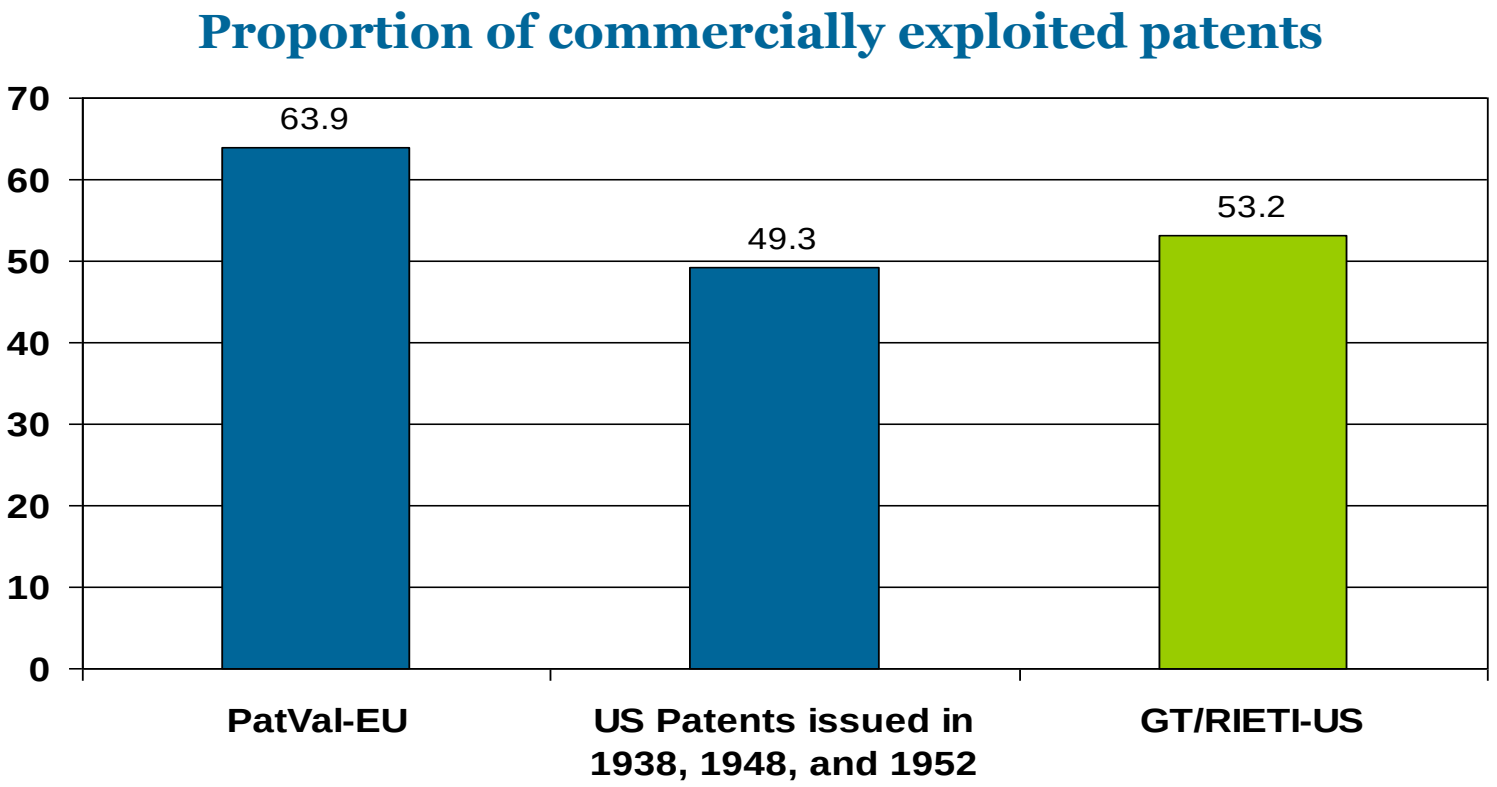
Patent applications quadrupled, patent grants tripled in the United States since 1980



Source: U.S. Patent Statistics Report, U.S. Patent and Trademark Office (USPTO)

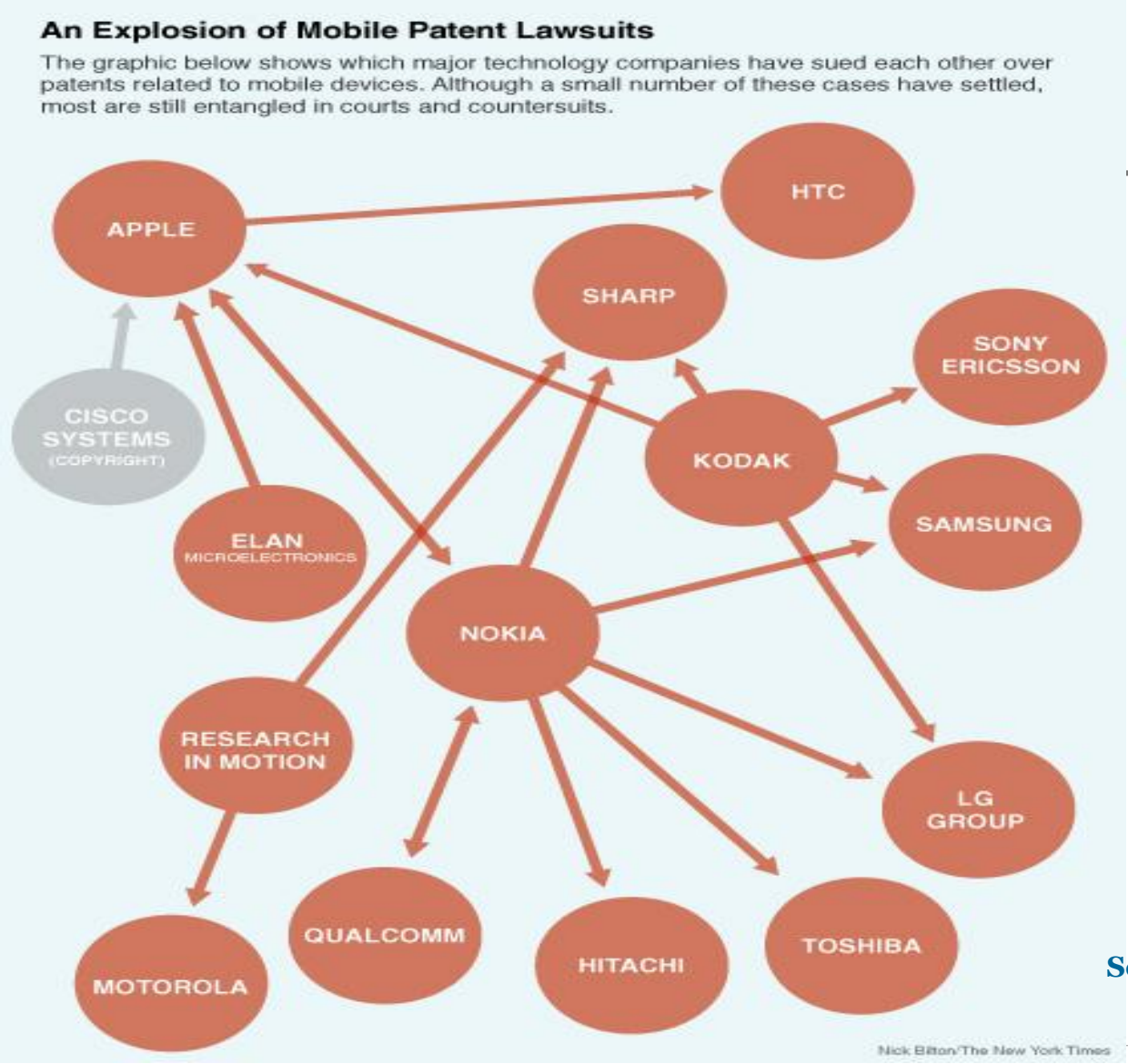
Motivation

Only about a half of granted patents in the U.S. is commercially exploited



Sources: PatVal-EU from Giuri et al. 2007; US Patents issued in 1938, 1948 and 1952 from Sanders et al. 1958; and GT/RIETI by authors

Mobile patent lawsuits



Source: New York Times, March 4, 2010