RIETI Policy Seminar

Standards and Intellectual Property: Strategies Japan should adopt in light of current global trends

Handout

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Dynamic effects of patent pools: Evidence from inter-generational competition in the optical disc industry

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Background

- We have seen both an increasing need for combining technologies and an increasing fragmentation of patent ownership in recent years.
- They have enhanced the necessity for developing an efficient institutional mechanism for aggregating technologies.
- A patent pool is one candidate.

DVD patent pools

- The two pools (6C and 3C) cover almost all bundle of the essential patents globally
  => “Two” stop shopping for global operations

- A third party assesses essentiality of the patents

- The licensors commit to price.
  - No price increase for additional SEPs later disclosed

- The licensors commit to RAND (Reasonable and Non-Discriminatory) licensing based on published price list.

- Royalty is distributed based on the number of patents by licensors in 6C.

Prior research

- Theoretical research shows positive economic contributions of a well-designed pool on the diffusion of a standard.
  - Shapiro (2001), Lerner and Tirole (2004)

- Empirical papers suggest some evidence of negative effects of the pools on R&D by licensors.
  - Lampe and Moser (2010, 2013), Joshi and Nerkar (2011)

- Theoretical research also has begun to address a dynamic issue about generations.
  - Gallini (2014)

Inter-generational competition

- A modern pool guided by competition authorities focuses on the integration of complementary patents for a specific standard.

- Standards often evolve over time, and inter-generational competition is important.
  - CD, DVD, and BD/HDDVD in the optical disc industry

- Patent pools may affect not only R&D for the current generation standard, but also R&D for the next-generation standard.

Joshi and Nerkar (2011)

- They focused the effects of the DVD pools (3C, 6C) on R&D by licensors and licensees.
  - Negative effects

- Aggregated all optical disc patents.
  - Ignored the inter-generational competition.

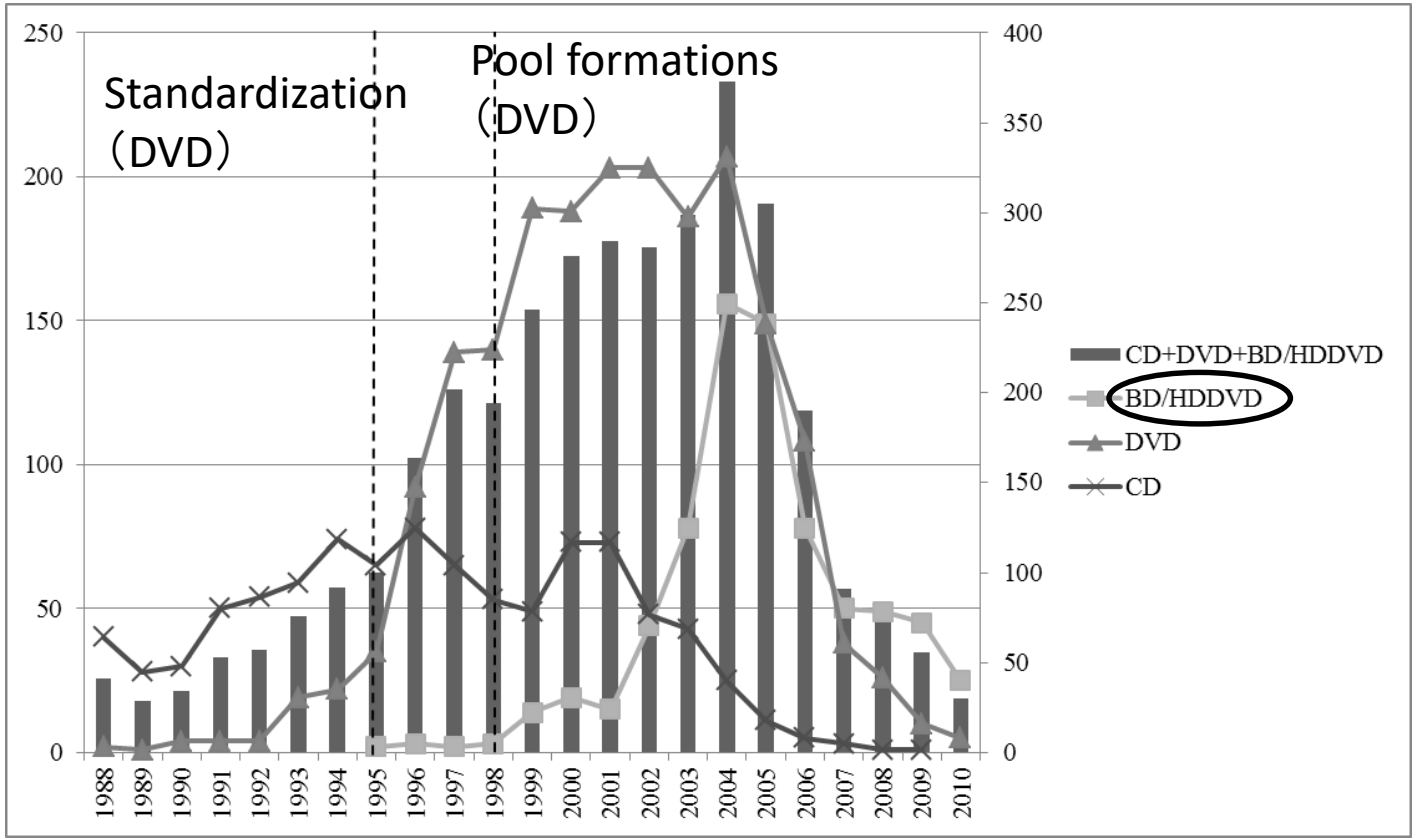
- Underestimated the effects of the pools.
  - They ignored the effect of the standard agreement before the pool formations.
  - The firms anticipate the pool formation at the time of the standard agreement.

Our research

- We identified the population of patents in optical disc technologies more correctly.
  - Cooperative Patent Classification (CPC)
  - Classification of essential patents by each pool

- Divided the patents into
  - CD
  - DVD: the **C**urrent **G**eneration **S**tandard (**CGS**)
  - BD/HDDVD: the **N**ext-**G**eneration **S**tandards (**NGS**)

Number of patent families on CD, DVD, and BD/HDDVD



Our research

- Examine how the agreement and pool formations on the CGS affect R&D for the NGS.
  - DID framework

- Licensors (DVD): treated group
- Licensees (DVD): treated and control groups
- Nonparticipants: control group
  - Firms which are developing optical disc technologies, but are not licensors or licensees.

- Compare the performance of licensors with that of nonparticipants.

Determinants of R&D for NGS

	After the standard agreement	After the pool formations
Licensors	・R&D opportunity for NGS (＋) ・Experience developing DVD technologies (＋) ・Sunk cost and replacement effects (－)	・R&D opportunity for NGS (＋) ・Experience developing DVD technologies (＋) ・Sunk cost and replacement effects (－) ・Collusive restraint of R&D accompanying the patent pools (－)
Licensees	・R&D opportunity for NGS (＋)	・R&D opportunity for NGS (＋) ・Experience exploiting DVD technologies (＋) ・Sunk cost effect (－)
nonparticipants	・R&D opportunity for NGS (＋)	・R&D opportunity for NGS (＋)

R&D opportunity for NGS

- When innovation is cumulative and includes multiple generations, R&D for the NGS builds on the technologies for the CGS.
  - There exist 75 families on DVD / 239 essential families on BD (= 31%).

- If firms developing technologies on the NGS anticipate that the SEPs on the CGS are licensed under RAND conditions ex-post, they can expect that *the hold-up problem* can be avoided.

↓

- The agreement and pool formations on the CGS would have **positive effects** on R&D for the NGS
  - **not only by licensers, but also by licensees and nonparticipants.**

Experience (Licensors)

- When innovation is cumulative and includes multiple generations, the licensors have stronger R&D capability for the NGS
  - based on the experience of developing DVD technologies at the time of the agreement.

↓

- Both events on the CGS would have **positive effects** on R&D for the NGS **by licensors.**

Sunk cost and replacement effects (Licensors)

- Because the licensors made large sunk R&D investment in the CGS, they would have chosen a project for the NGS that would exploit the existing complementary assets.
  - Sunk cost effect

- The expected profit from the CGS would make the licensors reluctant to invest in the NGS.
  - Replacement effect

↓

- Both events on the CGS would have **negative effects** on R&D for the NGS **by licensors.**

Hypotheses

- *(H1) Both the agreement and pool formations on the CGS will increase R&D for the NGS by licensors, relative to nonparticipants*
  - *if the effect of experience in the CGS dominates the sunk cost and replacement effects.*

The standard wars

Next-CD	SD (Toshiba, Panasonic)	MMCD (Sony, Philips)
The DVD standard was announced based on **the SD format** in 1995.		
DVD pools	6C (Toshiba, Panasonic)	3C (Sony, Philips)
Next-DVD	HDDVD (Toshiba)	BD (Sony, Philips, Panasonic)
Toshiba retreated from HDDVD in 2008.		
BD pools	Premier BD (Toshiba)	One blue (Sony, Philips, Panasonic)

- Most of **the 6C licensors** (Toshiba, Panasonic) were winners in the competition for the DVD standard.
- They would have made more sunk R&D investment in the DVD standard than **the 3C licensors** (Sony, Philips).

Hypotheses

- *(H1) Both the agreement and pool formations on the CGS will increase R&D for the NGS by licensors, relative to nonparticipants*
  - *if the effect of experience in the CGS dominates the sunk cost and replacement effects.*

↓

- *(H2) These R&D promoting effects would be smaller for the 6C licensors with larger sunk R&D investment on the CGS, than the 3C licensors.*

Data and dependent variable

- PATSTAT Database
  - US patents
- Panel dataset of 110 firms by application year from 1988 to 2010
  - 16 licensors, 14 licensees and 80 nonparticipants
- Dependent variables
  - the number of families
  - the number of families weighted by forward citations (to consider quality of inventions)

- DID framework
- OLS models, taking the log of these dependent variables

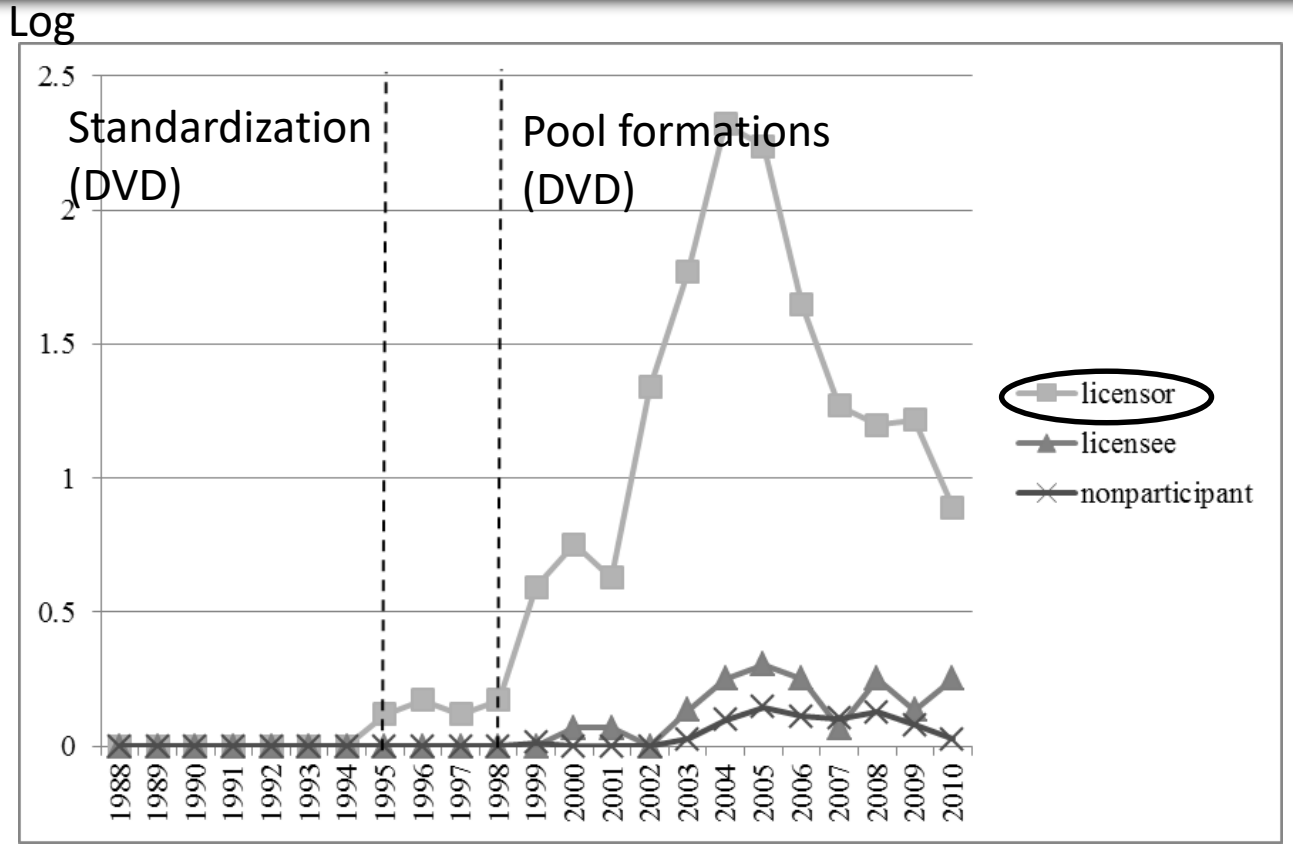
Independent variable

- *Standardization (1995-1997)*
  - A binary variable that takes a value of 1 for all observations between 1995 and 1997 before the pool formation
- *Pool (1998-2000)*
  - A binary variable of the first period after the pool formation
- *Pool (2001-2010)*
  - A binary variable of the second period after the pool formation

- *Licensor*
  - *6C, 3C*
- *Licensee*

- Control variables
  - *Firm fixed effects, firm technological diversity, firm age, application years*

Number of families on NGS per firm of three types



	(2)	(3)	(5)	(6)
	In(Families)		In(Citation-weighted families)	
Standardization(1995-1997)×Licensor	0.068		0.556**	
	(0.044)		(0.216)	
Pool(1998-2000)×Licensor	0.306**		1.145***	
	(0.119)		(0.356)	
Pool(2001-2010)×Licensor	0.727***		1.585***	
	(0.203)		(0.384)	
Standardization(1995-1997)×6C		0.051		0.608**
		(0.065)		(0.293)
Pool(1998-2000)×6C		0.082		0.730**
		(0.092)		(0.356)
Pool(2001-2010)×6C		0.381**		1.102***
		(0.170)		(0.345)
Standardization(1995-1997)×3C		0.052		0.087
		(0.059)		(0.126)
Pool(1998-2000)×3C		0.716***		2.043***
		(0.255)		(0.704)
Pool(2001-2010)×3C		1.220***		2.301***
		(0.339)		(0.630)
Standardization(1995-1997)×Licensee	-0.013	-0.018	-0.022	-0.050
	(0.012)	(0.013)	(0.017)	(0.033)
Pool(1998-2000)×Licensee	0.002	-0.002	0.031	0.023
	(0.022)	(0.023)	(0.076)	(0.077)
Pool(2001-2010)×Licensee	0.037	0.029	0.051	0.034
	(0.034)	(0.035)	(0.052)	(0.056)

- Standardization × Licensor, Pool × Licensor
  - Positive and significant
  - Support H1
- Pool × 6C
  - Smaller than 3C
  - Support H2

Conclusion

- Both the agreement and pool formations on the CGS encouraged the licensors to invest in R&D for the NGS.

- These R&D promoting effects were smaller for the 6C licensors with larger sunk R&D investment on the CGS, than the 3C licensors.

Implication

- The DVD pools seemingly didn't constrain the R&D competition for the NGS among the licensors
  - contrary to the prior empirical work.

- The competition policy and RAND commitment would have contributed to it.
  - The scope of the pools was narrowly specified, and the clear commitment to RAND licensing for the CGS existed, which were essential for competitive R&D for the NGS.

Key references

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Determinants of R&D for CGS

	After the standard agreement	After the pool formations
Licensors	・R&D opportunity for CGS (＋) ・ Experience developing DVD technologies and licensing income (＋) ・Inefficiency of the patent pools (－)	・R&D opportunity for CGS (＋) ・Experience of developing DVD technologies, complementary assets and licensing income (＋) ・Inefficiency of the patent pools (－)
Licensees	・R&D opportunity for CGS (＋)	・R&D opportunity for CGS (＋) ・Experience of exploiting DVD technologies and complementary assets (＋) ・Inefficiency of the patent pools (－)
nonparticipants	・R&D opportunity for CGS (＋)	・R&D opportunity for CGS (＋)

Hypotheses (CGS)

- *(H1) Both the events will increase R&D for the CGS by the licensors, relative to the nonparticipants*
  - *unless the pools are highly inefficient.*

- *(H2) Both the events will increase R&D for the CGS by the licensees over time, relative to the nonparticipants*
  - *unless the pools are highly inefficient.*

	(2) ln(Families)	(4) ln(Citation-weighted families)
Standardization(1995-1997)×Licensor	1.037***	2.620***
	(0.189)	(0.388)
Pool(1998-2000)×Licensor	1.500***	2.760***
	(0.240)	(0.506)
Pool(2001-2010)×Licensor	1.119***	1.810***
	(0.203)	(0.311)
Standardization(1995-1997)×Licensee	-0.003	-0.068
	(0.029)	(0.100)
Pool(1998-2000)×Licensee	0.140	0.363
	(0.103)	(0.364)
Pool(2001-2010)×Licensee	0.300***	0.525***
	(0.113)	(0.198)

- Standardization × Licensor
  - Positive
  - Support H1
- Pool × Licensor
  - Positive
  - Support H1
- Pool(2001-2010) × Licensee
  - Positive
  - Support H2