
What are the Determinants of Inbound and Outbound Open Innovation Performance?

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Agenda

- Research Purpose
 - Theoretical Framework
 - Data
 - Situation of OI in Japan
 - Results
 - Summary
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Research Purposes

■ Limitations of Research on Open Innovation (OI)

- No comprehensive theoretical framework has been proposed for understanding OI.
- Major studies in OI employed case studies. A few quantitative studies were conducted, however, they employed secondary data.
 - Laursen and Salter (2006) , Spithoven et al. (2010)
- Research conducted on OI thus far has focused only on US and EU industries, except Asakawa et al.(2010).

■ Research purposes

- To develop a theoretical framework to understand the performance of inbound and outbound OI.
 - To understand OI through a questionnaire survey to Japanese manufactures.
 - To test the proposed theoretical model through a structural equation modeling.
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Determinants of Inbound and Outbound Open Innovation Performance (1/2)

- OI Window (Hemmert 2004)
 - In order to harness OI, the institutionalization of a formal system or window to acquire external knowledge and to provide internal knowledge is necessary.
- Environmental factors: Transaction cost theory (Coase 1937; Williamson 1975)
 - Technology change (Pisano 1990; Chesbrough 2003)
 - Competition (Chesbrough 2003)
 - Appropriability of technology (Levin, Cohen, and Mowery 1985; Teece 1986; Pisano 1990)
- Organizational/ Capability Factors: Resource based view/capability theory (Wernerfelt 1984; Langlois and Robertson 1995; Teece and Pisano 1994)
 - Absorptive capacity (Cohen and Levinthal 1990)
 - Technological capability/ resources
- Relational Factors: Trust theory (Granovetter 1985)
 - Trust in the firm (Clark & Fujimoto 1991; Sako 1998)

Determinants of Inbound and Outbound Open Innovation Performance(2/2)

■ Strategy Factors

- R&D- Marketing Integration/ consistency (Iansiti 1998)
- Core technology development
- Pro-patent strategy
- Licence-out strategy

■ Characteristics of the R&D process

- Heavyweight project leader (Clarke and Fujimoto 1991)
- Formalized R&D Process (Cooper 1986)

■ Collaborative R&D Partners

- Domestic universities
 - Foreign universities
 - Research institutes
 - Rivals (von Hippel 1988)
 - Customers (von Hippel 1988)
 - Suppliers (von Hippel 1988; Nishiguchi 1994)
 - Subsidiaries
 - Parent company
 - License-in
 - Acquisition of technology start-ups
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Theoretical Framework

Transaction Cost Theory

Environmental Factors

Resource based view /competency theory

Organizational/ Capability Factors

Trust Theory

Relational Factors

Window for OI

Strategy

R&D Process

Collaboration Partners

Performance of Inbound Open Innovation

Performance of R&D

Performance of Outbound Open Innovation

Data

■ Method

- Mail survey of Japanese manufacturers (2007-).

■ Sampling frame

- Manufacturers listed in the Japanese stock exchange market and having an R&D laboratory.

■ Sample/response/response rate for each year is shown below.

- 2007: 450/122/27.1%

- 2008: 419/132/31.5%

- 2009: 485/127/28.2%

- 2010: 434/134/30.9%

- 2011: 451/136/30.2%

- 2012: 448/109/24.7%

- 2013: 488/125/25.9%

- Total: 3175/885/27.8%

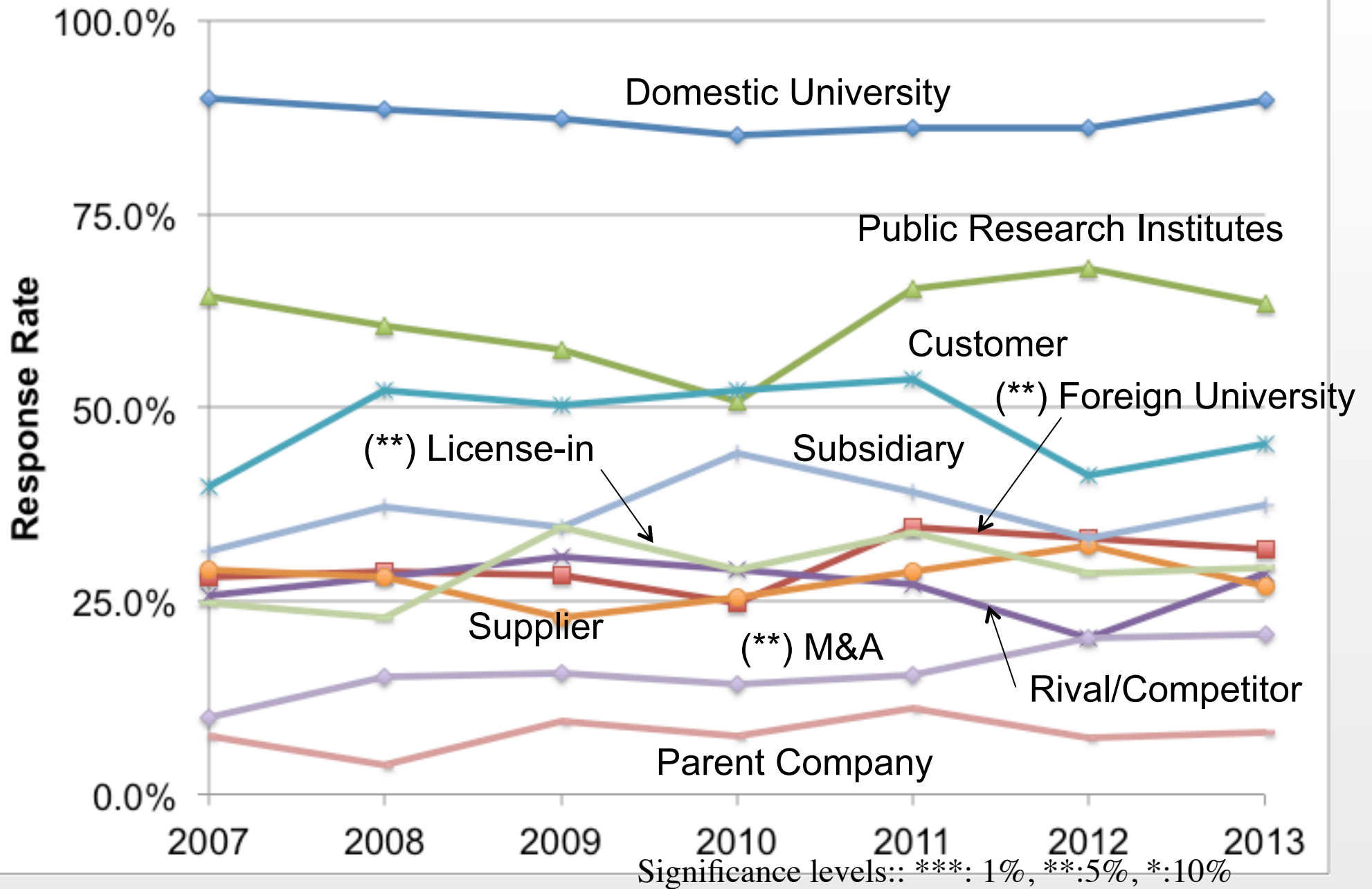
■ “No response bias” was not found

- It was confirmed that there was no difference between the firms that responded and those that did not, in terms of sales and the distribution of industrial classification.
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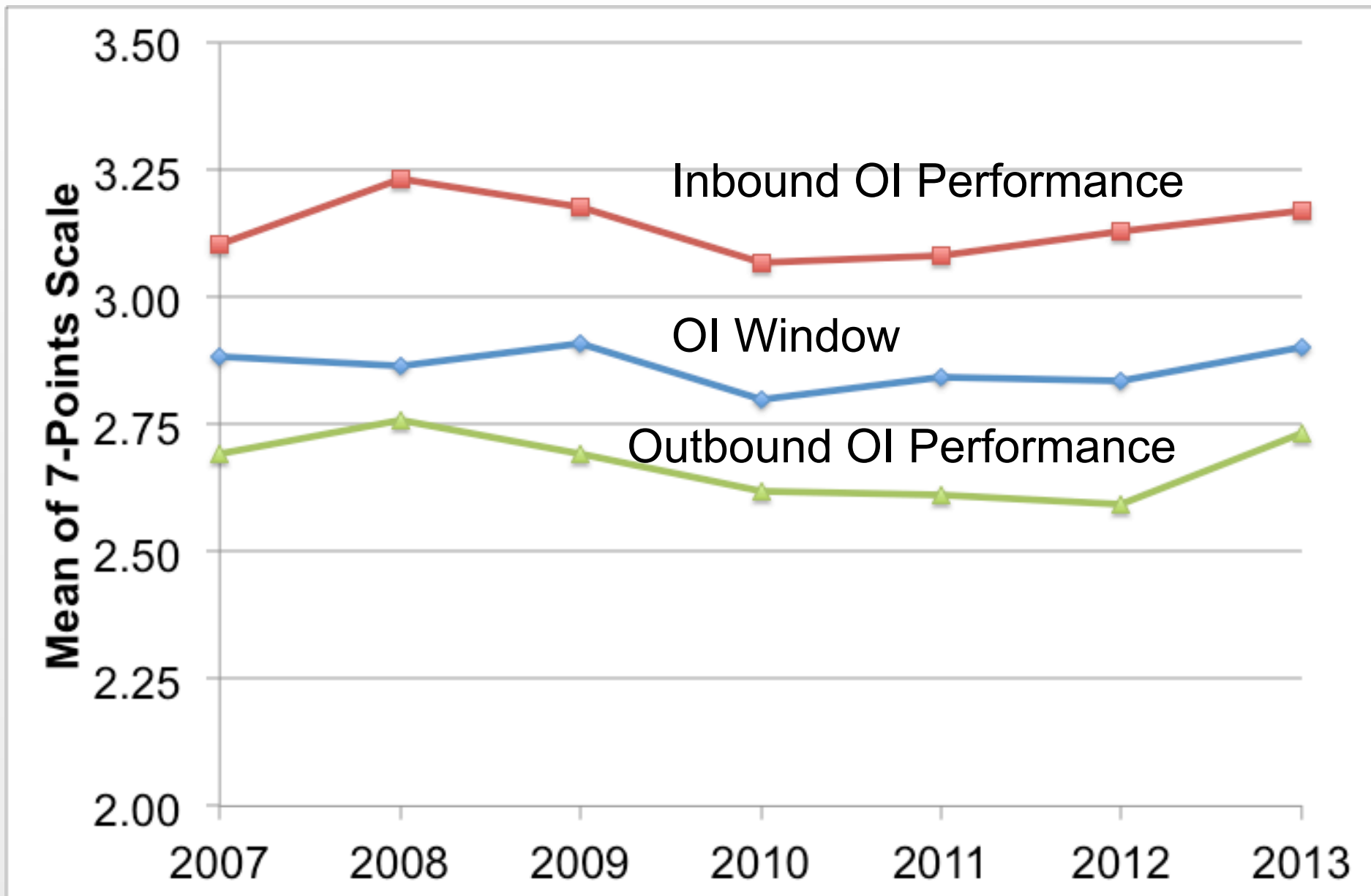
Measurement Scale Development

- The constructs were measured with *subjective judgment* scales.
 - Most of constructs are unobservable. For each construct, a few questionnaire items were developed. Items were measured using the Likert-type five-point scale. The reliability of the scales was confirmed with Cronbach's alpha.
 - Examples
 - Performance of inbound OI (Cronbach's alpha = 0.872)
 - *Introduction of external technology has accelerated the firm's R&D speed.*
 - *Introduction of external technology has enabled the development of innovative products in the firm.*
 - *The products of the firm that incorporate external technology have succeeded in the market.*
 - Performance of outbound OI (Cronbach's alpha = 0.784)
 - *The firm's technology is licensed to other firms, which enables them to develop innovative products.*
 - *The products of other firms that have licensed the firm's technology have succeeded in the market.*
 - *The firm's revenue from licensing has increased.*
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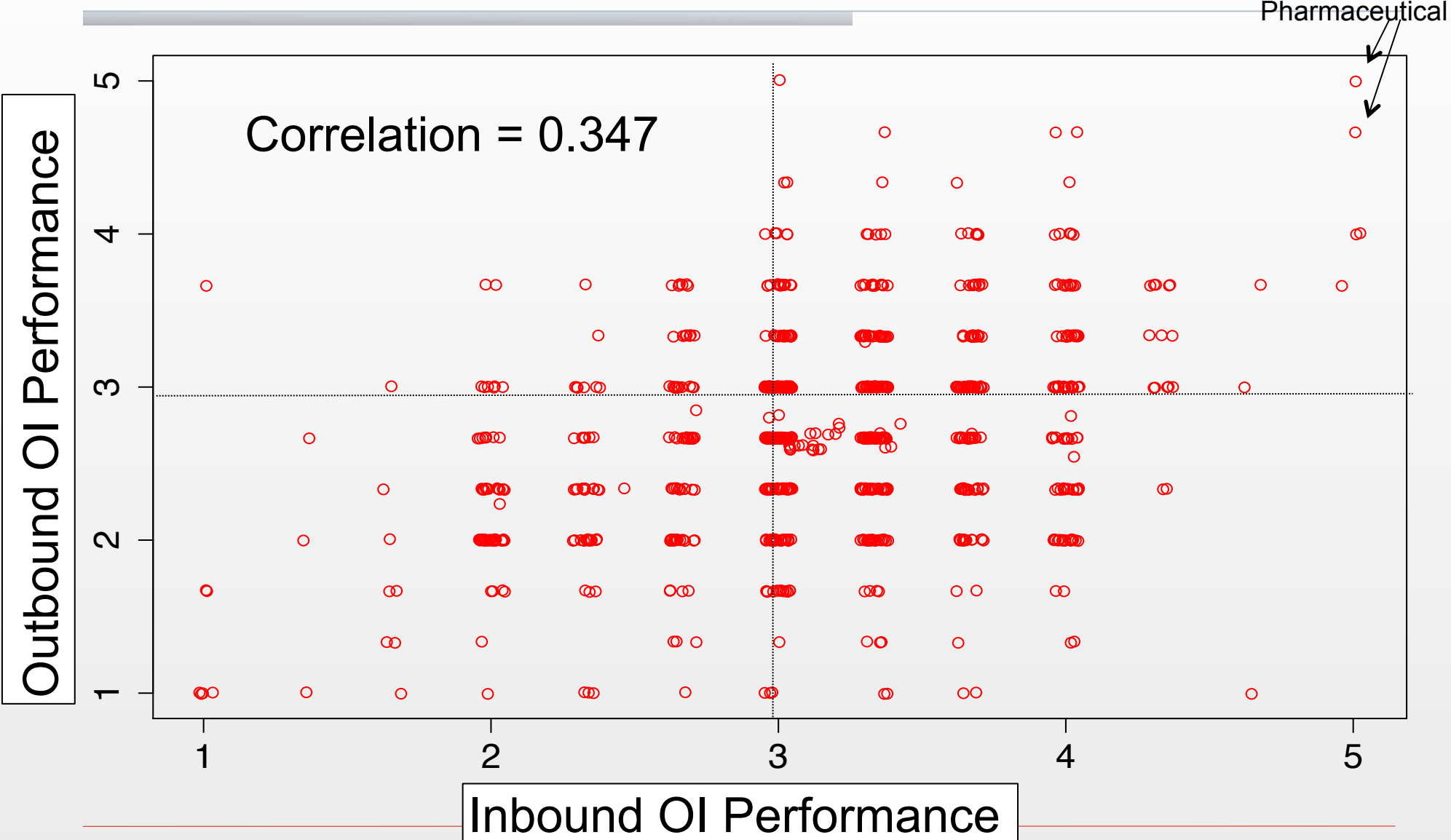
Situation of OI in Japan: Collaboration Partners



Trends of Open Innovation Performance



Relationship Between Inbound and Outbound OI Performance



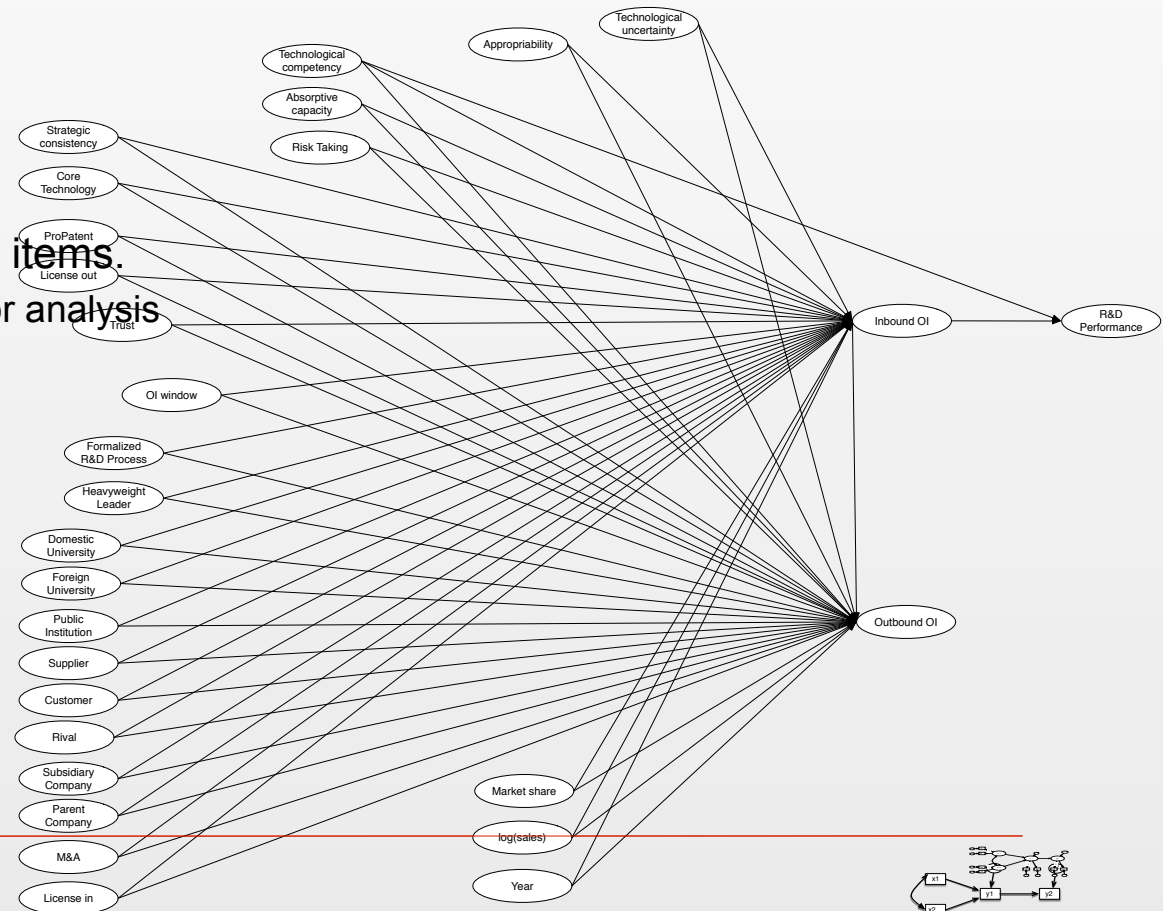
Analysis (1/2)

Method

- Structural equation modeling (Jöreskog and Sorbom 1999)
 - Examines relationships among (unobservable) variables such as organizational culture, trust, strategy, OI performance, etc.

■ Controls

- Industry dummy
- log of sales
- Market share
- Yearly trend was found for certain items.
 - “Year of survey” was introduced for analysis



Analysis(2/2)

- Moving window analysis
 - The same model was estimated for 2007-2011 and 2009-2013 samples to examine change in relationships among variables.
 - For multi-year response firms, the latest response was employed for the analysis.

 - Single and multi-sample analysis
 - To find differences and similarities between B2B and B2C samples. Pooled sample analysis and two sample analysis was conducted. The model fit of the pooled sample analysis (RMSEA = 0.062) was better than that of the two-sample analysis (RMSEA = 0.112).
 - Results are robust between B2C and B2B industries.
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Table Results of Estimation

		2007-2011 (N=390, RMSEA =0.062)			2009-2013 (N=341, RMSEA =0.067)		
		Inbound OI Performance	Outbound OI Performance	R&D Performance	Inbound OI Performance	Outbound OI Performance	R&D Performance
OI window		0.125*	0.362***		0.201***	0.272***	
Environmental	Appropriability	-0.035	0.000		-0.027	0.000	
	Technological uncertainty	0.030	-0.005		0.011	-0.007	
Capability	Absorptive capacity	0.229***	0.047		0.216***	0.045	
	Technological competency	0.184***	0.382***	0.524***	0.075	0.21***	0.569***
Organizational Culture	Risk Taking	0.058***	-0.024		0.056***	-0.062**	
Relational	Trust in a Firm	0.051*	-0.034		0.039	0.007	
Strategy	Strategic consistency	0.024	0.072**		0.014	0.041	
	Core Technology	-0.029	0.001		0.059**	0.047	
	ProPatent	0.025	-0.045		0.001	-0.014	
	License_out	0.023	0.139***		-0.025	0.153***	
R&D process	Heavyweight Leader	0.014	-0.033		0.015	0.036	
	Formalized R&D Process	0.034**	-0.038**		-0.015	-0.033*	
Collaboration Partners	Domestic University	0.191**	-0.141		-0.008	-0.02	
	Foreign University	-0.031	0.046		0.023	-0.022	
	Public Institution	-0.035	-0.112		0.036	-0.09	
	Rival	0.031	0.045		-0.019	0.124	
	Customer	-0.14**	-0.001		-0.003	0.076	
	Supplier	0.059	0.025		0.078	-0.121	
	Subsidiary Company	-0.036	0.142*		0.071	0.189**	
	Parent Company	0.102	-0.098		0.149*	0.059	
	License_in	0.122*	0.101		0.179**	0.06	
	M&A	0.134*	0.072		-0.004	-0.035	
Industry	Consumer goods	-0.024	-0.029		0.019	-0.025	
	Food	0.06	0.073		-0.071	0.061	
	Auto Motives	-0.015	0.099		-0.011	-0.006	
	Pharmaceutical	0.031	0.004		0.163**	-0.18*	
	Chemical	-0.026	-0.01		-0.047	-0.043	
	Ceramics	0.145*	0.044		-0.018	0.115	
	Precision mechanics	-0.012	-0.047		0.017	-0.161	
	Electronics	0.06	-0.014		0.037	-0.146	
	Machinery	0.038	-0.098		-0.021	0.086	
Other controls	log(sales)	0.025	-0.065***		0.027	-0.042*	
	Year	0.012	-0.042*		0.026	0.005	
	Market share	-0.077***	-0.02		-0.067***	-0.001	
Inbound OI Performance			0.076	0.213***		0.221**	0.196***

Significance levels:: ***: 1%, **:5%, *:10% Red (blue) cell indicates positive (negative) and significant at least 10%.

Summary (1/2)

- Theoretical framework to understand OI that integrate transaction cost theory, competence theory, and trust theory was proposed.
 - Situation of OI in Japan is described with longitude questionnaire survey.
 - Outbound OI is less developed.
 - Inbound and Outbound OI have different aspects (correlation =0.347).
 - Japanese manufacturers are also going to utilize the market to acquire external knowledge, as in the US.
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Summary (2/2)

- Testing the proposed model resulted in the following findings:
 - Inbound OI improves R&D performance.

 - Importance of OI Window and capability
 - Among many variables, “acquisition/provision window of technology” and “technological competency” positively affect both “inbound and outbound OI performance”. This result indicates that, in Japan, performance of OI is determined by capability and internal system of firms rather than transaction cost related variables.

 - Japanese manufacturers is shifting from relation based to market based knowledge acquisition
 - We also confirm that “trust in the firm” positively affects inbound OI at early period. However, it is insignificant at the later period. This results also indicates Japanese manufactures shifting to market oriented knowledge acquisition.

 - Importance of license-out strategy that integrate business model for outbound OI
 - Outbound OI performance is positively affected license-out strategy. Establishing a technological strategy is more important to improve outbound OI.

- We confirmed that our findings are stable between B2C and B2B industries.

Limitation and Future Research

- We believe our study contributes to understanding OI. However, further research is required.
 - Theoretical refinement
 - Technological competency should have a positive correlation with absorptive capacity. Firms with higher absorptive capacity should have better acquisition/provision windows. We neglected the relationships between variables, and theoretical elaboration is necessary to understand OI.
 - Advanced Modeling: Panel-like Modeling
 - We employed moving window approach. Although, most of respondents answered 1.8 times during 7 years, panel like modeling would be effective to understand causality.
 - International comparison
 - International comparison would also be meaningful for confirming the generalizability of our findings.
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Thank you!

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