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Mergers and R&D in Recent Japanese Manufacturing: Learnings from Empirical Analyses

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Introduction: Motive and Research Questions

- (1) Recently in high-tech fields and also in low- and middle-tech fields, many mergers have been carried out with reference to **innovation**.
Many proposed mergers have emphasized ;
 - "strengthening R&D & technological capabilities" (dynamic-efficiency)
 - "improving managerial efficiency" (X-efficiency)
- (2) Recently, an interesting case of merger offer: the proposed acquisition by *Pfizer* of *AstraZeneca*, which has failed to take place in 2014. *AstraZeneca* rejected the offer, emphasizing that "**there is little evidence that big mergers have improved innovation in the pharmaceuticals industry**". The assertion suggests the relationship between merger and R&D.

(3) The recent interesting relevant findings

- R&D intensity has a positive effect on market mobility (*i.e.*, fluctuation in firms' market share and position), suggesting that innovation may lead to fierce competition (Doi, Honjo and Kudo [2014])
- R&D intensity of a firm leads to the firm's greater international competitiveness, which is picked up by share of foreign sales (*i.e.*, exports plus foreign subsidiaries' sales) in the whole sales (Doi, Kudo and Kato [2014]).

These findings suggest that **innovation may be important for competition and competitiveness in domestic and global markets.**

(4) Merger effects on R&D activity

Thus, the relationship between competition and R&D activity, in particular between mergers and R&D activity is one of the most important policy issues today.

However, existing studies provide varied effects regarding the effects of mergers and merger regulations on R&D activity.

(5) Purpose of the paper: research questions;

- *How have mergers affected R&D activity in recent Japan?*

- to empirically explore the effects of mergers consummated since 2000 on R&D activity in Japanese manufacturing industries (*dynamic effect*).

- *What can we learn from the evidences?*

- to suggest issues which should be examined in the analysis of innovation effects of mergers, and also in the enforcement of merger regulation (*dynamic assessment*).

- Suggestions from this paper

- *How have mergers affected R&D activity in the recent Japan?* (dynamic effect)

- ⇒ frequent failure to improve R&D activity post merger

- diverse effects of mergers on R&D activity

- *What can we learn from the evidences?* (dynamic assessment).

- ⇒ less examination on dynamic assessment

- necessary to “economic analyze” the process of dynamic assessment in the enforcement of merger regulation

II. Survey of Existing Studies: Diversity in Findings

(1) Theoretical Examination: Interaction and Diverse Relationships between Firms

- the "market power" hypothesis: If mergers strengthen market power, a risk-avoiding "quiet life" may weaken the incentive of technological development.

The hypothesis is likely to be supported by the findings that in EU after a cartel breaks down, the former cartel-joining firms frequently prefer mergers among them (Davies *et al.* [2014]). In Japan, there is no definite relationship between cartel breakdown and merger among detected cartels.

- the "Schumpeter(ian)" hypothesis: Mergers which expand firm size and industry concentration are effective in the promotion of innovation, capturing greater R&D capability (appropriability, financing and risk-taking), greater R&D efficiency (economy of scale in R&D) and more chances to apply the R&D outcomes (diversification) as major promoters of technological development.

Concerning the validity of these hypotheses, a very great amount of empirical study has been developed, but there is no resolution to the controversy.

- Further reasoning

The theoretical analyses of oligopoly clarify the diverse price activities of oligopoly firms. These facts may suggest a similar possible effect on R&D activities as well.

1) **Unilateral effect** in R&D: "innovation diversion" theory (Farrell & Shapiro [2010])

- One party of joining firms launches an improved existing product, or a newly developed product which would considerably reduce the sales of the other party. Through avoiding R&D investment which has the possibility to cause "**cannibalization**" of sales between products after the unification (with horizontal merger), and also through **internalization** of the leakage of R&D performances, a merger can have a negative effect on R&D incentive.
- This effect depend mainly focuses on the relation of products between the joining parties. In fact, recent policy has focused on the unilateral effect.

2) Antagonistic reaction: [innovation balance](#)

- Rivals' antagonistic reaction may take an aggressive innovation activity, balancing out the R&D-restricting effect of merger as a whole. The consequence may be a positive "innovation balance".

Appendix 1 Industry Effects of Mergers : "Innovation Balance"

		R&D of a merging firm	
		Expansion	Decline
R&D of non-merging firms	Expansion	> 0	$> \text{ or } < 0$
	Decline	$> \text{ or } < 0$	< 0

Note: Innovation Balance = effect of a merging firm + effects of non-merging firms; $>$ or < 0 .

- the post-merger behavior and performance of a merging firm are affected by the behavior of non-merging rivals. As a result, the market performances of the merging firm and the industry in question are not definite. The R&D strategy of a merging firm is likely to be affected by the behavior of rivals and non-merging firms.
- (3) “Coordinated effect” in R&D: an implicit cooperation which reduces R&D with mutual understanding between a merging firm and non-merging firms.
- The possibility of the coordinated effect in R&D is not necessarily definite, and may be smaller than in the case of its unilateral effect.

(4) The effects of vertical and diversification mergers

Those types of merger (including a "congeneric" type) may have different effects on R&D.

For example,

- the “**exclusive unilateral effect**” which through less competition weakens the R&D incentive of a merging firm.
- the “Schumpeter(ian) effect” which leads to larger incentives to promote R&D through more R&D opportunities or obtaining internally and stably more R&D funds

(2) Survey of Empirical Results: Diverse Effects

As noticeable studies;

- 1) Colombo & Garrone [2006]: a "clinical" type of analysis based on detailed questionnaire inquiries and data from interviews for 31 cases
 - examine the effect of mergers on research facilities, number of R&D staff and R&D expenditures of joining firms
 - analyze the R&D activity of a merging firm by business segmentation, not the R&D activity of a merging firm as a whole
 - show that mergers and especially horizontal mergers tend to cause a decline in R&D activities
 - also show that both the technological and market relationships between the joining parties have a significant influence on the performance of merger
- ⇒ more desirable approach toward analysis on merger effects

2) Caldenrini *et al.* [2003] :

- analyze the effects of mergers on the number of patents of an acquired firm ("inside effect")
- the innovation activities of an acquired firm (almost horizontal type) tend to decline after acquisition
- the decline is caused by " administrative" issues of integrating R&D activities

3) JFTC[2007] & Ornaghi [2006]:

- analyze rivals' R&D reaction ("outside effects")
- the inside (for a merging firm) and outside (for non-merging firms) effects of a merger (JFTC: automatic vending machine)
- shows that mergers have an adverse effect on the R&D of non-merging firms (Ornaghi)

(3) Theoretical and empirical suggestion

Thus, the R&D effects of mergers are neither definite theoretically nor empirically.
Therefore, it is difficult to assess the effects of merger on R&D.

III. Methodology: Back to the simple

- Compare two R&D-related variables of joining parties and a merging firm between pre- and post-merger : R&D intensity and number of patent application
- Sample: listed firms
- “Back to the simple”

(1) Measures of R&D Activities: R&D Intensity and Number of Patent Application

- 1) R&D intensity: R&D expenditures-sales ratio as the input aspect of R&D activity
the pre-merger ratio: the weighted average of joining parties
- the analytical period : pre-merger 3 years, and post-merger 5 years
 - the source: R&D expenditures from the "general selling and administrative costs" and "current-term manufacturing costs" in the "consolidated profit and loss statement" of the *Annual Security Report* of a joining or merging firm

- The relationship of the before-and after- ratios of R&D intensity

$$\sum_i \{ \sum_n (RD_{n \cdot 0-i} / R_{n \cdot 0-i}) (s_{n \cdot 0-i}) \} / 3 \text{ or } 5 \cong \sum_i (RD_{0+i} / R_{0+i}) / 3 \text{ or } 5$$

where **RD**: R&D expenditures, **R**: sales, **s**: the ratio of sales of a joining party to total sales of all joining parties (**n**: 1,2 with two joining parties), **i**: the years of observation (1,..,3 or 5), and suffix **0-i** and **0+i**: the i-th year before merger and after merger

- The approach includes some qualifications ;
 - no "relative" evaluation (or a "difference-in-difference test", or a "counterfactuals test")
 - diversification (diversified firms)

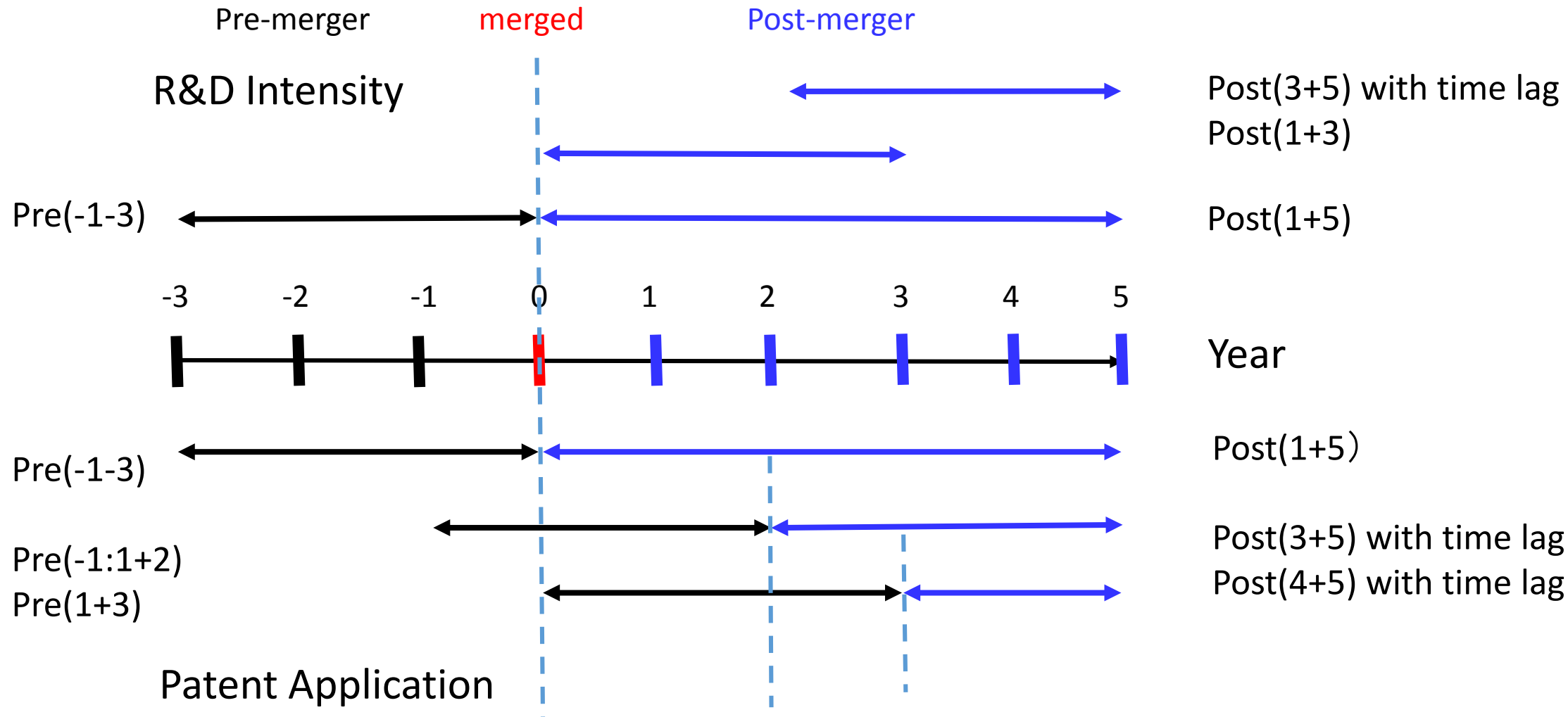
2) the number of "patent application" as measure of R&D output

- Calculated from the *Japan Patent Office's* published data
- Has some qualifications;
 - the count number of application by a merging firm (unconsolidated figures), not corporate-wide consolidated figures
 - time lags problem: the pregnancy period from starting of R&D activities to invention, the period from invention to patent application, and the period from patent application to "publishing" by the *Patent Office* (*i.e.*, applications are officially published one year and a half after)
 - applied patents, not filed patents

2) Merger Cases – 39 Cases for 2000-2008 –

- **39** merging firms selected during **2000** to **2008** in manufacturing
- Samples
 - 1 for sugar manufacturing; 1 for milling; 2 for cooking oil; 2 for paper manufacturing;
 - 5 for pharmaceuticals; 1 for cosmetics; 1 for industrial-use gas, tires, firebricks, sheet glass, petroleum products, iron and steel, aluminum sash, and housing machinery respectively; 2 for bearings; 1 for control units, construction machinery, photocopier machines, storage batteries, tiny motors respectively;
 - 2 for toys
- **35** for horizontal merger; **1** for vertical merger; and **3** cases for diversification merger

Fiscal Years for Comparison



IV. Results and Discussion

(1) R&D intensity

- When comparing the pre-merger **3** year average and the post-merger **3** year average, the post-merger average rises in **17 cases (44%)** out of 39 available cases, and falls in **22 cases**
- When comparing the pre-merger **3** year average and the post-merger **5** year average, the post-merger average rises in **17 cases (50%)** out of available 34 cases and falls in **17 cases**
- When comparing the pre-merger **3** year average and the post-merger **3** year average for the 3rd to 5th year after merger, the post-merger average rises in **17 cases (55%)** out of available 31 cases and falls in **14 cases**
- Thus, **there is no the evidence that mergers had considerably strengthened R&D in most of the cases**
- Careful interpretation is necessary, due to some qualifications included

Table 2 Change in R&D: before and after

	<u>Pre-3/Post-3</u>			<u>Pre-3/Post-5</u>			<u>Pre-3/Post-3-to-5</u>		
	+	—	Total	+	—	Total	+	—	Total
R&D Intensity	17	22	39	17	17	34	17	14	31
No. of Patent Application	11	28	39	9	25	34	11	23	34

Note: Pre-3: 3-years average pre-merger; Post-3(5): 3(5)-years average post-merger; Post-3-to-5: 3 years average for the 3rd to 5th year after merger; +: increased; —: decreased.

- In "progressive" industries: > 3 or 4 %
Of 15 cases where 5-years-average R&D intensity post-merger is 3% or greater, 9 cases show an increase (9/15). Also, with 4% or greater of R&D intensity, 7 cases out of 10 available cases experienced an increase (7/10).
- In cases which were “investigated” for possible antitrust regulation by JFTC
5-years-average R&D intensity increased post-merger in all of 5 available cases (5/5).

(2) Analysis of the Number of Patent Publications: 34 mergers

- compare the average for post-merger 3 years or 5 years with pre-merger 3 years average (Table 2) :
 - the post-merger 3-year average increased in 11 cases (28%) of 39 mergers, and declined in 28 cases.
 - the post-merger 5-year-average increased in 9 cases (26%) of 34 mergers, and declined in 25 cases.
 - average of the post-merger 3rd to 5th year increased in 11 cases (32%) of 34 mergers, and declined in 23 cases.
- compare the average for post-merger 3rd to 5th years with average for pre-merger 1st and post-merger 1st and 2nd years (with 2 years lag) (Table 3)
 - out of 34 available cases, the average increased in 12 cases (35%), and declined in 22 cases.
- compare the average for post-merger 4th to 5th years with average for post-merger 1st to 3rd years
 - the similar findings to the above (with 3 years lag) (Table 3)
- the patent publication-based analysis may involve some major qualifications; time lag, strategic application, unconsolidated data, quality of patents. Therefore, careful application

Table 3 Results of Patent Publications: Mergers from 2000 on

Patent Application Time	Increase	Decrease	Total
2-year lag (comparing pre-post 3 with post 3-5)	12	22	34
3-year lag (comparing post 3 with post 4-5)	12	22	34

Note: pre-post3: 3-year average from 1st year pre-merger and 2 years post-merger; post4-5: the 2-year average from the 4th to 5th year post-merger

(3) Findings and their Interpretation

Although most of proposed mergers emphasize the ‘strengthening of technological capability and R&D’ as source of competitiveness and differentiation, there is no a large number of cases which suggest clearly the evidence that mergers had considerably strengthened R&D activity.

The findings may be explained by earlier mentioned reasons.

V. Policy Implications: “Dynamic Assessment”?

Policy Implications;

- the relation between mergers and innovation is a major focus in competition policy: "dynamic consideration"
- important to reevaluate the technological performance of merging firms post-merger: ex-post evaluation of mergers and, merger regulation or remedies
- should note the diversity of effects as well as the deterioration of R&D performance post-merger. Competition policy's inquiry is to find out those conditions under which different effects respectively can take place
- methodological difficulties in merger assessment, in particular based on dynamic consideration: "dynamic assessment"
- in merger regulation, a "clinical test" may be useful and necessary

- Therefore, it is important to apply “specific assessment criteria” which can take into account factors inducing the diverse effects: It is important to “economic analyze” assessment criteria and process to discriminate between mergers with R&D-enhancing and R&D-restricting effects.
- But, existing studies address less the assessment, in particular the “dynamic assessment” of merger effects for its regulation. An economic analysis should be directed to merger review process issues such as criteria and procedure of dynamic assessment.

VI. Concluding Remarks

- The important findings;
 - 1) more of the consummated mergers have failed to show increased R&D activity
 - 2) different results between mergers, suggesting diversity in merger effect
- Methodology for evaluating a merger's dynamic effects: back to the simple and Clinical test
- Dynamic consideration in merger regulation
- Dynamic assessment, and its economic analysis

