Catch-up in Productivity and Innovation among Korea, Taiwan, Japan

Implications for Management Practices

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Deriving Policy Implications from my Research

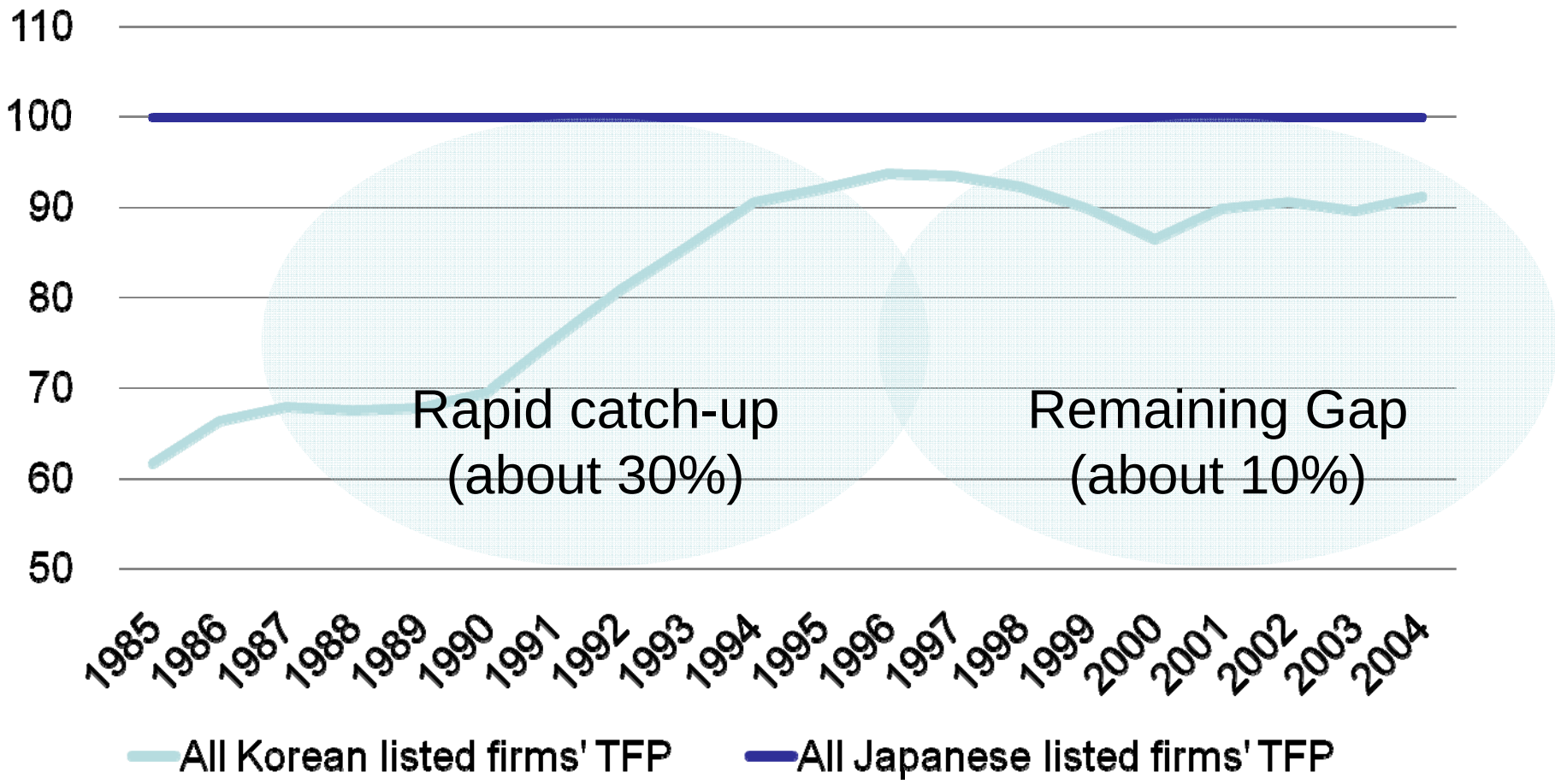
1)Jung & Lee (2008: under revision for ICC)

Productivity Catch-up by the Korean firms with the Japanese firms

2) Park & Lee (2006: Industrial & Corporate Change)

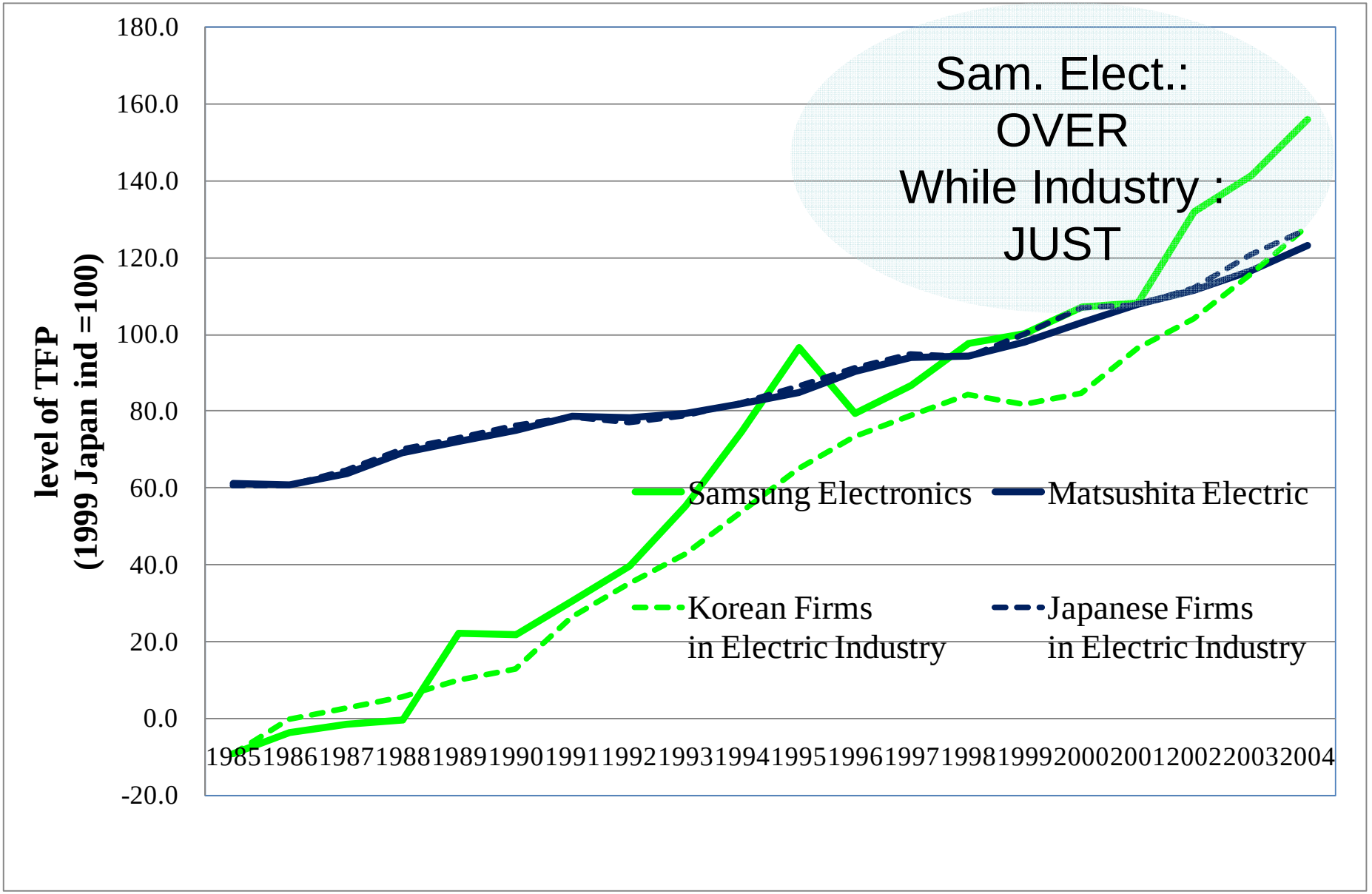
Linking the Technological regimes to Technological catch-up: Analyzing the cases of Korea and Taiwan using U.S. patent data

TFP Catch-up: Korea vs. Japan

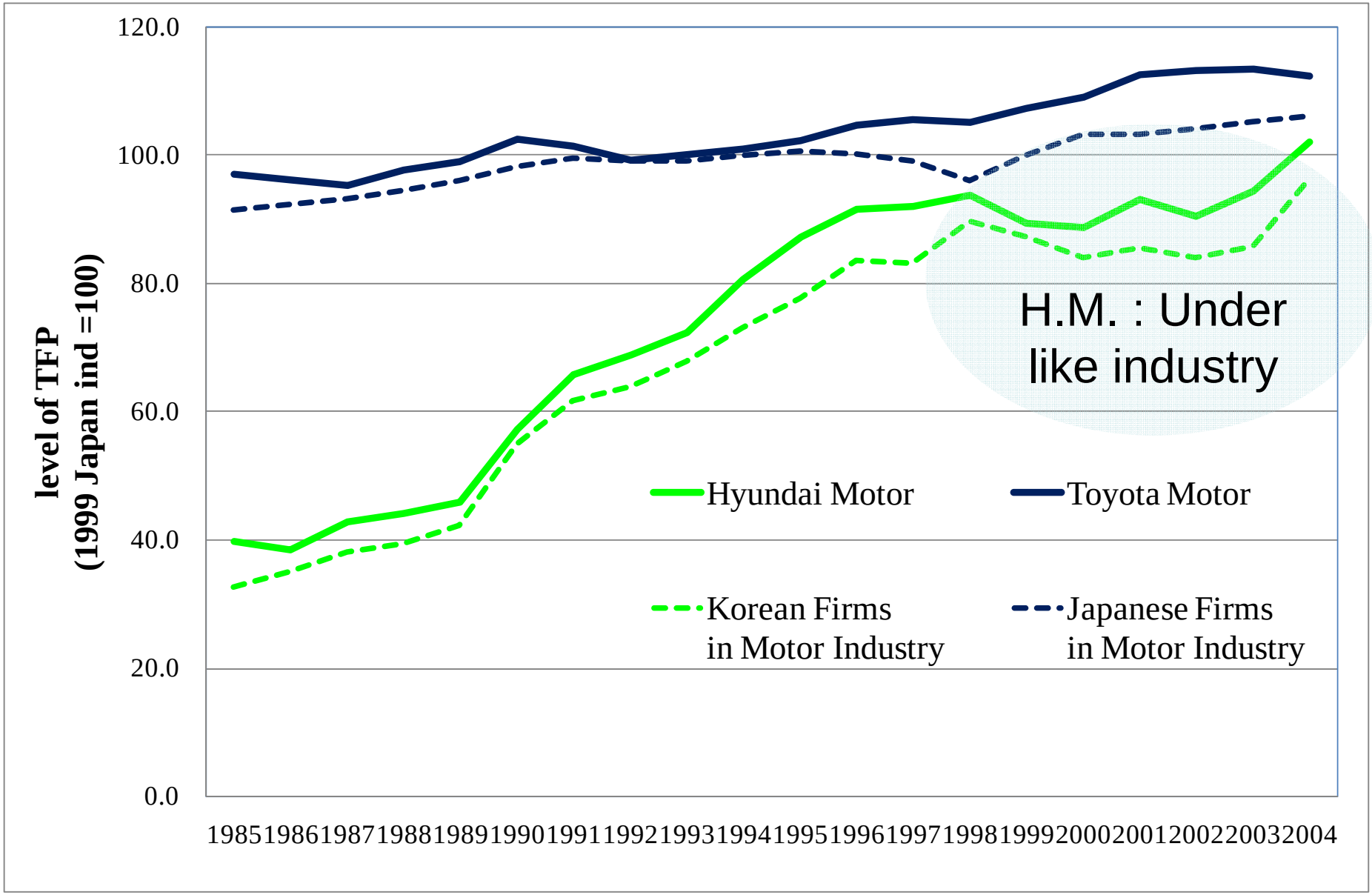


Note : Note TFP level of all Japanese listed firms in each year is set to be 100.
We can regard the difference as % gap of TFP between two countries.

“Convergence” : Samsung v.s. Matsushita



“Gap persists” : Hyundai v.s. Toyota



- The Catch-up Puzzle:

=>Why easy in IT but difficult in Autos?

- Answer: Neo-Schumpeterian Frameworks of
- SSI (sectoral systems of Innovation) and Technological Regimes

  from Nelson & Winter (1982); Malerba (2004)

$\Rightarrow$ both Sectoral and firm-level variables

as determinants of catch-up

Paper 1: Measuring TFP catch-up

- TFP Catch up index of each firm is sum of two sub-part; (intra-national + inter-national gap)

(1) TFP level difference of each Korean firm from the average level of Korean firms in the same industry

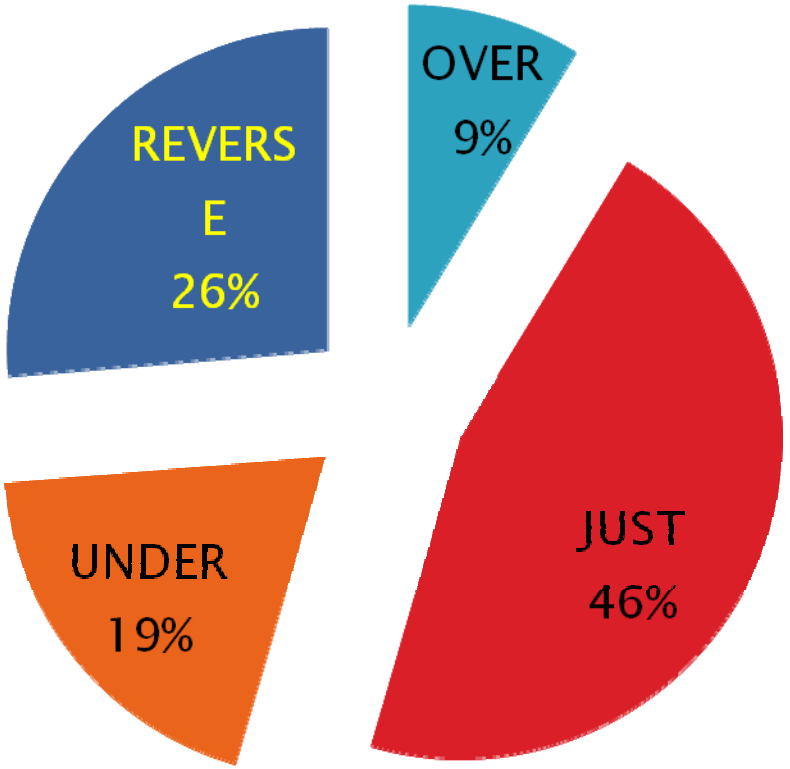
(2) TFP level difference of that Korean industry from the same Japanese industry

4 patterns of TFP Catch-up

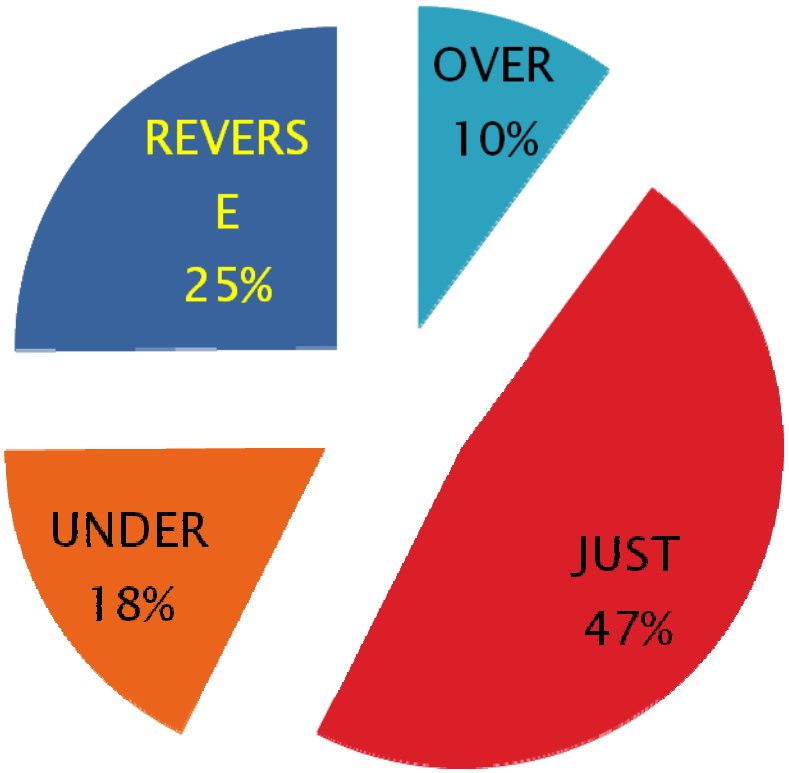
ICPA code	industry name	1985	1990	1995	2000	2004	Catch-up pattern
6	Food and kindred products	81.7	110.3	116.7	111.2	110.9	OVER
9	Lumber and wood	124.5	141.1	131.8	137.9	150.9	OVER
10	Furniture and fixtures	87.0	99.6	119.2	125.0	129.1	OVER
16	Stone clay glass	80.0	92.2	108.9	108.6	112.6	OVER
14	Petroleum and coal products	73.7	163.7	195.3	114.0	102.7	JUST
15	Leather	108.5	104.3	128.0	121.1	104.2	JUST
18	Fabricated metal	90.7	100.0	128.5	110.0	96.3	JUST
19	Machinery non-elect	91.8	92.5	122.0	110.2	108.5	JUST
20	Electrical machinery	24.0	30.8	75.0	73.1	96.6	JUST
22	Transportation equipment and ordnance	74.8	84.0	103.8	92.5	97.0	JUST
7	Textile mill products	48.8	57.1	81.3	87.8	82.4	UNDER
8	Apparel	7.7	19.4	53.2	57.5	59.6	UNDER
11	Paper and allied	72.5	75.6	92.2	74.0	86.6	UNDER
21	Motor Vehicles	38.6	54.5	75.1	78.8	88.0	UNDER
23	Instruments	33.9	40.7	73.1	60.2	61.0	UNDER
12	Printing publishing and allied	81.6	98.4	106.4	111.1	88.3	REVERSE
13	Chemicals	72.7	78.7	91.0	90.0	80.9	REVERSE
17	Primary metal	67.2	70.0	89.2	78.8	61.3	REVERSE
24	Rubber and misc plastics	55.6	61.6	80.5	81.7	76.0	REVERSE
	total	61.6	69.5	92.1	86.5	91.2	

4 catch-up patterns : Shares

Sales
In 2004



Firm numbers
In 2004



What determines the TFP Catch-up Performance?

Hypothesis 1, 2

Hypothesis 1

Sectoral Systems of Innovation
(Malerba 2002, 2004)

1. Explicitness of knowledge and technology(+)
2. Degree of embodied technology transfer(+)
3. Top firm dominance(+)

Hypothesis 2

Firm level learning and capability
(numerous literatures)

1. External discipline(+)
2. Efficiency wage(+)
3. Innovation capability(+)
4. Size(+)

Innovation(TFP catch-up)
(Sectoral catch-up + Firm level catch-up)

- Explicitness/Tacitness of knowledge

- High explicitness of knowledge
- = easiness of codification :

  the knowledge may be easily converted into information using formulas, diagrams, numbers or words.

- **So, more difficult for the late-comer countries to catch up advanced countries in this tacit knowledge sector.**

Explicitness of knowledge and TFP catch-up

Industry code (Icpacode)	Industry name	TFP Catch-up Index in 2004	Explicitness of knowledge and technology (Patent/R&D)		
			1990	1995	2000
20	Electrical machinery	96.6	6.2	25.6	4.2
21	Motor Vehicles	88	1.4	11.1	2.3
23	Instruments	61	1.2	1.8	2.7

Note. The values in the table are industry total patent number over industry total R&D expenditure(unit : 1billion) in each year.

Findings from Regressions

- First, we find that the TFP catch-up of Korean firms is positively related with such sectoral variables as the "explicitness of knowledge and technology" and the "degree of embodied technology transfer".
- This suggests that catch-up is more likely to happen in sectors where technologies are more explicit and easily embodied in machineries and equipment and where such technologies are imported from abroad.

- This finding helps to explain why the TFP of Korean firms is now close to, or even higher than, Japanese firms in electronics sectors, whereas in automobile sectors, the TFP gaps still remain after some catch-up.

- **Second, we find that the degree of top firm dominance of sectors is significant, which implies that catch-up in sectors with more monopolistic large firms is more likely to happen.** Also more catch-up with monopolistic market structure combined with external discipline form world markets

- Third, the paper confirms the importance of the firm-level variables of exporting (external discipline), innovation capability, and incentive effects of higher wage rates (efficiency wage hypothesis).

Implications 1: Management Practices!

1) Productivity policy to consider sectoral differences

* Sectors with tacit knowledge: better to accumulate sector/firm-specific knowledge by stabilizing labor relations, OJTs and on-site experiments (trial & errors);

  whereas M&A more risky

* Sectors with explicit knowledge: to promote flexible labor markets for more diffusion of knowledge:

  effective M&A and/or scouting of new workers

2) Attention to following key variables (intra-national catchup)

- Innovation effort (R&D) for intangible asset
- Incentive schemes (efficiency wage effects)
- Exporting for learning and discipline effects
- Access to foreign knowledge base

◆ Paper 2 (Park & Lee 2006; ICC)

Measuring sectoral Catch-up with patent data

1) Occurrence of catch-up = whether or not there is positive change in the US patent share (scope of patenting activities) -> (probit regressions)

2) Degree of catch-up = degree of positive change in share (regressions for the sectors with occurrence)

3) Technological capabilities of a country in a specific sector: share of a country in that sectors

◆ Independent variables

1) Technological opportunities : growth rate
2) Cumulativeness of technical advances (persistence) : share of persistent registrant
3) Appropriability of innovations : self-citation received
4) Originality (broad base of knowledge)

5) Fluidity (Uncertainty) of technological trajectory : (max no – min no)/avg no of patents
6) Initial stock of knowledge : initial share
7) Relative technological cycle time (speed of change) : relative citation lag
8) Accessibility to external knowledge flows (spillover) : citation from non-G7 to G7

The Key results : the advanced vs. catching-economies

Catch-up more likely in sectors with :

short cycle time of technology;

whereas the advanced countries do better in sectors with longer cycle time.

=> similar to the leapfrogging argument by Perez and Soete (1988) and Freeman and Soete (1997);

shift or emergence of new technological paradigms can serve as a window of opportunity for the late comers

Determinants of:
technological capability and catch-up

Variable	Possibility (Occurrence) of technological catch-up		Degree of technological catch-up		Technological capability		
	Two Catch-up countries	One virtual catch-up country	Two Catch-up countries	One virtual catch-up country	Advanced countries.	Two Catch-up countries	One virtual catch-up country
OPPOR	(-)	(+)	(+)	(+)	(+)	(+)	(+)
CUMUL	(-)	(+)	(-)	(-)	(-)**	(-)**	(-)**
APPRO	(+)	(+)***	(+)***	(+)***	(-)	(+)***	(+)***
ORIGINALITY	(+)	(+)	(-)	(-)	(-)	(-)	(-)
FLUID	(-)	(+)	(-)	(-)	(+)	(-)	(-)
INITIAL	(+)***	(+)***	(-)	(-)	(+)	(-)	(-)
CYCLE TIME	**(-)*** **	**(-)** **	**(-)**	**(-)** **	**(+)*** **	**(-)*** **	**(-)*** **
Knowledge access	**(-)**	**(-)**	**(+)*** **	**(+)*** **	**(-)**	**(+)** **	**(+)** **

Implication 2: Management Practices!

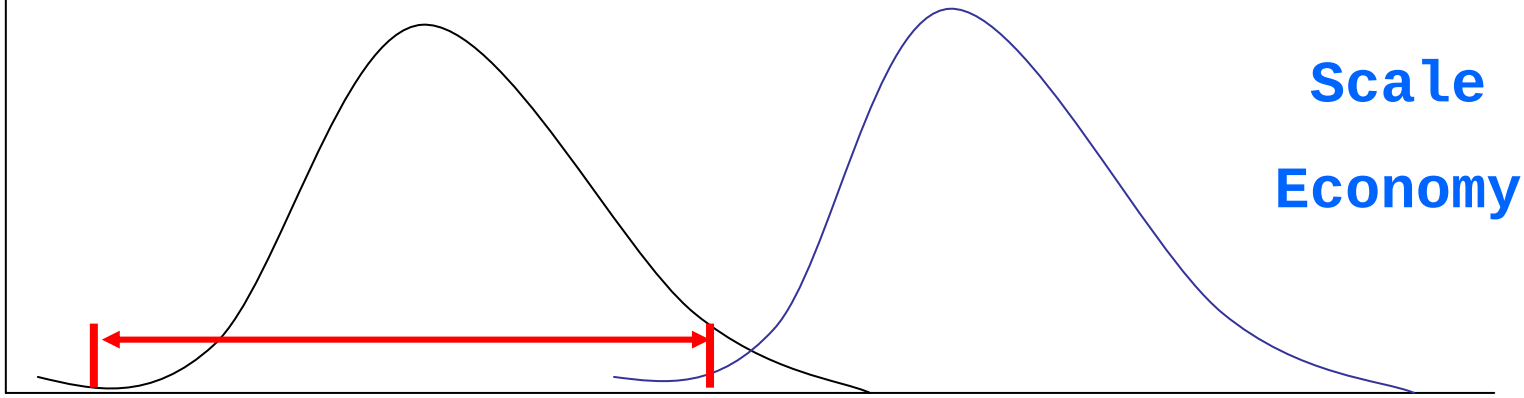
1) In sectors with short cycles;
quick and timely decision-making
and investment quite critical:

eg) Korean chaebols (aggressive) vs. Japanese (cautious)

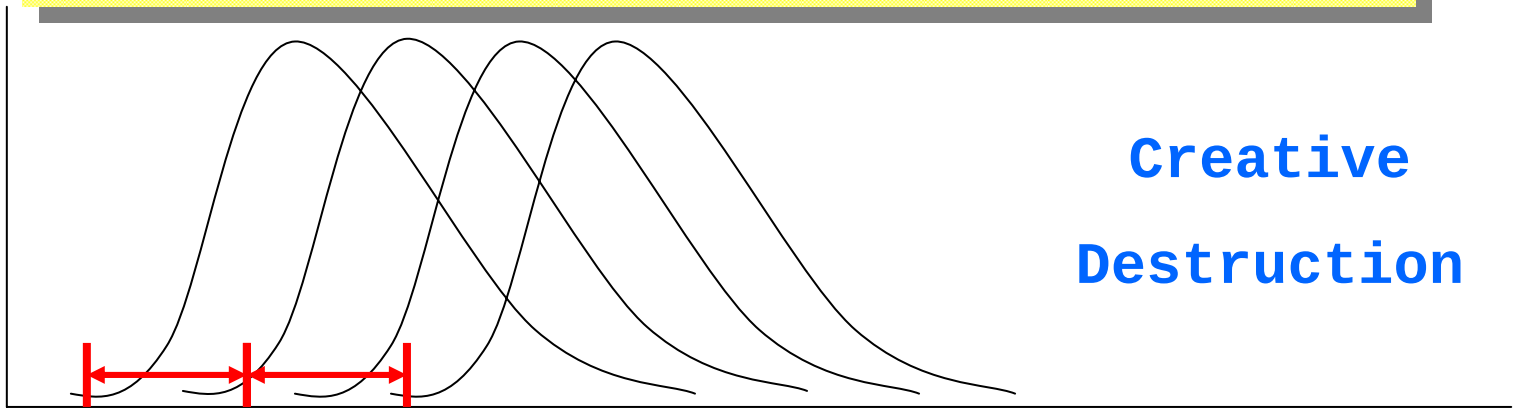
2) In general, more and more sectors and products,
getting shorter and shorter cycles;

=> timing matters more than quality of products

Before: long life Cycle



Now: short life Cycle



Increasing uncertainty and change

-> detailed planning impossible

- Before: Thinking First : → action

- Now: Doing First : -> finding new solutions/idea/products

Source: prof. D. Shin at Yonsei univ.

Thank you!!

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