

NIS Transformation and Recombination Learning in China

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(1) NIS as Analytical Instrument

**(2) NIS Transformation in China
—Why does a gradual process work?**

**(3) Re-combination Learning
--Is a Chinese Model Emerging? How
plural are leaning models and
development paths?**

NIS as Analytical Instrument

- **The importance of institutions**—defines incentives and the pattern of information flows
- **“Interaction between technology and institutions”**—it drives dynamic and complex innovation and change
- **The importance of policy and policy institutions**—policy process determines the outcome of reform programme; “Interaction between policy and the work of NIS”
- **“Systems” for innovation**—R&D institutions along are not innovation systems; firms alone can not innovate.
- **Explanation of performance of aggregate social system via survey on micro-foundations**

Evaluation Criteria on NIS Transformation

Openness	<p>for the vitality of NIS</p> <ul style="list-style-type: none"> --In various forms: <ul style="list-style-type: none"> Technology Licensing; Procurement of capital goods; FDI; OEM Assembly; Sample Machine import
Incentives	<ul style="list-style-type: none"> --Strength --Orientation (to innovation or to quantitative expansion)
Clustering	<p>Characters of interaction between system's members</p> <ul style="list-style-type: none"> --Vertical (I-O relation) and horizontal relations --Structure (vertical integrated or network-based) and operational norms of firm
Supporting institutions	<p>Embody knowledge flows, mediate clustering/linkages</p> <ul style="list-style-type: none"> --via planning apparatus or market mediation --Policy capacity in strategic integration --Legal, educational, technological infrastructures
S&E base	<p>Competence structure and innovation potentials</p> <ul style="list-style-type: none"> --Strength and specialized pattern of knowledge creation --Intensity and responsiveness to the need of firms
Learning dynamics	<p>How the innovation "dynamo" firms learn and innovate</p> <ul style="list-style-type: none"> --Models of learning

<i>Year</i>	<i>R&D % N. Income</i>	<i>Year</i>	<i>R&D%GDP</i>
<i>1953</i>	0.1	<i>1978</i>	1.5
<i>1954</i>	0.2	<i>1979</i>	1.5
<i>1955</i>	0.3	<i>1980</i>	1.5
<i>1956</i>	0.6	<i>1981</i>	1.3
<i>1957</i>	0.6	<i>1982</i>	1.3
<i>1958</i>	1.0	<i>1983</i>	1.4
<i>1959</i>	1.6	<i>1984</i>	1.4
<i>1960</i>	2.8	<i>1985</i>	1.2
<i>1961</i>	2.0	<i>1986</i>	1.3
<i>1962</i>	1.5	<i>1987</i>	1.0
<i>1963</i>	1.9	<i>1988</i>	0.8
<i>1964</i>	2.1	<i>1989</i>	0.8
<i>1965</i>	2.0	<i>1990</i>	0.8
<i>1966</i>	1.6	<i>1991</i>	0.8
<i>1967</i>	1.0	<i>1992</i>	0.7
<i>1968</i>	1.0	<i>1993</i>	0.7
<i>1969</i>	1.5	<i>1994</i>	0.7
<i>1970</i>	1.6	<i>1995</i>	0.6
<i>1971</i>	1.8	<i>1996</i>	0.6
<i>1972</i>	1.7	<i>1997</i>	0.6
<i>1973</i>	1.5	<i>1998</i>	0.7
<i>1974</i>	1.5	<i>1999</i>	0.8
<i>1975</i>	1.6	<i>2000</i>	1.0
<i>1976</i>	1.6	<i>2001</i>	1.1
<i>1977</i>	1.6	<i>2002</i>	1.1
<i>1978</i>	1.8 (1.5 of GDP)		

The Pre-reform R&D Institution Portfolio

R&D establishments: total 9,153

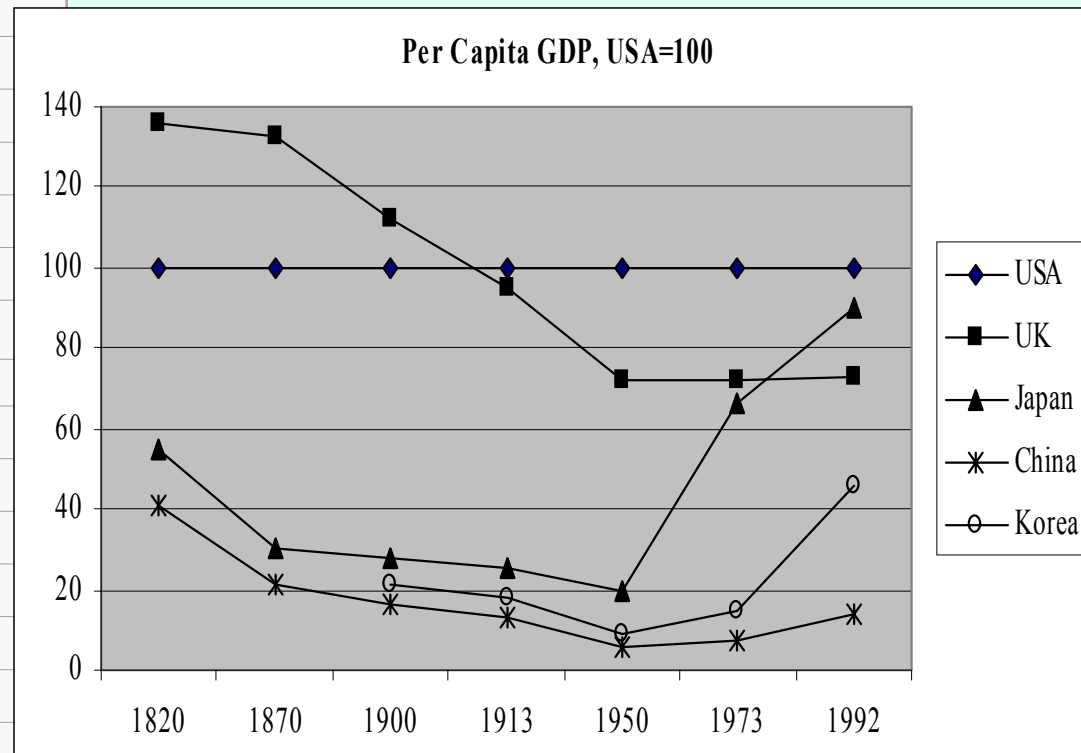
In which

Those at the levels above “county”: 5,793

Those at the county level: 3,360

S&E: total 343 thousand

In which who work in the first category:
319 thousand .



NIS Transformation in China: The policy *process*

1985	<i>Technology Market (1)</i>
1987	<i>Merger (2)</i> of R&D institutes into firms
1988	The Torch Programme <i>Spin-off Enterprises and New and High Technology Industry Zones (3)</i>
Early 1990	<i>Transformation of R&D institutes on a whole institute basis (4)</i>
1999	Clarify and legitimate upon real progress of transformation

Result: Multiple Policy Solutions

(All the measures at current price)

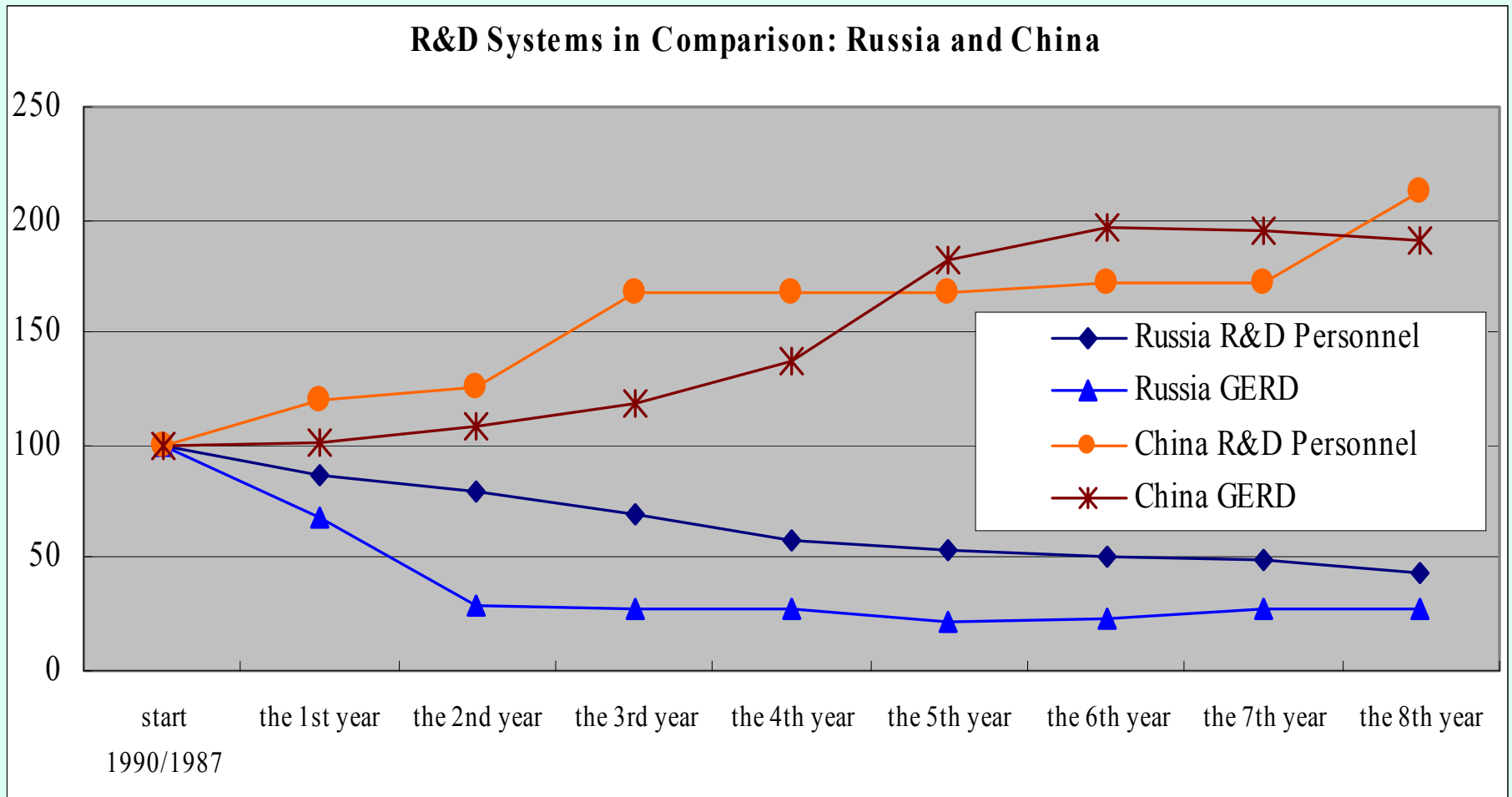
	1985	1990	1995	2000
(1) Technology Market Contract fees (RMB Billion)	2.30	7.51	26.83	65.07
(3) Spin-offs Number of NTEs	-	1,690	12,937	20,796
Annual turnover (RMB Billion)	-	5.94	151.2	920.9
Export (USD Billion)	-	0.69 (RMB B.)	1.55	13.81
R&D Performer (%) Enterprises Independent	(1987) 29.3	n.a.	43.7	60.0
R&D institutes	54.7	n.a.	42.1	28.8
Universities	15.9	n.a.	12.1	8.6

Official registration on transformation, By 2000
(2) Merger.....311
(4) Transformed to be profitable entities...629
(others) Become a part of University.....24

Why does a gradual process of reform work?

China: A gradual process leads to continuous growth

Russia: A “Shock Therapy” is associated with decline



Why does a gradual process of reform work?

- **“Unintended fit” needs the feasibility to adapt**
 - Experimentation generates knowledge and information to reduce uncertainty
 - ** *Such information and knowledge serve as **input** in policy-making and in strategic adjustment at firm/R&D institute;*
 - ** *This paves ways not only for **policy adjustment** but also **pointing to where firms/R&D institutes to move for survival and further growth***
- **Preconditions**
 - Adaptive/responsive policy-making
 - Strategic vision as a general guidance
 - Consensus and Political stability: “controlled chaos”

“Recombination Learning” in Market Reform

- **Four Parallel Processes**

1, Market reform and trade liberalization

(that produce new incentives and induce innovative capabilities reallocation);

2, Re-organization of accumulated capabilities

(in novel and productive ways);

3, Intensive technical/managerial learning

(to identify and fill major gaps in inherited capabilities); and

4, Institutional restructuring

(that support these developments).

“Recombination Learning” in Market Reform

Example Sector	PC	Machinery	Textile
Technological gaps	--Product architecture	--Design engineering --Production Engineering	--Design --International marketing
Means of filling the gaps	--Use and sales of advanced products	--Technology licensing	--OEM production
Accumulated capabilities	--Design --Testing --R&D --Production	--Design --Testing --Production	--Production
Institutional restructuring	--Spin-offs	--Transformation of R&D institutes --Transformation of state enterprises	--Export-production Zones --Joint-ventures --Local Small startups

Learning Mechanisms in Comparison: Is a Chinese model emerging?

- “Recombination”—associated with 1, large scale of institutional restructuring; 2, “higher” level of competences are re-deployed through absorption of “lower” while missed competences
- Specialized competitive advantages are still in formation—transitional characteristics
- Both domestic and international markets are important in providing incentives and learning opportunities—the size of domestic market; the release of accumulated capabilities and depressed demands
- Is a Chinese model emerging?—plural learning models and development paths between NIS and over time

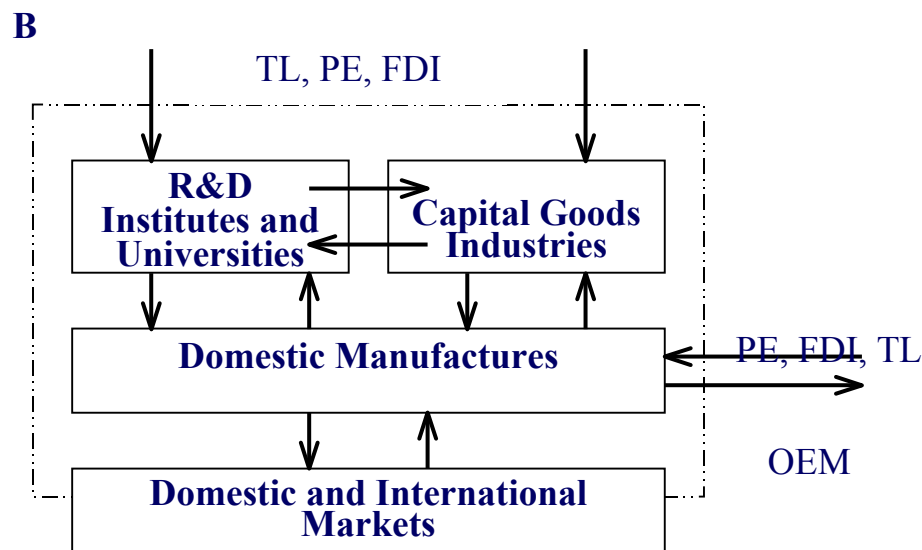
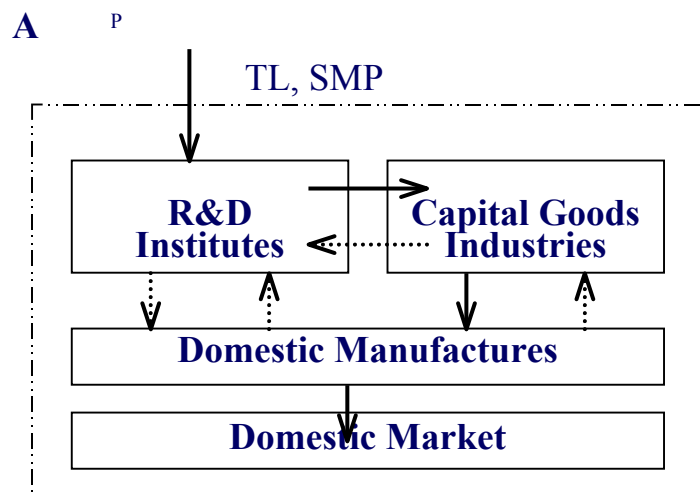
Learning Mechanisms in Comparison: The Korean and Taiwan Innovation system

NIS characteristics	Korea	Taiwan
<i>Learning mechanism</i>	Cyclic reverse traveling up the capability ladder	High entry and forward and backward linkages
<i>Community of learning practice</i>	Individual firms	A group of firms
<i>Priority of S&T and industry policy</i>	“Picking the winners” to give direct support	Invest in infrastructure and neutral regulatory stipulation
<i>Supporting institutions</i>	Provided by firms themselves under the close alliance with the government	Network, technological infrastructure; market friendly regulatory institutions
<i>Location of R&D</i>	80% at private firms	50% in public institutes
<i>Technological strengths</i>	‘Mass’ technology, large systems	‘Niche’ technology, small systems

Evaluation of NIS Transformation in China

Openness ++ **Incentives ++**
Clustering + (in relation to industry structure and firm structure)

	1985	1990	1995	2000
Import of capital goods (USD Billion)	16.24	16.85	52.64	69.45 (1999)
FDI (USD Billion)	1.96	3.49	37.52	40.72



TL: Technology Licensing
 SMP: Sample Machine Procurement
 PE: Procurement of Equipment
 FDI: Foreign Direct Investment
 OEM: OEM Assembly

Figure 11 Transformation of the China's NIS

Evaluation of NIS Transformation in China

Supporting/Coordination Capacity + –
 Science and Engineering Base + –
 (A “shallow” structure of innovation competences)
 Learning Dynamics +

	Year 1		Year 2	
(1) R&D expenditure Billion (GDP%)	1987	5.67 (1.0%)	2000	89.6 (1.0%)
1.1) Basic Research %		7.7		5.2
1.2) Applied Research %		32.1		17.0
1.3) Experimental Development %		60.2		77.8
2.1) SCI International Rank	1987	24	1999	10 (India 13) (Russia 8)
2.2) ISTP International Rank		14		8 (India 23) (Russia 7)
2.3) EI International Rank		10		3 (India 12) (Russia 9)
3) Patents, USPTO granted Number: China	1992	41	2001	266
India		24		179
Russia		67		239
S. Korea		586		3,763
Taiwan		1,252		6,544

Conclusions

- NIS is **conceptual**.
- **Plural models and paths of development and adaptive policy or policy learning** are among the most important conceptual implications.
- It gives support to necessary **paradigm-shift** in thinking of development approaches and of development and transformation policies

Conclusions

- NIS is **instrumental** as well
- The study on NIS transformation in China shows that the NIS approach has **the power in handling complicated process** at very high aggregate level of a nation like China
- Analysis of NIS is **multiple-disciplinary**. Analytical boundaries and research framework have to be developed suitable to the subject and goals of a certain study.

Conclusions

- China is in a historical turning-point again in social-economic and innovation system development. Challenges come from both the problems accumulated and changes in technological opportunities and international environment.
- Strengthening the S&E base, deepening the competence structure, improving supporting institutions, promoting clusters and networking, widening the participation of people in innovation and learning as diagnosed are among the most pressing challenges, if China is to maintain the momentum to development and modernization.

Quality Item	Evaluation
Openness	+ +
Incentives	+ +
Clustering	+
Supporting and Coordination Capacity	+ -
Science and Engineering Base	+ -
Learning Dynamics	+

Thank you!