

# UILs (University-Industry Linkages) for Economic Catch-up in Asia

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# The Asian Team

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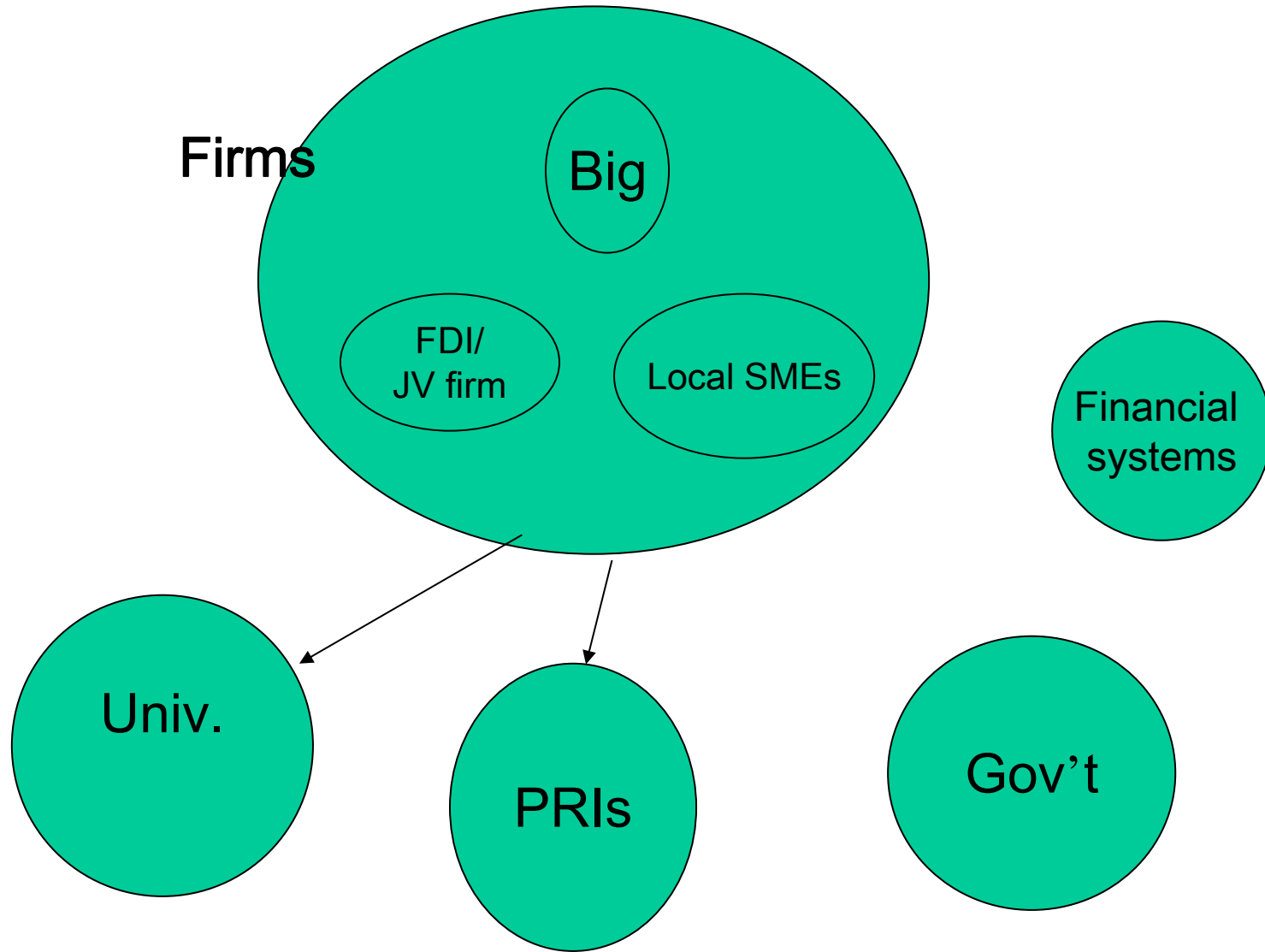
# UIL for Catching-up Development

- Increasing importance of Knowledge in development
  - > increasing importance of univ. as source of knowledge and idea for business
  - > new chance for catch-up by late-comer countries.
- Similar to leapfrogging thesis:  
paradigm shift -> opening window of opportunity for late-comers
- \* Of course, both new opportunity and new barriers to the Late-comers, but worth to explore as some success cases are there

## Justifying our study: Two way Causality: Knowledge (Education) <-> Development

- 1) Increasing importance of knowledge (Triple-Helix)
- 2) But, Univ. in LDCs tend to be teaching univ.
- 3) But, does not mean: there is no role of Univ., (exc. Teaching)  
Rather more role and/or demand for Univ.
- 4) Some Univ./PRIs has some innovation (R&D) capacities that  
can be tapped or utilized when certain supporting institutional changes and  
incentives are provided. (eg. China, S. Africa->India, Brazil)  
our job: to find more success cases and disseminate (& theory)
- 5) Why action? Market failure (Cognition failure), System failure
- 6) Globalization: From Industrial Policy to Knowledge Policy  
but how to handle the challenge of international division labor among Univ.s  
in the world. And global labor markets

*NIS and Developmental Univ.*



# Common Theoretical Framework

## Concept of Universities

Developmental Universities (cf: high capa univ. in DC)

= teaching + research + entrepreneurial

+social servicing (ideological)

cf) societal: to tackle knowledge divide) -> new contribution, vs.

Western concepts

\* Gradual progress: Korea in the past,

Now simultaneous but with different weight among the 3/4.

-- Two ways of giving weight: with one unit or over different units; namely Comprehensive vs. specialized univ .

The weight should reflect the levels (stages) of development,

also, each function should be new and more dev-oriented

eg) old teaching vs. custom made teaching.

# Firms and Univ. Survey in Asia

- 1) Korea: Number of the firms surveyed: 600  
(sample: Innovation survey)  
Number of the university professor surveyed: 2,395  
(prof's in engi. & natural science in univ's with TLO)
- 2) India: Number of the firms surveyed: 462  
(3 sectors: auto, bio and It in 6 prominent cities of four states in India)  
NO. of professor & PRI researcher surveyed: 735  
( 8 cities in four states of India.)
- 3) China: Number of the firms surveyed: 302  
Large & medium-sized manufacturing firms (199)  
Private S&T firms (73); High-tech Start-ups (30)  
Number of the university professor surveyed: 203  
24 univ's in 4: Beijing, Tianjin, Shanghai, Guangzhou
- 4) Malaysia: Number of the firms surveyed: 361  
( 3 sectors: auto, bio and electro)
- 5) Thailand: Use the existing Innovation survey results

# EmergEd Issues & Findings by Today

1) What are the most common modes? Contract research?

2) Different modes by development stages?

In the US, public space interaction most common.

3) Univ. and in-house R&D, substitutes or complementary?

4) Who does/needs UILs? Big or small firms?

Not just small but also big ones

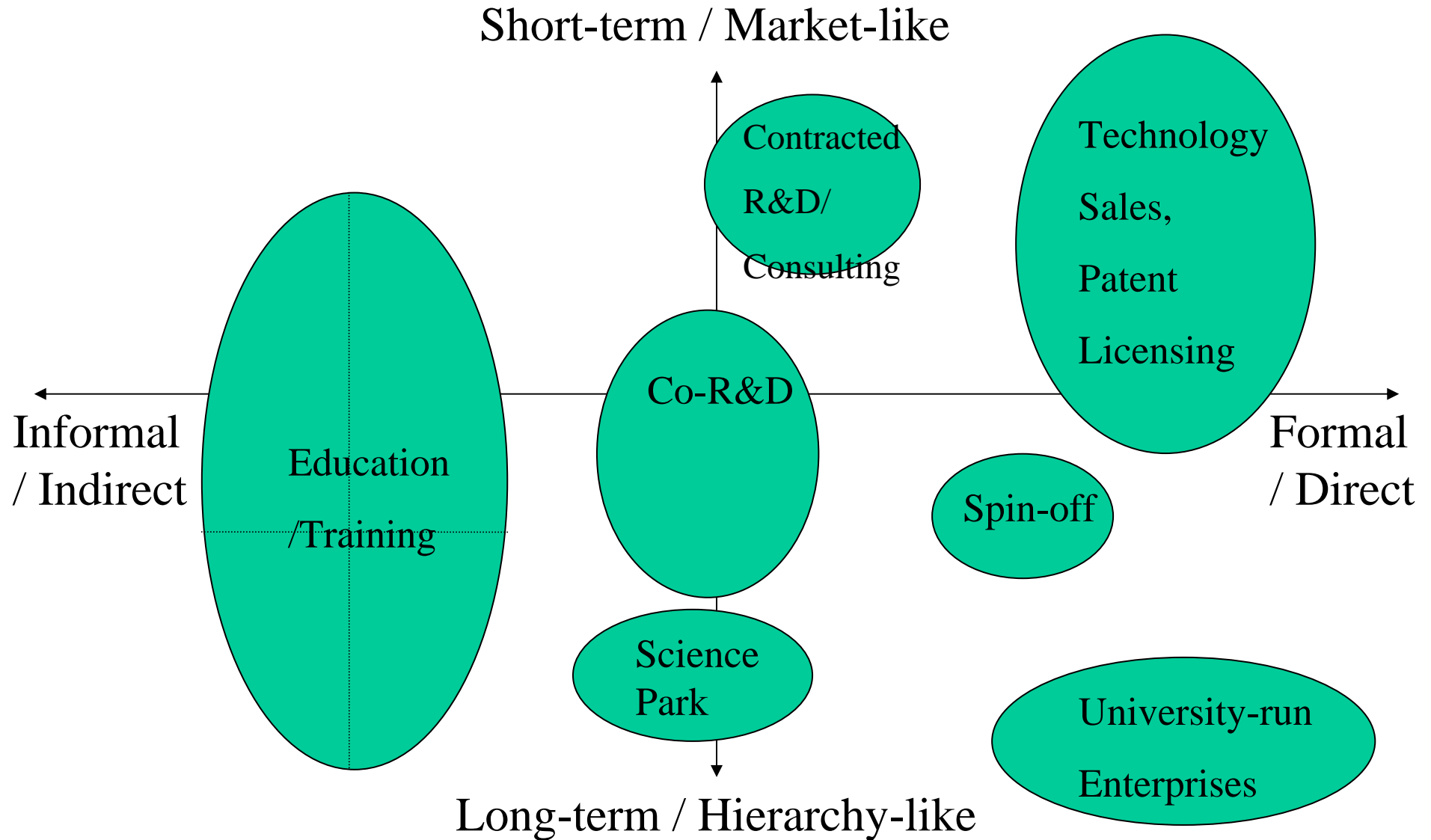
5) Extent and Performance of the UILs

6) What can be suggested as policies for catchup?

# Modes of the UILs in Asia: Tentative Findings

- 1) Different results from the US (C-M Survey) in Cohen et al.(2002), Branscomb et al.(1999)
- 2) Open science channels, like conferences, papers, informal interactions not common modes in Asia
- 3) More formal channels more common in Asia:
  - Korea: Contract-based research
  - China, Malaysia: joint projects, contract research, licensing
  - Thailand: Consulting services
- 4) Why so? Maybe in the US, firms have their own R&D capacity, and thus less need for contract research or joint projects with Univ's
- 5) If so, suggest that there is a role for Univ. for firms in Latecomers with less capabilities for R&D

# 2-dimensional map



# Modes of the UILs in China

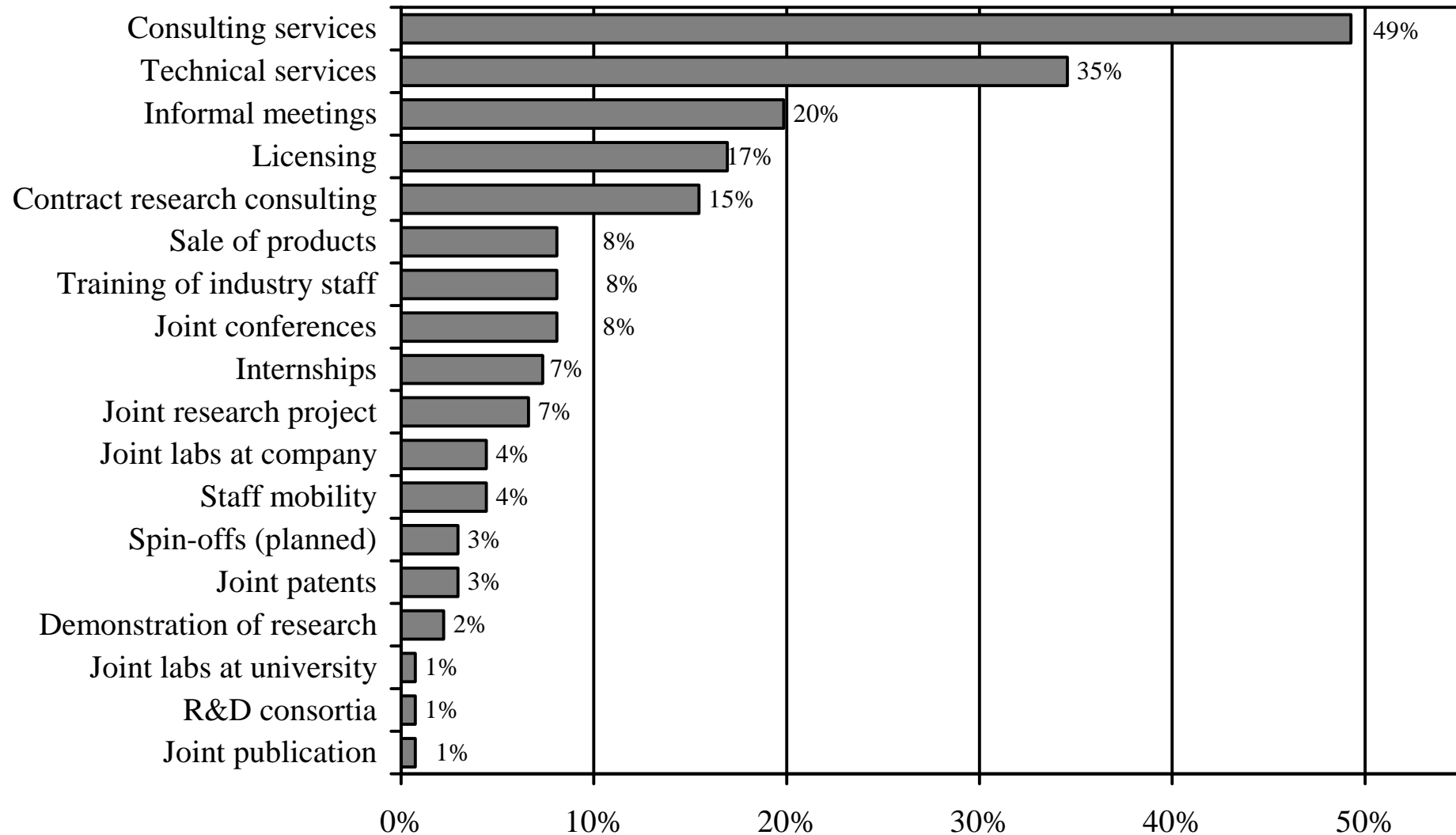
Contract-based formal > Informal, Personal, Open Science Channels

A-I Channel that contributes to the innovation in the Firm	Moderately or Very Important	%	Very Important	%
<b>1) Patents</b>	<b>174 (3<sup>rd</sup>)</b>	<b>57.6</b>	<b>107 (1<sup>st</sup>)</b>	<b>35.4</b>
2) Publication and reports	130	43.0	44	14.6
3) Public conferences and meetings	110 (-3 <sup>rd</sup> )	36.4	24 (-1 <sup>st</sup> )	7.9
4) Informal information exchange	118	39.1	35	11.6
5) Recently hired graduates with above-Master degree	159	52.6	74	24.5
<b>6) Licensed technology</b>	<b>178 (2<sup>nd</sup>)</b>	<b>58.9</b>	<b>78 (3<sup>rd</sup>)</b>	<b>25.8</b>
7) Consulting with individual researchers	159	52.6	62	20.5
8) Contracting research with universities	159	52.6	70	23.2
<b>9) Joint or cooperative R&amp;D projects</b>	<b>193 (1<sup>st</sup>)</b>	<b>63.9</b>	<b>105 (2<sup>nd</sup>)</b>	<b>34.8</b>
10) Participation in networks that involve universities	96 (-1 <sup>st</sup> )	31.8	31 (-2 <sup>nd</sup> )	10.3
11) Temporary personnel exchanges	120	39.7	34 (-3 <sup>rd</sup> )	11.3
12) Incubators	109 (-2 <sup>nd</sup> )	36.1	42	13.9
13) Science and/or technology parks	141	46.7	61	20.2

# Modes of the UILs in Korea

modes	from/with universities		from/with PRIs	
	Freq'y	%	Freq'y	%
contract (collaborate or separate) research	242	62.9	192	58.0
patents licensing and technical learning	11	2.9	16	4.8
mutual utilization of R&D facilities and equipment	62	16.1	75	22.7
mutual dispatch of researchers and/or students and doing collaborate research	13	3.4	4	1.2
creating joint venture or spin-off under the technological collaboration with universities and PRIs	1	0.3	9	2.7
dispatching corporate researchers to universities or PRIs and technical learning	8	2.1	0	0
technical consulting and special lectures of professors of universities or researchers of PRIs	34	8.8	27	8.2
designating professors or researchers as formal advisory member and taking advices from them	14	3.6	8	2.4
Total	385	100.0	331	100.0

## UIL modes at Thai universities (n=136, multiple answers possible)



Source: Schiller 2006a:80

# Different Modes by Dev't Stages, firm capabilities, and types of universities

- 1) **Early Stages: Firms with few in-house R&D** activities but facing diverse problems in production  
→ need for consultancy services from Universities (Universities do not have much R&D capa either):  
Examples: Thailand firms
  - 2) **Medium Stages: Firms with some in-house R&D activities** but having difficulties or need for certain specific R&D targets  
-> Go for contract research or joint projects (or licensing) with the Univ.s  
(Eg. Korea or large firms in China)
  - 3) **Mature stages: Firms with strong in-house R&D capabilities**  
-> less need for more direct interaction with univeristies -> open science channles like papers, conferences, and informal interactions including consulting eg). US
- \*\* Types of University: Community-Service/Dev't University in Africa or Indoenesia: tend to organzie meeting/confercnes to provide information and training opporutnities for people

Entrepreneurial		spin-around	spin-off	spin-off	paper, seminar
Research		consulting svc	contract research	licensing	Consulting svc
Teaching	Students (prd)	foregin doct for R&D		Local Students for R&D	
	few R&D	Some R&D activities	low in-House R&D	high in-H R&D	Open Innovation

# Univ. and Firms' R&D, Substitutes or Complementary?

1) Doing contract research does not mean that Univ.'s research can substitute firms' in-house R&D;  
firms already doing R&D has more need for contract research with Univ's

2) Similar reasoning applies to the question of Who needs the UILs, big or small firms?

Answer: both! Big firms need that too!

(somewhat unexpected from our early hypothesis)

Why: big firms in LDCs are not that strong in R&D either;

or Those doing R&D have needs for more UILs

3) Regressions in Korea and China;

## Who needs vs. can do UILs?

- 1) Needs-based (innovation needs): might be more in SMEs
- 2) But, Those firms who actually do Uils turn out be big firms or firms relatively more developed or strong in each country
- 3) Exmample: minining in Argentina, South Africa, and Indonesia; Textile and Foods in Thailand.

# Who does UILs in China?

(Similar Logistic Regression as in Cohen et al 2002)

**Table 9: Determinants of the Utilization of Academic Institutions (Logistic Regressions)**  
(N=301)

	Universities		PRIs	
Dependent variables	Suggesting new projects	Completing existing projects	Suggesting new projects	Completing existing projects
Intercept	-0.626	-0.821**	-0.240	-0.661*
p-value	0.111	0.038	0.535	0.091
Log firm size	0.300**	0.270*	0.111	0.228
p-value	0.036	0.059	0.427	0.107
Start-up dummy	0.079	-0.264	0.045	0.174
p-value	0.815	0.444	0.892	0.606
POE dummy	0.156	0.554*	-0.054	0.054
p-value	0.586	0.053	0.847	0.847

Notes: \*: significant at 10%; \*\*: significant at 5%; \*\*\*: significant at 1%

- Large firms or state-owned firms needs the UILs

# Extent and Performance of the UILs

- In general, not wide spread:
  - India: only 12%, Korea: 60%
  - > some correlation between collaboration rates and stages of development?
- But, doing UILs firms show satisfaction in general.

# Share of Firms doing (UILs) Collaboration in India: only 12% !!

CENTER	collaborated	Not collaborated	Total
Mumbai	31.46	68.54	100.00
Cochin	50.00	50.00	100.00
Chennai	10.53	89.47	100.00
Bangalore	13.56	86.44	100.00
Pune	3.77	96.23	100.00
Coimbatore	1.11	98.89	100.00
Delhi	6.78	93.22	100.00
Total	11.26	88.74	100.00

# Trends of more UILs in Korea:

strength	collaboration with universities				collaboration with PRIs			
strength	before 2000		after 2000		before 2000		after 2000	
strength	frequency	%	frequency	%	frequency	%	frequency	%
very low	284	55.4	244	40.7	303	59.1	310	51.7
low	103	20.1	101	16.8	99	19.3	84	14.0
medium	82	16.0	125	20.8	71	13.8	91	15.2
high	39	7.6	113	18.8	37	7.2	96	16.0
very high	5	1.0	17	2.8	3	0.6	19	3.2
Total	513	100.0	600	100.0	513	100.0	600	100.0

- 1) Even after 2000, 40.7%, have almost no collaboration and 16.8% of the respondents; very low collaboration with universities.
- 2) PRIs, 51.7% and 14.0% of the respondents have had almost no and very low collaboration with PRIs.

# Performance of the UIs in Korea

performance	universities		PRIs	
	frequency	%	frequency	%
Success or failure				
So far, it is successful	121	31.5	111	33.9
The collaboration is going on and it would be successful soon or later	118	30.7	88	26.9
The collaboration is going on but it would not be successful.	45	11.7	33	10.1
So far, it is not successful	100	26.0	95	29.1
Total	384	100.0	327	100.0

More than 60%: success, but still high failure rate of 40%

## Success rates in Collaboration in Malaysia: high!!

	<b>Automotives</b>	<b>Biotechnology</b>	<b>Electronics</b>
Yes	15(23%)	101(86% )	73(61%)
No	41(62%)	4(3%)	18(15%)
Expect it to be successful	10(15)	10(9)	23(19)
Do not expect it to be successful	0(0)	2(2)	5(4)

## Determinants of UIL cooperation in Korea, 2002 KIS

	Industry-university cooperation			Industry-GRI cooperation		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
SIZE	0.06 (1.01)	0.03 (0.52)	0.08 (1.21)	0.08 (1.19)	0.05 (0.79)	0.08 (1.27)
RD_INT	0.66 (1.13)	0.68 (1.15)	0.68 (1.17)	0.81 (1.32)	0.84 (1.37)	0.84 (1.37)
GROUP	-0.23 (-1.17)			-0.31 (-1.52)		
CHAEBOL10		0.26 (0.68)			0.08 (0.19)	
CHAEBOL11+			-0.93 (-2.02)**			-0.84 (-1.79)*
COST	0.11 (1.68)*	0.11 (1.68)*	0.12 (1.71)*	0.10 (1.45)	0.10 (1.46)	0.10 (1.49)
RISK	0.10 (1.46)	0.10 (1.48)	0.10 (1.49)	0.12 (1.83)*	0.12 (1.79)*	0.12 (1.83)*
G_SUP	0.62 (4.54)***	0.62 (4.57)***	0.62 (4.57)*	0.80 (5.68)***	0.81 (5.76)**	0.81 (5.74)***
IN_IPR	0.33 (1.86)*	0.31 (1.73)*	0.35 (1.93)*	0.16 (0.87)	0.13 (0.73)	0.16 (0.88)

## Impact of UIL cooperation on the innovation probability

	Probit model		Probit model (endogeneity controlled)	
	Industry-university cooperation	Industry-GRI cooperation	Industry- university cooperation	Industry-GRI cooperation
	Model 1	Model 2	Model 3	Model 4
SIZE	0.03(0.28)	0.04(0.35)	0.04(0.40)	0.04(0.39)
RD_INT	-1.56(-2.37)**	-1.61(-2.36)**	-1.05(-1.63)	-1.03(-1.76)*
GROUP	0.00(0.02)	0.01 (0.03)	-0.10(-0.36)	-0.15(-0.52)
COST	0.12(1.24)	0.11(1.21)	0.17(1.51)	0.11(1.30)
RISK	0.08(0.83)	0.08(0.82)	0.10(1.20)	0.11(1.37)
G_SUP	0.21(1.05)	0.19(0.95)	0.61(2.19)**	0.62(2.08)**
Demand-Pull	0.42(4.85)***	0.42(4.83)***	0.42(5.02)***	0.42(5.05)***
Cost-Push	0.17(2.11)**	0.17(2.13)**	0.25(2.88)**	0.22(2.65)**
AGE	-0.01(-0.11)	-0.01(-0.17)	0.00(0.01)	0.01(0.05)
EXPORT	0.23(1.18)	0.21(1.07)	0.41(1.87)*	0.43(1.86)*
FOREIGN	0.55(1.10)	0.51(1.03)	0.19(0.46)	0.39(0.97)
Industry dummies	Included	Included	Included	Included
IUG	0.51(2.19)**	0.58(2.24)**		
IUG^			-1.69(-1.65)	-1.40(-1.40)
No. of obs	538	538	538	538

## Impact of industry-university cooperation on firm performance

	Model 1			Model 2		
	Patent	sale	Labor productivity	Patent	sale	Labor productivity
SIZE	0.10 (4.88)***	0.01(0.44)	0.01(1.28)	0.11 (6.76)***	0.01(0.48)	0.01(0.11)
RD_INT	0.25(0.85)	0.35(1.06)	-0.08(-1.28)	0.22(1.00)	0.57(2.24)**	-0.09(-1.51)
GROUP	-0.05(-0.84)	-0.12(-1.75)*	0.03(2.10)**	-0.05(-1.13)	-0.08(-1.51)	0.03(2.21)**
Demand-Pull	0.08(1.50)	0.10(1.50)	0.01(0.61)	0.06(1.55)	0.02(0.84)	0.01(0.64)
Cost-Push	0.00 (0.18)	0.08 (3.39)***	0.01 (2.22)**	-0.00 (-0.12)	0.07 (3.87)***	0.01 (2.13)**
AGE	-0.06 (-2.29)**	-0.06 (-2.14)**	0.01 (0.84)	-0.06 (-2.80)**	-0.04 (-1.77)*	0.00 (0.61)
EXPORT	0.05(1.02)	0.03(0.53)	0.01(0.81)	0.04(1.09)	-0.01(-0.23)	0.01(1.08)
FOREIGN	-0.05(-0.43)	-0.08(-0.67)	0.04(1.50)**	-0.04(-0.44)	-0.02(-0.23)	0.03(1.39)*
IUG(UNIV)	0.05(0.90)	0.07(1.10)	0.01(1.17)	0.04(0.99)	0.01(0.16)	0.01(0.94)
IMILLS	0.40(1.85)*	0.40(1.70)*	0.13(2.44)**	0.29(1.99)**		0.12(2.69)**

# UILs leading to more product innovation, not process innovations in India

Types of firms by	Product innovation		Process innovation	
	Mean rank	Asymp. Sig	Mean rank	Asymp. Sig
<i>Univ-Collaborating Firms</i>	209.16		76.31	
<i>Non Collaborating Firms</i>	176.41	.027	84.14	.384
<i>Firms using university suggestion a s source of information for new projects</i>	154.93		80.62	
<i>Firms not using university suggestion a s source of information for new projects</i>	136.08	.091	79.28	.873
<i>Firms using PRI suggestion a s source of information for new projects</i>	157.45		81.22	
<i>Firms not using PRI suggestion a s source of information for new projects</i>	135.01	.039	79.62	.825

## Reason for no collaboration

- 1) Firms' R&D enough / Unv not strong enough
- 2) Mismatch and/or lack of understanding (trust) from both sides, in mismatch in the demand and supply of knowledge and mismatch in capabilities.
- 2) lack of the collaborative infrastructure

# Why no collaboration in India?

Reasons	Not at relevant	Slightly relevant	Moderately relevant	Very relevant	DK/CS	Total
Our firm's R&D is enough to innovate	6.71	21.65	32.01	37.8	1.83	100
Universities have no understanding of our line of business	13.41	26.22	31.71	23.78	4.88	100
Public research institutes have no understanding of our line of business	17.07	23.78	34.76	19.82	4.57	100
Contractual agreements are difficult	15.24	27.74	35.37	17.99	3.66	100
Lack of trust	21.65	26.83	29.57	18.9	3.05	100
Quality of research is low	19.57	26.61	33.94	14.68	5.2	100
University concerned only with <i>big science</i>	11.31	29.97	36.7	17.13	4.89	100
Geographic distance	20.12	30.18	32.93	10.06	6.71	100
Difficulties in dialogue	13.41	32.93	35.37	10.67	7.62	100
Intellectual properties issues	8.84	27.13	35.67	20.43	7.93	100

# Why low collaboration in China (firms survey)

Table 12: Why Universities and PRIs Unimportant as Knowledge Source?

	Possible Reasons	Frequency	%	Category
1	The firm's R&D is enough to innovate (N=74)	25	33.80%	Firm-specific
2	Universities have no understanding of our line of business (N=73)	24	32.90%	Cultural
3	<u>PRIs</u> have no understanding of our line of business (N=73)	24	32.90%	Cultural
4	Contractual agreements are difficult (N=73)	18	24.70%	Trans. Cost
5	Lack of trust (N=73)	13	17.80%	Trans. Cost
6	Quality of research is low (N=73)	12	16.40%	Other
7	Universities and <u>PRIs</u> concerned only with big science (N=73)	16	21.90%	Cultural
8	Geographic distance (N=73)	6	8.20%	Other
9	Difficulties in dialogue (N=73)	7	9.60%	Cultural
10	Intellectual property issue (N=73)	18	24.70%	Trans. Cost

# Why low collaboration in Korea

(firms survey)

	before 2000		after 2000	
	freq.'y	%	Freq'y	%
lack of interest or capability of professors and universities	24	6.2	26	7.5
<b>lack of interest or capability of firms</b>	<b>127</b>	<b>32.8</b>	<b>116</b>	<b>33.6</b>
lack of support policy and institution of the government	30	7.8	33	9.6
<b>lack of collaborative infrastructure between firms and universities</b>	<b>176</b>	<b>45.5</b>	<b>132</b>	<b>38.3</b>
Others	1	0.3	3	0.9
no necessity	24	6.2	28	8.1
no idea / no responses	5	1.3	7	2.0
Total	387	100.0	345	100.0

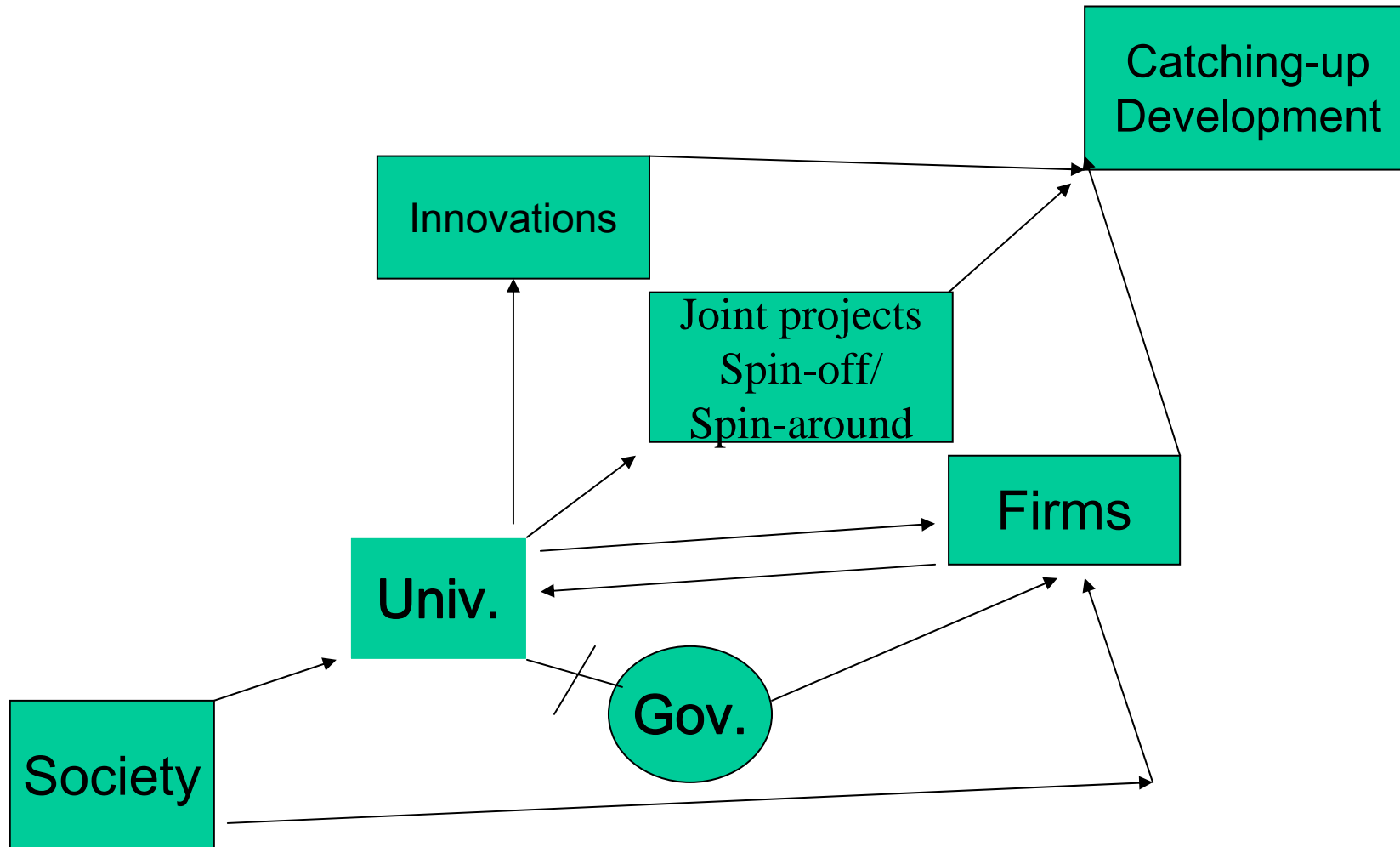
# Summary of the Surveys in Asia

- Univ. not an important sources of new information or knowledge; but would increase as firms grow
- Firms with UIL usually not many but increasing & satisfied.
- Who does UILs: those firms with some R&D activities regardless of size or age; (foreign firms do not do b/c they are not doing much R&D locally)
- Modes: formal channels than open or informal channels: due to weak absorption capacities and lack of infrastructure
- Consulting services -> contract research/licensing
- Why no UIL: weak Uni's R&D and mismatch and transaction costs.
- Those who do UIL : satisfied
- UILs -> better in product innovation than process innovation

# Can the UILs be a new vehicle for catch-up?

- Yes and no! (but, UIL increasing with dev't level)
- Not as substitute for firms R&D but as a supplements!  
(Asian now at the stage to utilize more UILs in their upgrading to higher value-added)
- Not the Drivers but Facilitator!
- But, diverse and transitory forms possible, like spin-off, spin-around, and joint projects? As in post-reform China
- Better to utilize diverse channels, suitable to your developmental needs
- Not only univ's but also PRIs (given resource scarcity in LDC, PRIs are often better equipped than Univ to respond to Uni')
- Also, first try to enhance firm capa, then they will demand more UILs and then more satisfied with better results.

# Paths for Catching-up Development



## Some Cases of Success

- In China: strong and successful emergence of academy-run enterprises.
- In Taiwan. Strong and successful spin-off from the PRIs (eg ITRI -> TSMC, UMC)
- Possible to happen in other countries if one create similar environment and incentives;
- 1) China model: incentives and support for professors, given some capacities of Univ.
  - 2) Taiwan and early Korean model: concentrate R&D Capacity in a few PRIs and transfer the R&D outcome to private sectors in various forms including spin-offs.
  - 3) Late Korean model: growth of firm R&D capacity rather stimulated and tapped un-utilized capacities of the Univ. (gradual and step-by-step increase of capacity of both Univ. and large firms.)

# Evolution in the Univ. GRIs and Firm. Relations in Korea

- a) 1960 & 70s: GRIs did the R&D and transfer the results to the private firms which had neither R&D capacity nor intentions.
    - > teaching universities, applied D-oriented GRIs
  - b) From mid 1980s: beginning of in-house R&D by big private firms, chaebols but still very weak univ. role as an organ; mostly contracted R&D by individual professors; joint research bt. Firms and GRIs
    - > research universities, and applied R-oriented GRIs
  - c) In the mid or late 1990s, Univ. began to take more roles as the sources of knowledge and much enhanced R&D capa. Of (big) firms which have not felt less need for coop with GRIs.
    - > entrepreneurial universities setting up TLO, more pure R oriented GRIs and new types of GRIs for SME's needs (contract R&D)
- 2) Is the Korean model generalizable? or must seek new modes where more role by the univ. from the beginning?
- > one mode or several modes for big firms or SMEs in different sectors
- 3) Should try to find optimal mode at the present condition or to make transition to future modes?