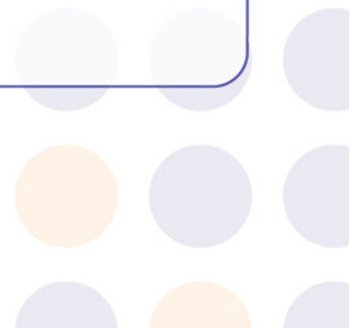


**TUSIAD-SABANCI UNIVERSITY
COMPETITIVENESS FORUM
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Korean Strategy for the Promotion of R&D and Innovation

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Korea.....

Geo-political feature....

◆ **A small, divided country bordering with China and Russia in the north and surrounded by the Japanese islands in the south.**

⇒ ***Highly dependent on neighboring countries for national security***

◆ **Major historical changes on the Korean peninsula - political, social, and cultural - have been the results of rivalry and/or cooperation among the neighboring powers.**



Korea.....

Geo-economic features....

- ◆ **A country with a small land – app 220 square Km or 99 square Km, if excluding the northern part of the peninsula, of which $\frac{3}{4}$ is non-arable mountains**
- ◆ **Very poor in natural resources – no oil reserve, insignificant reserves of coal and other resources**
- ◆ **Very limited economic interactions with western powers due to geographical remoteness – retarded in industrialization**
- ◆ **But it has to support a large population – 80 million people**



Korea.....

Cultural inheritance....

- ◆ **A very uni-cultural society strongly influenced by Confucian tradition**
 - ⇒ placing highest value on scholarship and education
 - ⇒ social order based on vertical relationships – respect for seniors and the elderly
- ◆ **Very closely knitted society, where family, school, religious and regional backgrounds are very important determinants of inter-personal relationships**
- ◆ **Relatively high social mobility – education has been the major vehicle to higher social class**



Korea.....

Where Korea was in the 60s.....

◆ **Socio-political situation: Unstable, recovering from the Korean War**

◆ **Economic situation: Traditional agrarian society, relying on agriculture for more than 60% of GDP**

⇒ GDP: \$3.36 billion, per capita GDP: \$87, share of manufacturing: 15%, unemployment: 22.3% (1961)

⇒ **One of the poorest economies then in the world suffering from all the problems that poor countries in those days were facing.....**



Korea

So, the most urgent challenge for Korea as a nation was how to liberate its people from the chronic poverty

◆ **But Korea lacked tools required for industrialization**

⇒ Korea had neither capital, resources nor market, not to mention technology

◆ **Yet, Korea had something that some others wanted but didn't have**

⇒ Human resource: illiteracy rate: 29%, college enrollment rate: 29.2% (1960) -- Educational level was far higher than suggested by the level of income

⇒ Consensus on the need for industrialization

⇒ "Can do" spirit of the people



Korean strategy.....

What Korea opted for.....

- ◆ Korea had no option but looking outward for resources, technology and market -- an **“outward-looking development strategy”** based on human resources
- ◆ But Korea was faced with additional constraints that further limited Korea’s strategic options for industrialization, such as **shortage of foreign exchanges and people’s desire for economic independence**
 - ⇒ So, Korea could not rely so much on direct foreign investment and foreign licensing for the acquisition of capital and technology as other developing economies did and do.....



Korean strategy.....

◆ Korea started with the following strategies

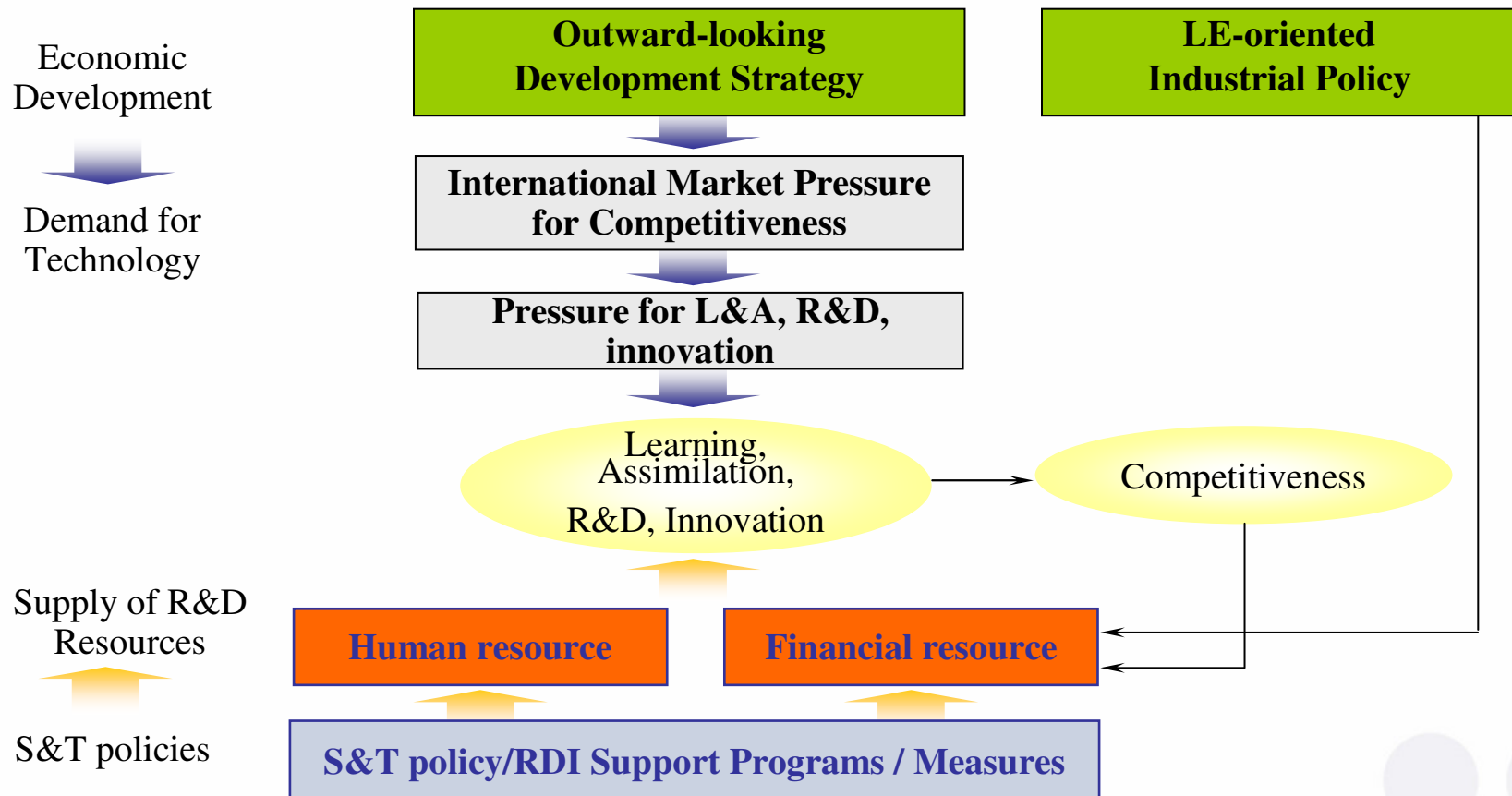
- ⇒ **Capital: Long-term foreign loans**
- ⇒ **Technology: OEM, reverse engineering, learning by operating foreign technologies...**
- ⇒ **Human resource: Expansion of education and training**
- ⇒ **Industry-targeting: Strategic industrial development**
- ⇒ **Market: Export expansion**
- ⇒ **Large enterprise orientaiton**

“Gov’t brought in large-scale foreign loans and allocated them for investments in selected industries, which led to massive importation of foreign capital goods and turn-key plant. Industries later reverse-engineered the imported capital goods for the purpose of acquiring the necessary technologies.”



Korean strategy for RDI

ACTIVE GOV'T SUPPORT+PRIVATE SECTOR PARTICIPATION





S&T Human Resource Development....

◆ Education system developed in response to the socio-economic needs

⇒ Focused on strengthening formal education system

⇒ **Invested in primary, secondary and tertiary education in advance – laid a foundation for industrial development**

⇒ Science and engineering programs have received far greater share of government's investments in education – more than 45% of college graduates in Korea are S&E majors

⇒ **Creation of KAIST:** Graduate programs have been rapidly expanded to meet the fast increasing demand for high-quality engineer

◆ Private sector's contribution– private universities account for about 75% of college enrollments

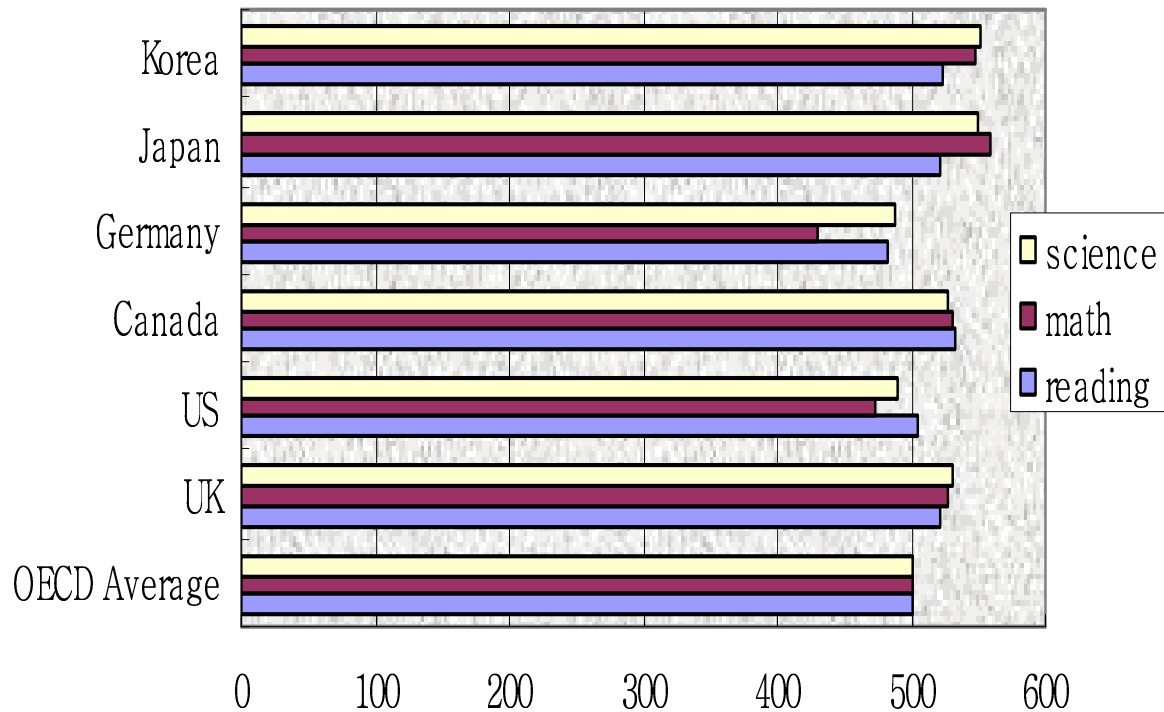


EDUCATIONAL ATTAINMENT

	1960	1970	1980	1990	2000
ILLITERACY RATE (PERCENTAGE)	29.4	12.4	7.2	4.1	2.2
UNIVERSITY ENROLLMENT RATIO OF HS GRADUATES (PERCENTAGE)	29.2	29.0	37.7	34.3	74.2
NUMBER OF UNIVERSITY GRADUATES	20,452	29,544	62,688	178,631	244,852
PERCENTAGE SHARE OF SCIENCE & ENGINEERING GRADUATES	34.6	45.7	46.4	40.9	44.5



LITERACY SCORES OF PISA 2000

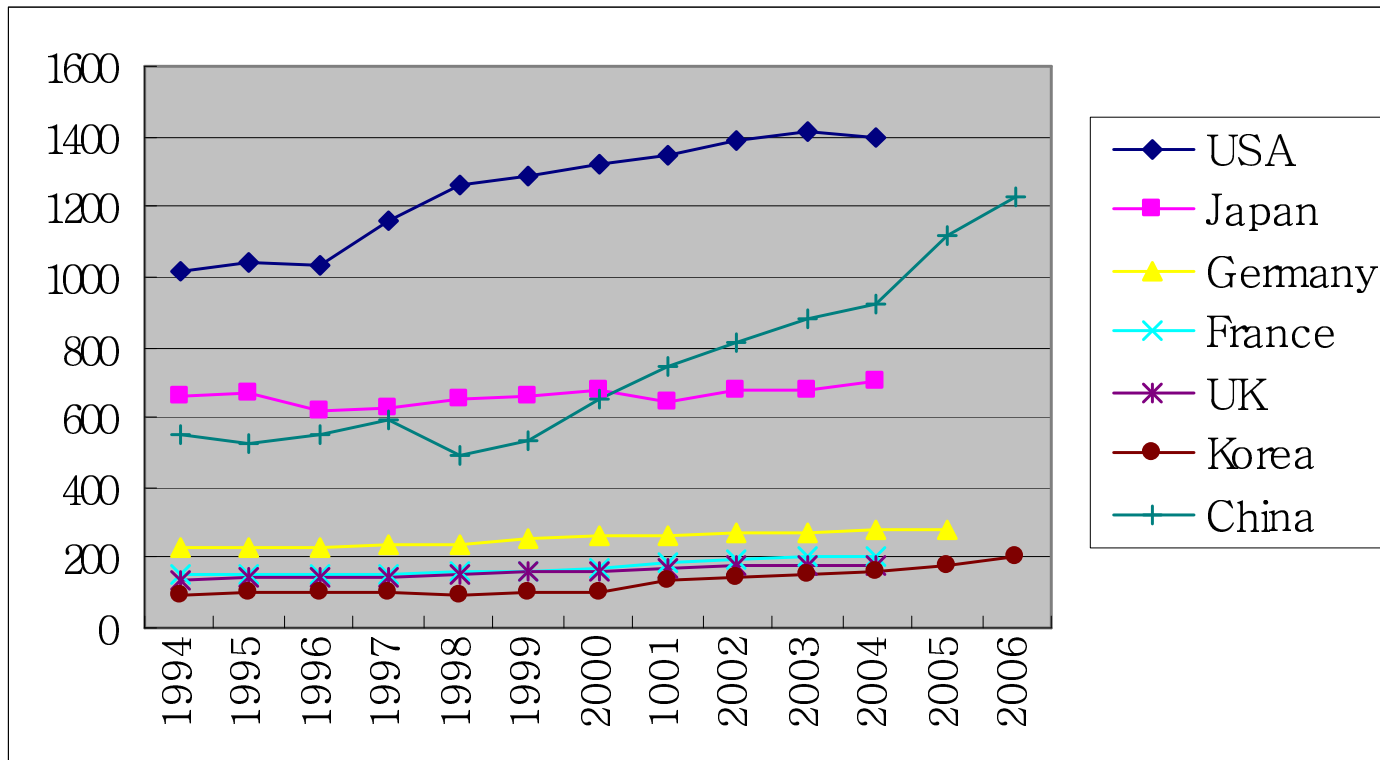


Source: OECD, *Education at a Glance*, 2005.

*PISA: Program for International Student Assessment



NUMBER OF RESEARCHERS



Korea has now an R&D manpower which is almost as large as that of the UK or France



◆ **Korea has made remarkable achievements in HRD, both quantitative and qualitative**

⇒ **College enrollment rate of high school graduates is the highest in the world (over 80% as of 2007)**

⇒ **Also, graduate programs have been improved remarkably over the past several decades, producing increasing number of S&E with advanced degrees**

⇒ **Linking research to education: ERC, SRC, etc..**

◆ **Still, the education system in Korea suffers from various problems.**





R&D and Innovation.....

◆ Industrialization in Korea has been an evolution from imitation to innovation

⇒ In the early stages, Korea focused on assimilating foreign technologies through informal channels, such as OEM arrangements, reverse engineering of imported capital goods, learning from construction and operation of turn-key plants.....

◆ Later, Korea turned to a strong drive for domestic R&D and innovation...

⇒ *It was in 1982 when the Korean government launched the National R&D Program, which has been expanded rapidly since then, and also took various measures to promote private industrial RD and innovation.....*

WHAT THE KOREAN GOVERNMENT HAS DONE TO PROMOTE AND FACILITATE R&D AND INNOVATION?

1960's

- Establishment of KIST (1966), MOST (1967)
- S&T Promotion Act (1967)

1970's

- Establishment of GRIs in the field of chemical & heavy industries in the mid-1970s ; creation of KAIST.....
- Construction of Daeduk Science Town (Started in 1974)

1980's

- Launching of the national R&D program (1982)
- Promoting private firm's research: financial, tax and other incentives to stimulate R&D investments

1990's

- Promotion of university research: SRC, ERC, etc.
- Introduction of new types of nat'l R&D programs
 - Highly Advanced Nat'l Program, The 21st Century Frontier R&D Program.
- Establishment of inter-ministerial coordination body: NSTC
- Opening of technology stock market --KOSDAQ

2000's

- Introduction of National Technology Road Map (NTRM)
 - To suggest TRMs for key technologies to secure products/functions.
- Introduction of overall coordination system
 - NSTC



LEGISLATIVE ACTIONS FOR S&T/HRD

S&T Framework Law (2001)

[Promotion of Technology Development]

- ✓ Technology Development Promotion Law ('72)
- ✓ Industrial Technology Promotion Law ('73)
- ✓ Biotechnology Promotion Law ('83)
- ✓ Basic Scientific Research Law ('89)
- ✓ Collaborative R&D Promotion Law ('94)
- ✓ Dual use Technology Promotion Law ('98)
- ✓ Brain Science Research Promotion Law ('98)
- ✓ Nano Technology Development Promotion Act ('02)

[R&D Institutes Promotion]

- ✓ Government Research Institute Promotion Law ('73)
- ✓ Korea Atomic Energy Research Institute Act ('73)
- ✓ Korea Science and Engineering Foundation Law ('76)
- ✓ Industrial Research Promotion Law ('86)
- ✓ Act on Korea Institute of Nuclear Safety ('89)
- ✓ Daegu-Kyongbuk S&T Institute Law ('03)
- ✓ Act on the Establishment and Management of Government R&D Institutes ('04)

[Nuclear Energy]

- ✓ Atomic Energy Act ('58)
- ✓ Nuclear Liability Act ('69)
- ✓ Act on Governmental Contract for Indemnification of Nuclear Damage ('75)
- ✓ Law for Physical Protection of Nuclear Facilities ('03)
- ✓ Radiation & Radioisotope Promotion Act ('02)

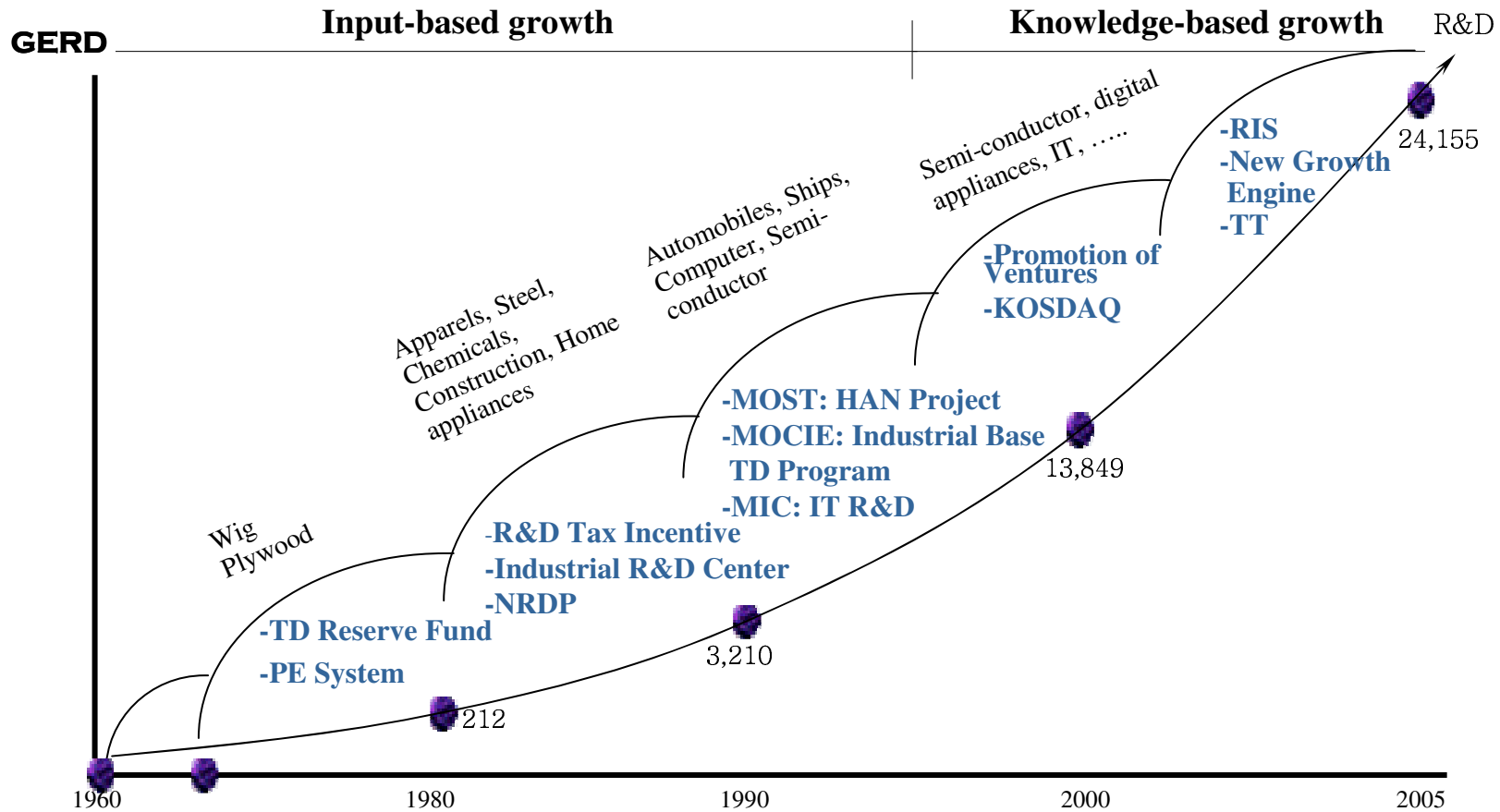
[HRD]

- ✓ Korea Advanced Institute of S&T Law ('80)
- ✓ Professional Engineers Law ('92)
- ✓ Gwangju Institute of S&T Law ('93)
- ✓ Female Scientists and Engineers Act ('02)
- ✓ Scientists and Engineers Mutual Aid Association Act ('02)
- ✓ Special Law for Reinforcing National S&T Competitiveness ('04)

[Others]

- ✓ Meteorological Service Act ('61)
- ✓ Standard Time Act ('86)
- ✓ Science Museum Act ('91)
- ✓ Presidential Advisory Council on S&T Law ('91)
- ✓ Daedeok Science Town Management Law ('93)

HOW THE GOVERNMENT HAS BEEN HELPING THE INDUSTRIES' RDI ACTIVITIES?





RDI SUPPORT PROGRAMS : 2005

	Number of Program		Budgets (2005)	
	No.	%	Million \$	%
Tax	17	6.6	1,480*	15.9
Financial	15	5.8	3,402**	36.6
Procurement	2	0.8	394	4.2
Legal, etc.	29	11.2	34	0.4
HRD	29	11.2	106	1.1
R&D Subsidy	77	29.7	3,253	35.0
T Trade	8	3.1	61	0.7
T Transfer	33	12.7	225	2.4
T Consulting	27	10.4	44	0.5
T Information	22	8.5	294	3.2
Total	259	100.0	9,296	100.0

* Tax revenue foregone

** Amount of loan available

EFFECTIVENESS OF RD&I SUPPORT PROGRAMS

$$P(y=1) = F(x\beta)$$

$$P(y=0) = 1 - F(x\beta)$$

P: Probability to innovate

x : Explanatory variables (RDI support programs)

β : Parameters

No of observation : 1,710 companies (STEPI Survey)

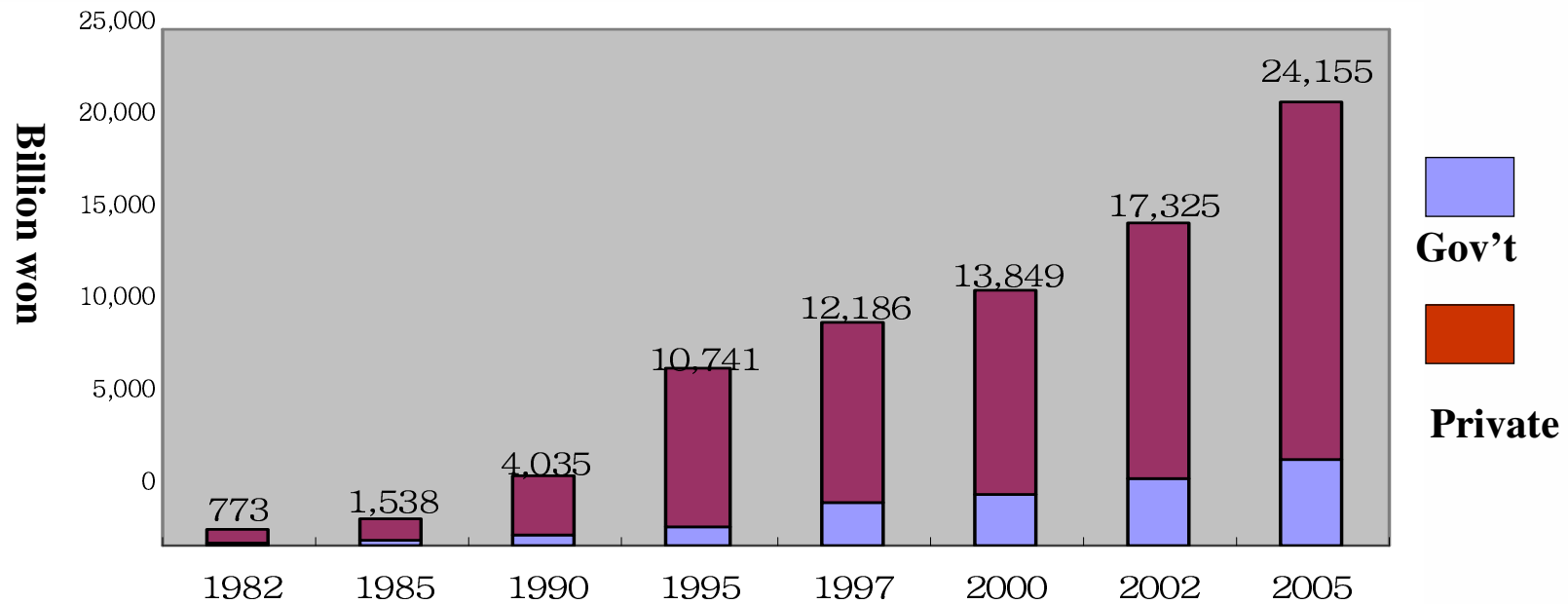
— OVERALL EFFECTS

	$\hat{\beta}$	Z-values
Tax	0.303	4.13
Loans	0.224	2.74
Procurement	0.148	1.06
Manpower	0.150	1.95
Legal, etc.	0.293	3.57
Technical	0.265	2.42

$\hat{\beta}$ for variables other than RDI support programs not shown (size, age, etc.)



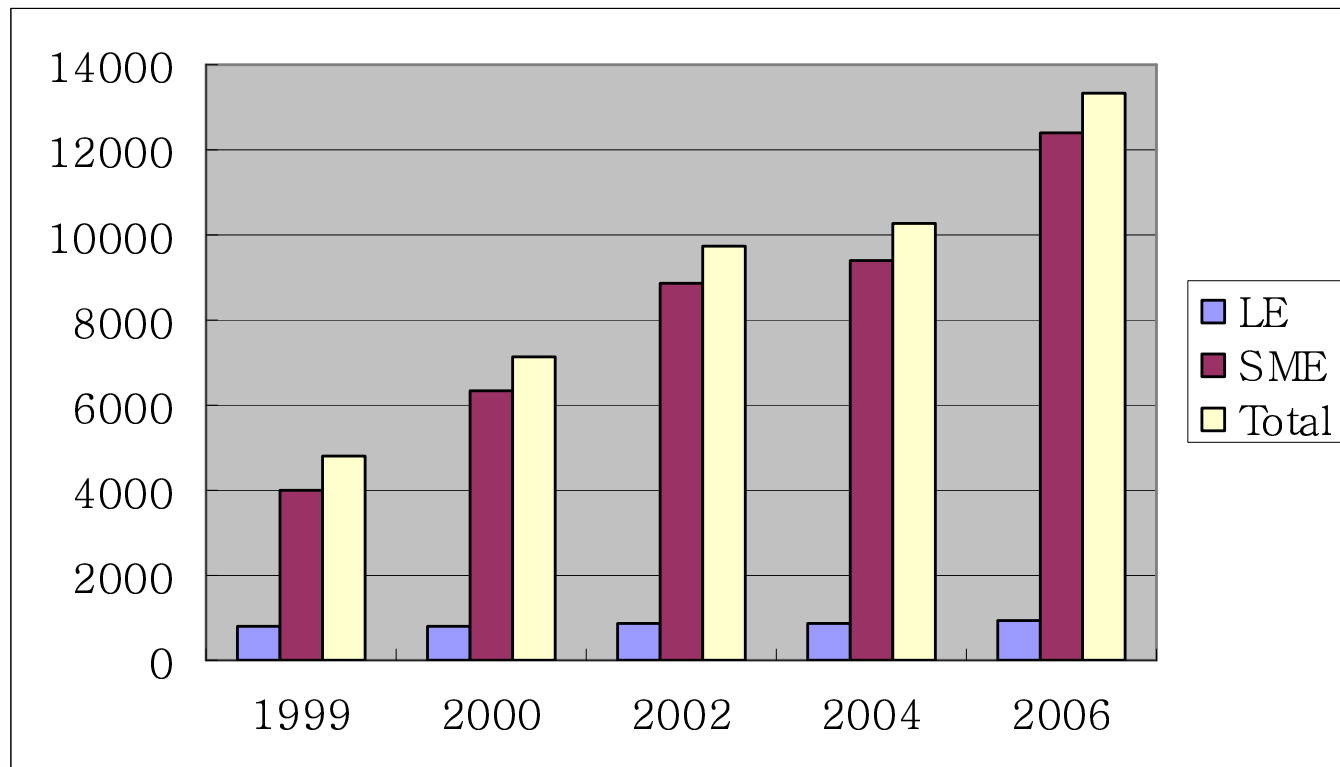
SO, HOW THE INDUSTRIES RESPONDED?



Korea today is the 6th largest spender on R&D among OECD countries

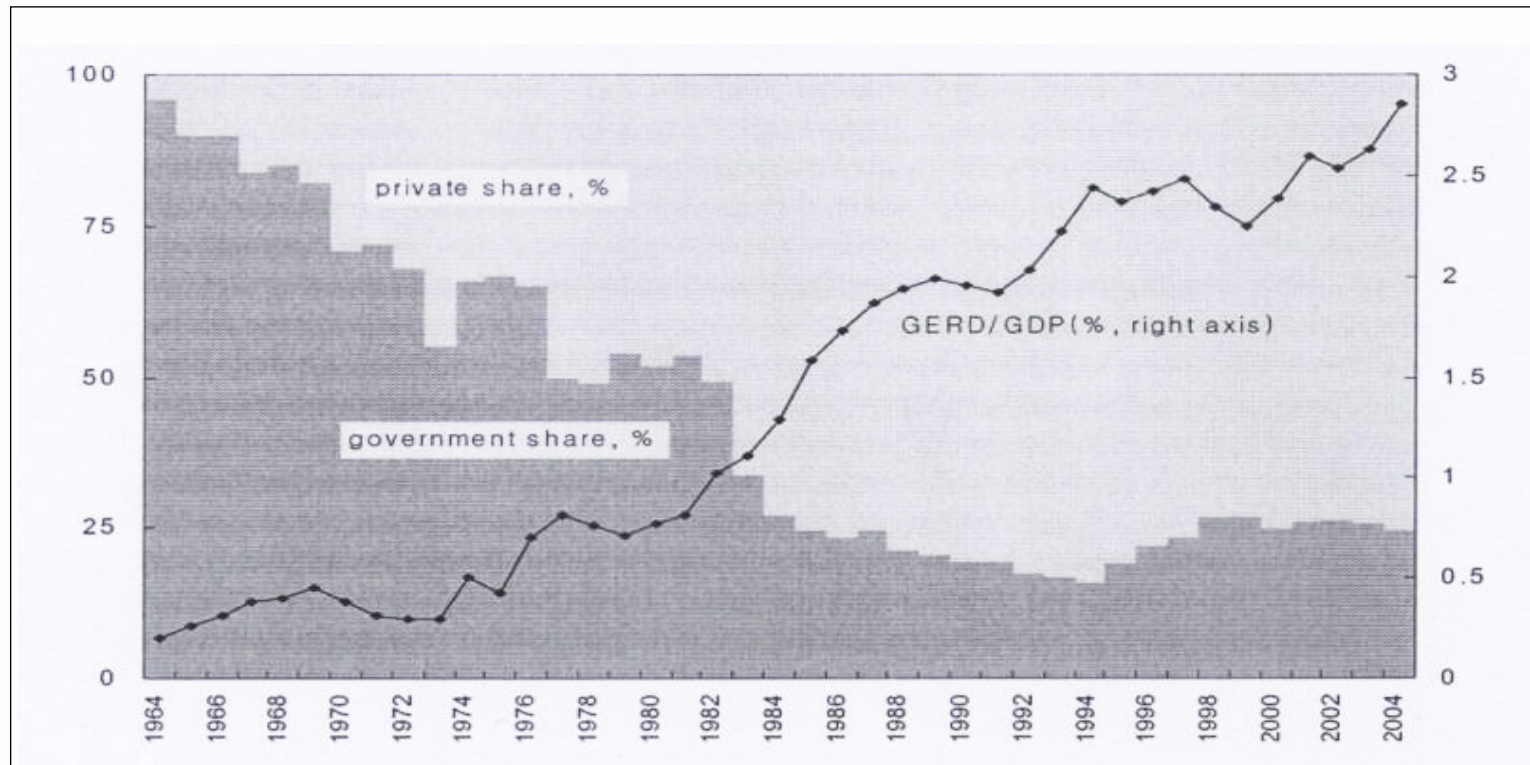


NUMBER OF INDUSTRIAL LABS





TREND AND STRUCTURE OF KOREA'S R&D

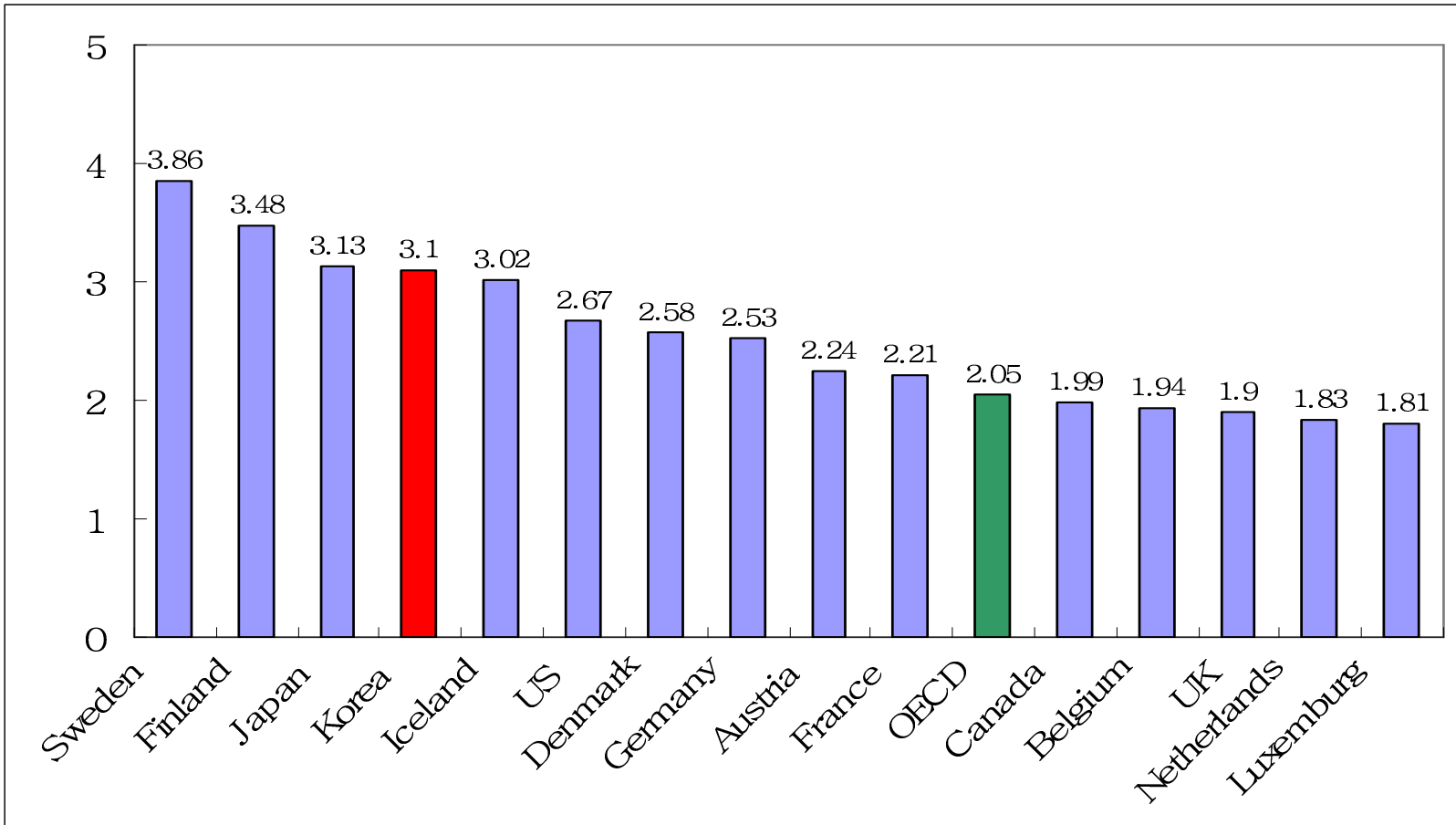


Source: Ministry of Science and Technology, Republic of Korea

PRIVATE INDUSTRIES ACCOUNT FOR OVER 75% OF THE GERD



R&D/GDP: AN INTERNATIONAL COMPARISON



WHAT KOREA HAS GOT FROM THE EFFORTS?

◆ Number of KPO patents granted

	1981	1985	1990	1995	2000	2004
Number	1,808	2,687	7,620	12,512	34,579	45,298
Korean share	12.8	13.0	33.5	52.5	65.6	66.7

◆ Number of US patents granted to Koreans : 7th in the world – World's 4th largest producer of industrial properties

◆ Number SCI publications : 14th in the world (Highest growth)

WHAT KOREA HAS GOT FROM THE EFFORTS?

- ◆ **Established world prominence in such areas as : LCD, semi-conductors, PDP, cellular phones, automobiles, shipbuilding, steel, etc.**
- ◆ **Emerg**ed as the 13th largest economy and 12th largest trading country in the world from one of the poorest countries within four decades...



What made the growth possible?

- ◆ **Market pressure for competitiveness**
 - ⇒ **Outward-looking development strategy**
- ◆ **S&T human resource**
 - ⇒ **Investment in education in advance**
- ◆ **Financial ability to fund large, risky projects**
 - ⇒ **Chaebol system**



◆ Linkage of S&T to strategic industrial development

⇒ Concentration of scarce resources on strategic areas

⇒ More than 75% of the industrial labs are in electronics(57.6%) and machinery and metal industries(17.9%), etc

◆ S&T infrastructure/Govt policies

⇒ Creation of GRIs to compensate for technological weakness of private industries

⇒ Legal and administrative infrastructure for S&T

⇒ RDI support programs...

★ Korean government played a key role in the process by stimulating demand for technologies and at the same time helping industries develop indigenous RDI capabilities

But, there are dark sides, too....

◆ Imbalance in RDI system

⇒ Basic science vs Development

‘over 85% of GERD for application and development’

⇒ Strategic industries vs other industries

‘More than 75% of the industrial labs are in electronics(57.6%) and machinery and metal industries(17.9%), etc’

⇒ Large enterprises vs SMEs

‘Top 5 firms account for more than 40% of industrial R&D’

⇒ Regional imbalance

‘More than 70% of R&D activities are concentrated in the Seoul and Daedok areas’

◆ Excessive reliance on private industries for R&D

⇒ Very vulnerable to changes in market



◆ **Weak international linkage in research and technology**

⇒ **Korea and Japan are among the lowest in terms of S&T globalization: patents with foreign co-inventors account for only 5% of the total domestic patents, and foreign ownership of domestic inventions is also the lowest among OECD countries**





CHALLENGES AHEAD

- ◆ **CREATIVITY EDUCATION**
- ◆ **ATTAINING EXCELLENCE IN RESEARCH, WHILE AT THE SAME TIME, ESTABLISHING TRANSPARENCY, TRUST, AND ETHICS IN RESEARCH AND INNOVATION SYSTEM**
- ◆ **GLOBALIZATION**
- ◆ **LINKING SCIENCE TO SOCIO-ECONOMIC DEVELOPMENT**
- ◆ **DIVERSE AND OPEN SOCIETY – OVERCOME THE CONSTRAINTS SET BY THE CONFUCIAN INFLUENCES**





WHAT KOREAN EXPERIENCES TELL

1. HUMAN RESOURCE IS THE KEY TO R&D AND INNOVATION !!!
⇒ **NO STRATEGY, NO MODEL WORKS WITHOUT HR**
2. NOTHING CAN BETTER MOTIVATE INDUSTRIAL RDI THAN MARKET COMPETITION ⇒ **IF THEY CAN SURVIVE W/OUT COMPETING IN THE MARKET, WHY INVEST IN RDI?**
3. GOVERNMENT CAN PLAY AN IMPORTANT ROLE IN S&T DEVELOPMENT ⇒ **STIMULATE DEMAND FOR TECHNOLOGY AS WELL AS HELP BUILD UP INDIGENOUS RDI CAPABILITY**
4. LINKING S&T TO INDUSTRIAL DEVELOPMENT IS ESSENTIAL TO MAKE RDI SYSTEM SUSTAINABLE
5. MOST ALL, **POLITICAL LEADERSHIP FOR S&T DEVELOPMENT CAN NEVER BE MORE EMPHASIZED!!**



THANK YOU

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