Science, Technology, Innovation and Growth

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Outline

- Science and technology (S&T) is an essential engine of economic growth
- S&T is most effective as part of a National Innovation System (NIS)
- Centers of Excellence help strengthen R&D capacity and stimulate innovation
- Kazakhstan may reap large benefits from a strong NIS

Science and technology (S&T) is an essential engine of economic growth

Why strong science and technology is needed

- Basic research produces new knowledge and major breakthroughs
- Applied research develops new uses for existing knowledge
- Research labs train human resources
- S&T leads to new products, firms and markets

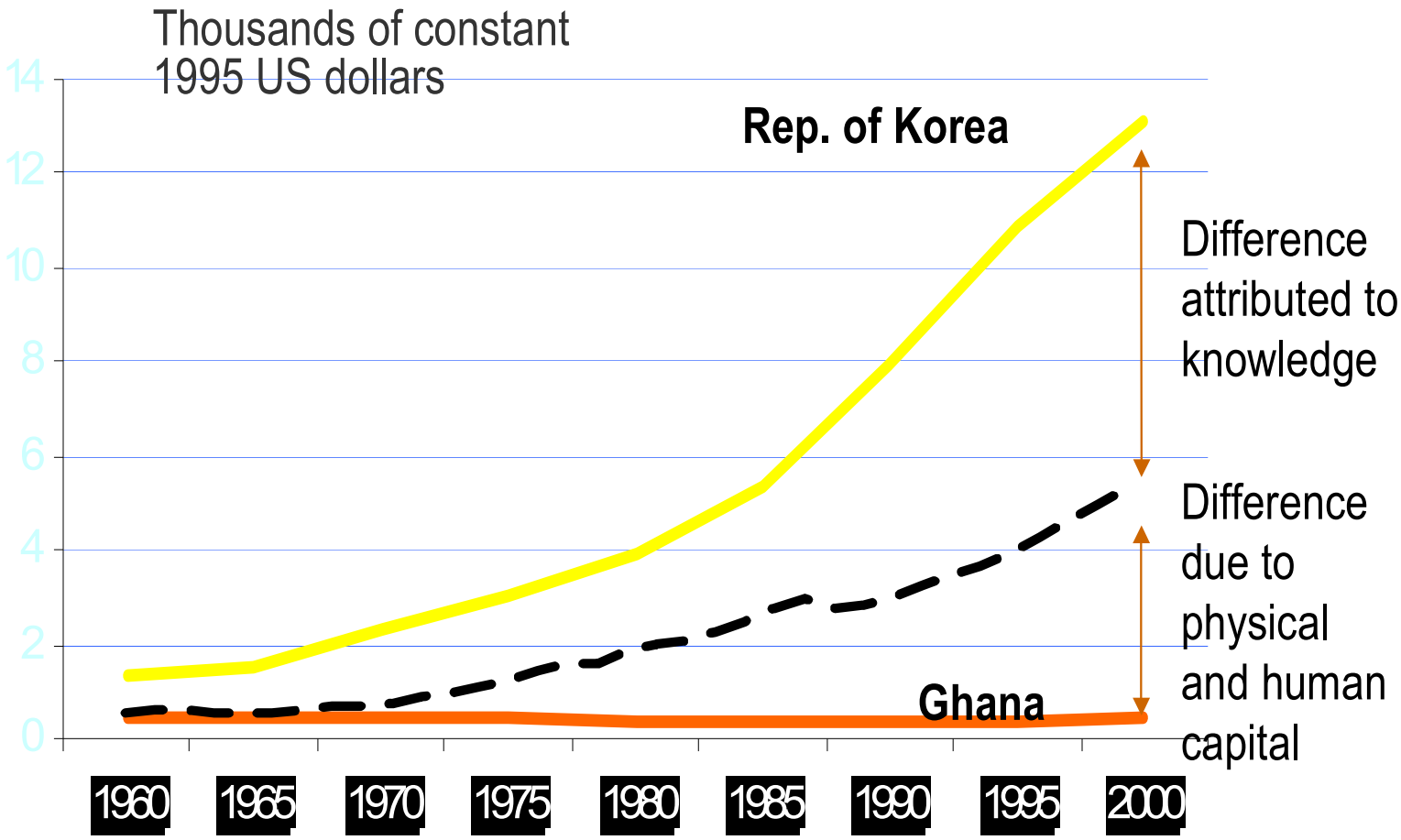
Economic advantages of S&T: High returns on investment

Author (year)	**Estimated Rates of Return**	
	Private	Social
Nadiri (1993)	20 - 30	50
Mansfield (1977)	25	56
Terleckyj (1974)	29	48 - 78
Sveikauskas (1981)	7 - 25	50
Goto-Suzuki (1989)	26	80
Bernstein-Nadiri (1988)	10 - 27	11 - 111
Scherer (1982, 1984)	29 - 43	64 - 147
Bernstein-Nadiri (1991)	15 - 28	20 - 110

Research in the U.S.

- S&T has driven the economy for last 5 decades
- Led to discovery of transistors, semi-conductors, software, biotech
- University research produced Intel, Hewlett-Packard, Microsoft, Genentech….

Knowledge makes the Difference between Poverty and Wealth…



S&T is most effective as part of a National Innovation System (NIS)

S&T plus innovation (STI) = prosperity

- S&T alone
  - Latin America: Two decades of investment in R&D = little effect on growth
- S&T&I
  - Asian ‘tigers’: From relative poverty to relative prosperity by *sustained funding* for innovation (Korea, Taiwan, Singapore)
- S&T may have little economic effect unless it is part of a National Innovation System

S&T is most effective when it is:

- Of ***high quality***
- ***Relevant*** to national needs
- ***Relevant*** to global trends
- ***Linked to local and international technology markets***

What is innovation?

- New knowledge
- **Plus:** Existing knowledge, adapted and diffused through the economy

What is a National Innovation System?

- Centers of Excellence
- Policies and incentives to speed technology commercialization
- ***Both*** are essential ingredients of economic growth

Example of building a National Innovation System: Korea (1)

Original condition:

- Unbalanced industrial development
  - Strong final assembly industry, but weak capital goods and system integration industry
- Unbalanced National Innovation System
  - Underdevelopment of university research system
  - Dormant industry-academic cooperation
- Lack of infrastructures for creative innovation
  - Lack of investment in basic science
  - Weak protection of intellectual property rights
  - Underdevelopment of venture financing and support system

Korea (2): Innovation Strategy

Promote balanced National Innovation System

- Vitalization of university research
- Networking among Industry, academia, govt

From supply push To demand pull

- Mission-oriented governmental R&D programs
- Technology targeting

Sustain infrastructure for creative innovation

- Sustained investment for basic science (KIAS)
- Increased protection for intellectual property rights
- Promotion of venture companies

Korea (3): Shift of S&T capacity from government toward industry & academia

	1970	1975	1980	1985	1990	2001
Public Institutes	84	66	49	24	22	13
Universities	4	5	12	10	7	10
Corporates	13	29	38	65	71	76
Total	100	100	100	100	100	100

Centers of Excellence help strengthen S&T capacity and stimulate innovation

Features of Kazakhstan's Centers of Excellence

- Scientific and academic excellence
- Broaden S&T base (including engineering, biotech, medicine, mathematics)
- Training of potential scientific leaders
- Attracting talented young people to science
- R&D with potential to advance economic and industrial development
- Research cooperation with international scientific community
- Partnerships with private sector

Millennium Science Initiative

- Global program to focus on Centers of Excellence
- Activities are ***integrated***
  - Integrated research and training
  - Integrated research activity across disciplines
    - R&D organized by problems, not disciplines
    - Interdisciplinary, competitively driven
- S&T linked to evolving NIS of country
  - Part of national development strategy
  - Locally planned and implemented
  - Links to private sector, emphasis on transfer of knowledge
  - Outputs of value to society and economy
  - Strengthens human resources

Example of MSI: Chile

- 3 Institutes and 17 Nuclei
  - Forest ecosystem services (multiple clients)
  - Complex engineering systems (industrial clients)
  - Patagonian ice fields (spin-off; climate studies)
- Links with industry
- Adds value to exports
- International research networks
- Outreach to community and education
- Helps attract back émigré researchers

Kazakhstan's potential rewards for a stronger National Innovation System

- Potential for knowledge discovery
- Potential for innovation and access to world markets
- Basis for world-level technology firms
- Models: Exxon-Mobil, Schlumberger, Freemont Mining, Intel, Microsoft

Reforms needed to ensure markets for Kazakh R&D

- Improve legal and regulatory policy framework
- R&D funding for competitively selected, peer-reviewed Centers of Excellence.
- Technology commercialization offices to link Kazakh scientists to international markets
- Supplier Development Program to help Kazakh firms become qualified suppliers to large foreign and domestic companies

How Kazakhstan may gain large benefits from stronger innovation

Latecomer advantage for Kazakhstan

- Most knowledge that Kazakhstan needs to increase wealth and growth already exists.
- Kazakhstan has the opportunity to import, absorb and diffuse this knowledge, as well as produce its own new S&T knowledge
- **Critical task: develop better capacity to absorb technology and a strategy for enhancing absorptive capacity**

Role of government (1): Sustained support of an "innovation environment"

- Educate and train people
- Stable governance, economic freedom, effective legal system
- Fiscal system that encourages wealth creation and does not discourage innovation
- Support must be *sustained* to be effective

Role of government (2): Guidance

- Policies and incentives, rather than specifications
- Sustained political leadership and coherent vision
- Direct operational control and interest of the President
- Innovation as pillar of national development strategy
- Talent in important ministries (Economic Planning, Industry & Trade, Education) that support science and technology
- Promote conditions that speed innovation to the marketplace
- Stimulate government-university-industry collaborations

Conclusion

How can Kazakhstan best support innovation through R&D?

- Recognize that R&D is a ***high-return investment***
- Adapt existing technology – more cost-effective and time-effective than competing at the frontiers
- Apply incentives for R&D-based industries of all sectors and levels
- Initiate reforms needed to
  - Focus R&D on national needs
  - Improve the legal and regulatory framework
  - Market diverse Kazakh technology products to large firms worldwide