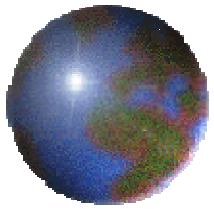
The Importance of National Innovation System in the Globalization of Technology



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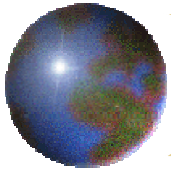
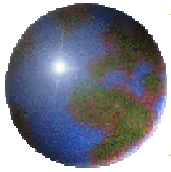


Outline of Presentation

- Introduction
- The National Innovation System (NIS) and Role of Government
- The Meaning of Globalization of Technology
- NIS and Related Public Policies: Comparison between NIEs and Malaysia
- Globalization of Technology: Indicators
- Participation in Globalization of Technology
- Conclusion



Introduction

- Knowledge and innovation are key drivers of today's economy
- Competitiveness derived from capability to generate technological innovation through production of knowledge and exploitation of external knowledge
- Advances in ICT facilitate knowledge flows across organizations and national borders
- Growing internationalization of scientific and technological activities

Introduction (cont'd)

- Public policies and programs designed to develop indigenous capabilities for effective participation in the globalization of technology
- Capacity to participate in globalization of technology depends on effectiveness of country's institutional framework that promotes technological learning
- Countries in the Asian-Pacific Region are in different stages of development and have different capacities for technological learning

The NIS and Role of Government

- Well-functioning NIS important in the globalization of technology
- Analysis of NIS could help explain disparities in countries' capacities to participate in globalization of technology
- NIS defined as "the national institutions, their incentives and their competencies that determine the rate of technological learning in a country (Patel and Pavitt)

The NIS and Role of Government (cont'd)

- Application of NIS for developed countries – narrow approach based on analysis of R&D system and on high-tech and science-based innovations
- To be applicable to both developed and developing countries analysis of NIS should cover all types of innovations and all types of technological learning (learning by using, learning by making, learning by hiring and interactive learning between agents in the innovation system)

The NIS and Role of Government (cont'd)

- Capacity of catch-up economies to absorb foreign technologies for economic returns depends on:

  1. Social capital – institutional framework
     - role of government
     - technological & skills level of the population
  2. Technological congruence – suitability of developed countries' technologies for use in catch-up economies

The NIS and Role of Government (cont'd)

- Public policies and programs should aim at:
  1. Enhancing capacity & capability to acquire, use, assimilate knowledge and technology available worldwide to generate technological innovations
  2. Developing infrastructure (physical & human capital) to attract MNCs in high-tech industries
  3. Enhancing capability to link up with the national systems in developed countries

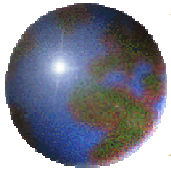
The NIS and Role of Government (cont'd)

- Science, technology and innovation policies should form an integral part of economic policy and should complement other related policies:

  1. Education & training policies to develop human capital (in particular S,E, T)

  2. Financial & fiscal policies to enhance R&D and other innovative activities in both public and private institutions

  3. Industrial & trade policies to upgrade capabilities of domestic firms to generate competitive products & services



The Meaning of "Globalization of Technology"

Globalization of technology takes place through 3 main routes (Archibugi & Pietrobelli):

1. International globalization of technology
   – export of technology-intensive products
   - transfer of know-how through patenting and licensing
   - installing plants in a foreign country to produce new products & processes
2. Global generation of innovations
3. Technological collaborations

NIS and Related Public Policies: Comparison between the NIEs and Malaysia

Two groups of developing countries:

First group (Malaysia, China Thailand and Philippines) – depend on MNCs to export technology-intensive products as part of their global production

Second group (NIEs - Republic of Korea, Taiwan, Singapore, Hong Kong) – started by utilizing and adopting technologies from developed countries but are now participating in global generation of innovations. Indigenous innovation capabilities developed through incremental and accumulative learning by adapting and imitating foreign technologies as well as correct policy choices

Education System & HRD

NIEs

- High govt. investment
- High enrollment in S&E
- High enrollment in tertiary education
- High enrollment in vocational training (ROK & Taiwan)
- Incentives to lure back S&E (ROK & Taiwan) helped in technological learning
- Incentives to attract foreign S&E (Singapore)

Malaysia

- High govt. investment
- Enrollment in S&E on the increase of late
- Low enrollment in tertiary education
- Scheme to lure back S&E & attract foreign S&E has not generated desired results (under review)
- Teaching company scheme to support SMEs (now suspended)

Research & Development (R&D)

NIEs

- High GERD/GDP (ROK-2.96; Taiwan-2.16; Singapore-2.11)
- High BERD as % of GERD (ROK-76%; Taiwan-63%; Singapore –63%)
- High RSE per 10,000 labour force (ROK-64; Taiwan-64; Singapore-87.6 (out of which 24.7% are expatriates)

Malaysia

- Low GERD/GDP – 0.5
- BERD as % of GDP: medium – 57.9% but highly concentrated; 78.8% of BERD spent by 4 industries
- Low RSE per 10,000 labour force – 15.6

Research & Development (R&D)

NIEs

- ROK - R&D performed mainly in large firms (chaebols); R&D in universities underdeveloped
- Taiwan – public RIs acquire technology & transfer to private enterprise (mostly SMEs)
- Singapore – significant R&D performed in private enterprises due to large no. of RSEs employed

Malaysia

- Longer history of R&D in public RIs compared to universities
- RIs established along economic sectors
- In private sector, R&D performed mainly by large firms

Financing Innovative Activity

NIEs

- Tax incentives
- Grants -govt. financing in ROK major factor in high BERD
- VC for local startups high in Singapore; available for RI spin-offs & new tech developed in universities
- VC provides Taiwanese entrepreneurs with best management practice
- VC in ROK important after Asian financial crisis

Malaysia

- Tax incentives –double tax deduction for R&D
- Grants:-

1. Industry R&D Grant Scheme (IGS)
2. Commercialization of R&D Fund (CRDF)
3. Technology Acquisition Fund (TAF)
4. Industrial Tech. Assistance Fund (ITAF)

- VC – nascent stage

Interaction Among Agents in NIS

ROK

- public-private linkage through NRPD
- university research underdeveloped; lately has received large funding from industry
- weak linkages between firms; large firms (chaebols) high vertical intergration; attention on SMEs after financial crisis

Taiwan

- public RIs major agent in knowledge acquisition and diffusion
- university not a significant agent
- networking among firms is government-driven
- linkages bet. firms in the form of R&D consortia & tech-based SA – RI key agent in linkage formation
- Industry assoc. bridge bet. govt. & firms

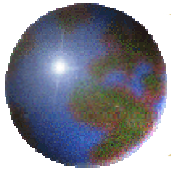
Interaction Among Agents in NIS (cont'd)

Singapore

- strong public-private linkages
- university play a key role in basic research
- Partnership bet. Govt. and private enterprises (including MNCs) in training

Malaysia

- weak public-private linkages
- weak linkage bet. firms except for certain sectors in which policy interventions force linkage bet. large & small firms



Globalization of Technology:Indicators

Category	Indicator
International exploitation of nationally produced innovations	Int. trade in high tech products FDI inflow and outflows Number of licensing agreements
Global generation of innovations	R&D financed abroad Patenting activity of MNCs attributable to R&D in foreign locations
International technological collaborations	Number & form of scientific & technical agreements

Participation in Globalization of Technology

- Comparison between NIEs and Malaysia

Conclusion

- Internationalization of scientific & technological activities are on the rise, but limited to developed countries, in particular the Triad countries which have well-functioning NIS
- Among the developing countries, the East Asian NIEs have the greatest potential to participate in the globalization of technology (GOT)
- The East Asian NIEs have used different policy measures & strategies to effect technological learning

Conclusion (cont'd)

- ROK and Taiwan developed innovation capabilities through incremental & accumulative process of learning by adapting & imitating foreign technologies
- Singapore engineered spillovers from FDI to develop innovation capabilities through targeted incentives
- FDI has been instrumental in transforming Malaysia's industrial structure but linkages between MNCs and domestic firms are limited

Conclusion (cont'd)

- A critical factor for the NIEs' successes in technological learning compared to Malaysia is the availability of educated and skilled human resource in science, engineering and technology
- Another critical factor is high investments in R&D, especially in industrial R&D
- Financing of innovative activities in the NIEs and Malaysia is through tax incentives and grants; VC funding has risen rapidly in the NIEs but is still at nascent stage in Malaysia

Conclusion (cont'd)

- Increased participation in GOT, especially in emerging technologies would require:

1. Strengthening linkage between industry and the science base
2. Increase in quantity & quality of human resource, in particular in R&D (especially for Malaysia)
3. Upgrade technological capabilities of SMEs
4. Enhance scientific & technological collaborations not only with developed countries but also among developing countries

Indicators	ROK	Taiwan	Singapore	Malaysia
High tech exports	High	High	High	High; largely contributed by MNCs
FDI inflows/outflows	Inflows: Low; restrictive policy until 1980s; more emphasis on arm's length licensing rather than FDI	Inflows: moderate; access to OEM/ODM relationships a major source for technological knowledge	Inflows: high; engineered spillovers from MNCs to develop domestic capabilities	Inflows: high; weak linkages bet. MNCs & domestic firms
Licensing agreements	Low ratio of licensing fee & royalty receipt to payment (0.3 compared to US at 2.36)	Low ratio of licensing fee & royalty receipt to payment (0.23 compared to US at 2.36)		Large deficits for licensing fee & royalty
R&D financed abroad		Production-oriented R&D mainly in China; R&D labs in Silicon Valley		negligible
Patents attributed to MNCs in foreign locations				
No. & form of scientific & technological collaborations	Low in cross-border co-authorship of papers; tech. collab. mainly JVs	Low in cross-border co-authorship of papers; tech. collab. mainly JVs		<1% of coauthored papers are with foreign scientists