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The Role of Technology Transfer in Economic Development:

Asian Successes

Middle Eastern Failures

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Asia vs. Resource Poor Arab countries

- Much of discussion is about resource poor Asian countries and resource poor Middle Eastern countries.
- Oil nations present different set of issues:
  - but little adoption of external technology except in the oil sector

Introduction

Alexander Gerschenkron (1962):

"advantages of relative backwardness"

ability of poor nations to benefit from accessing existing more productive technology from the developed nations.

Develop technology *de novo,* through R & D, or borrow existing technology from advanced countries

Local technology development: expenses and false roads.

Borrowing: much less expensive and less risky.

This presentation

- role of technology TRANSFER for the economic growth of countries:
- compare the economic evolution of:
  - some economies of the Middle East
  - Asian nations (Korea, Taiwan)
    - four decades of rapid economic growth

CURRENTLY

- **Discrepancies are striking:**
- **Korea:**
  - **Samsung, LG, Hyundai, et al**
  - **Taiwan: Acer (Gateway)**
- **Middle Eastern countries:**
  - **almost no manufactured exports, simple or high tech.**

Proximate sources of differences in performance: consensus

1. **high rates of investment in physical capital such as roads, buildings, machinery;**
2. **growing levels of education;**
3. **stable macroeconomic policy**
   - **avoiding inflation**
4. **emphasis on exports**
   - **motivates productivity gains and demand for international technology transfer.**

The proximate sources of differences: more explanations

- **economic growth as primary goal of government.**
- **Park Chung Hee, President of Korea:**
  - **“In human life, economics precedes politics or culture”**
- **Competent bureaucracy**
  - **insulated from populist pressures**

GDP growth

- **Figures 1 and 1a**
  - **roughly the growth in the standard of living for individual countries**
- ***A significant source of the discrepancies reflect the difference in the deployment of international technology.***

Figure 1
Rates of Growth of GDP per capita in constant 1995 prices

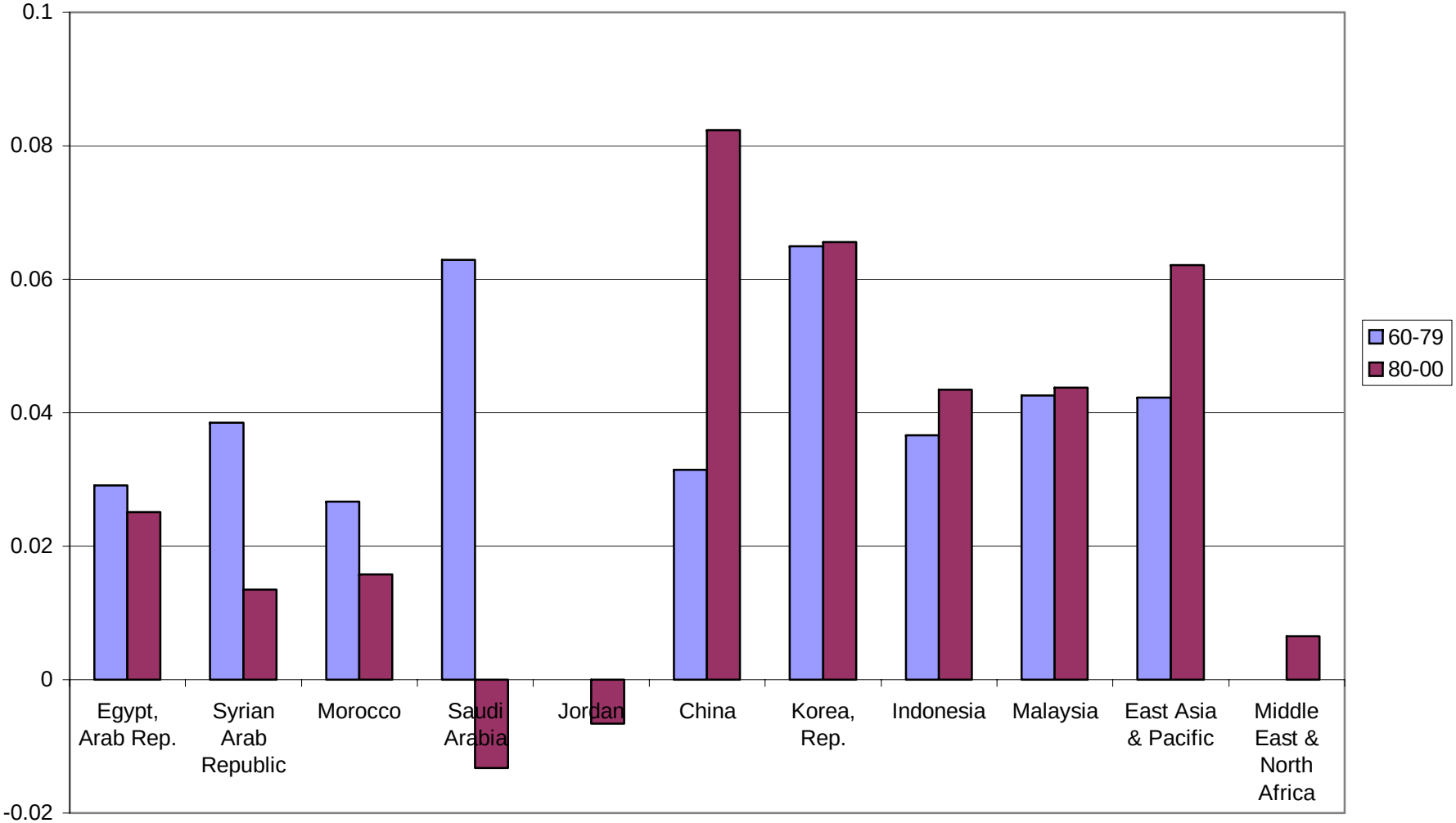
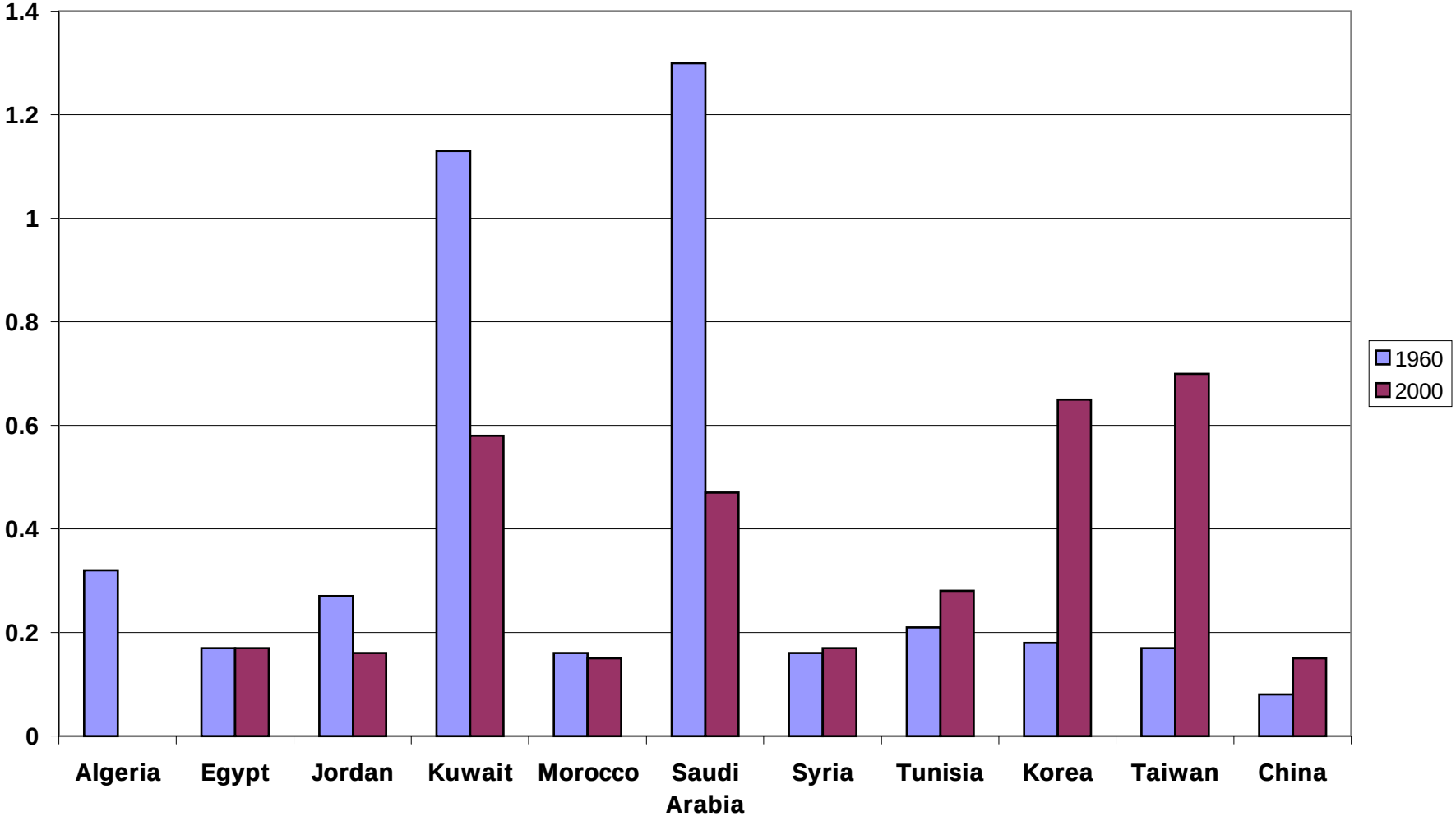


Figure 1a
Income per person relative to industrialized countries PPP



International Technology Transfer

- **Poor nations: new technology is imported through various channels**
- **Physical goods**
  - **intermediate manufactured inputs that incorporate new research;**
  - **new machinery with improvements in speed, internal quality control mechanisms, and greater energy efficiency.**

International Technology Transfer

Transfer of "disembodied knowledge"

Modes of transfer:

- **foreign direct investment;**
- **technology licensing agreements;**
- **employment of external consultants;**
- **knowledge not paid for; reverse engineering**

International Technology Transfer

- **The Asian countries**
  - **Japan, the 1950s:**
    - **technology licensing rather than FDI.**
  - **Korea, 1960s and 1970s**
    - **technology licensing, consultants, imported equipment and intermediates as sources of technical advance.**

Openness to Foreign Ideas and Influence

- **Overarching orientation in the Asian countries**
  - **Examples:**
  - **Late 19th century Japan: machinery from England**
  - **Lee Kuan Yew: FDI for Singapore in 1960s**
  - **Taiwan: advisers from U.S. universities and IMF**
  - **Classical musicians**
- **Contrast with Middle East:**
  - **absence of translations from other languages, students in West**

Education and technology

Two blades of a scissor

- **Technology inflow without local education base:**
  - **low productivity.**
- **Education without technology inflow:**
  - **low payoff.**

Experience in MENA

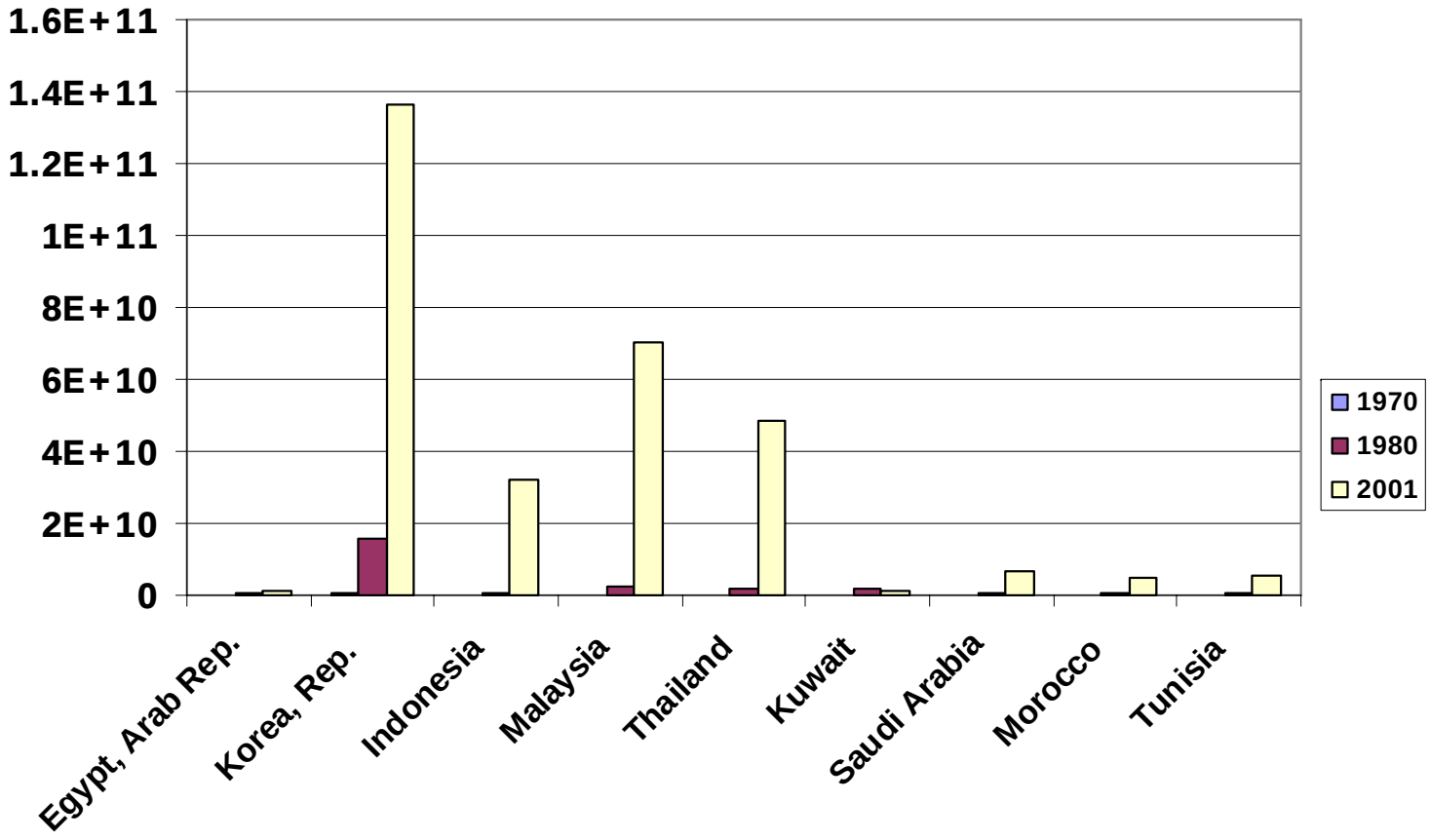
- **Resistance to involvement in international technology transfer**
- **insularity from world economy, except in energy exports.**

Trade issues

Exports of manufactured products from selected countries, 1980 and 2000. (Figure 2)

Middle Eastern nations barely participated in growth

Figure 2
Manufactured Exports, current dollars



Effects of increased mfg exports

- **Not only did the Asian nations increase their manufactured exports to an extraordinary degree, they increasingly shifted the structure to high technology goods: Table 1.**
- **Participation in manufacturing export markets:**
  - **shift to high technology exports**
  - **demands of competition:**
    - ***Need to ACCESS TECHNOLOGY FROM ABROAD*.**

Table 1
High Technology Exports
(billions of U.S. Dollars)

	1990	1995	1998	2001	2004
Egypt	..	6	2	12	15
Korea, Rep.	10.8	29.6	30.6	40.0	75.7
Indonesia	.11	1.7	2.2	4.4	5.8
Malaysia	6.0	25.4	31.6	40.9	52.9
Thailand	3.0	10.1	13.5	15.2	..
Kuwait	.01	.01	.01	.01	..
Saudi Arabia	..	.03	.05	.1	..
Tunisia	.05	.07	.1	.2	.4
Morocco	..	.01	.4	.4	.7

MENA

- **Economic policies did not encourage firms to enter into international trade:**
  - **the neglect of technology available from other countries.**

Embodied Knowledge

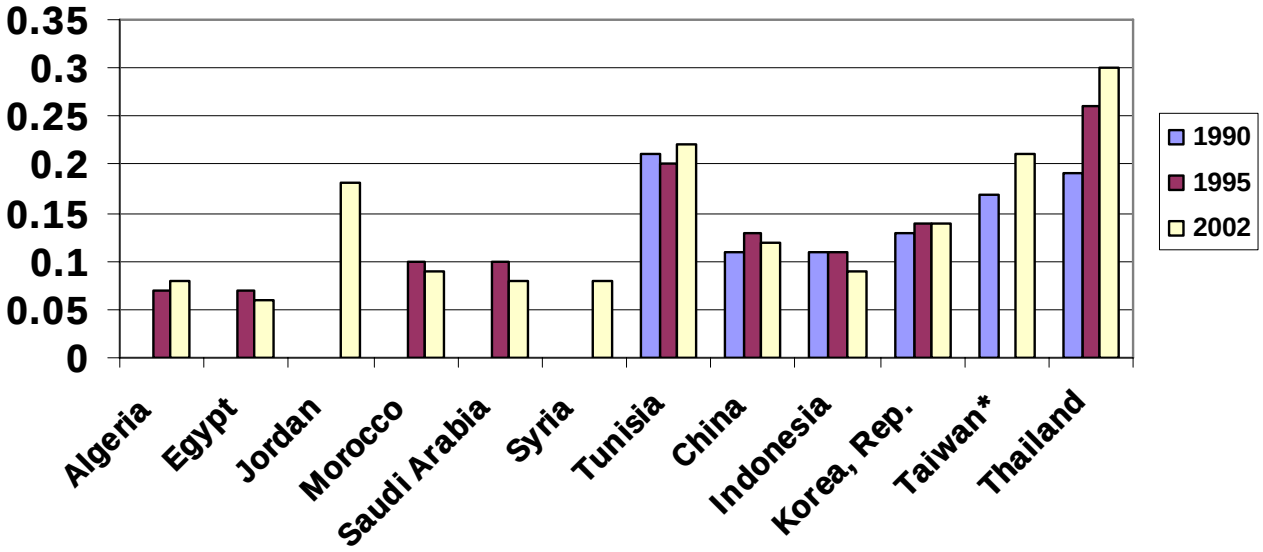
- Both intermediate goods and machinery
- Effects on productivity

Embodied Technology Imports – intermediate goods

Asian countries: ratios of intermediate imports, M_I/GDP, 50% more than in MENA (Figure 3)

Asian import pattern by 1970 exceeded that of the MENA nations in 2002

Figure 3
Imports of intermediates/GDP



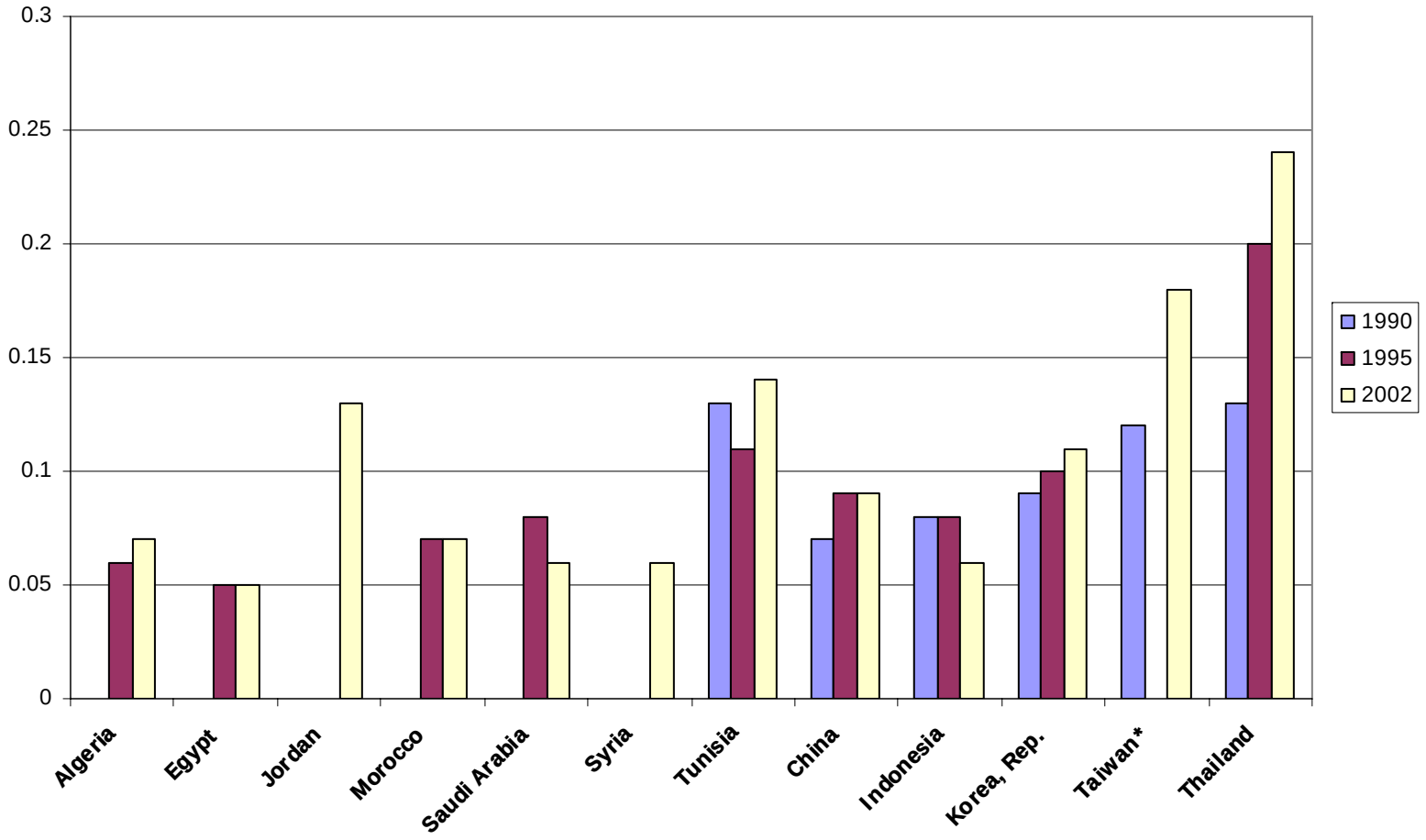
Equipment

equipment imports relative to GDP (M_E/GDP)-- Figure 4

Levels of the MENA countries, as late as 2002, are lower than those in the high performing Asian economies in 1990.

Data for earlier years: Korea and Taiwan.

Figure 4
Imports of Equipment/GDP



Foreign Direct Investment

Multinational firms establish plants in developing economies or buy existing firms and revitalize them:

1. import new equipment

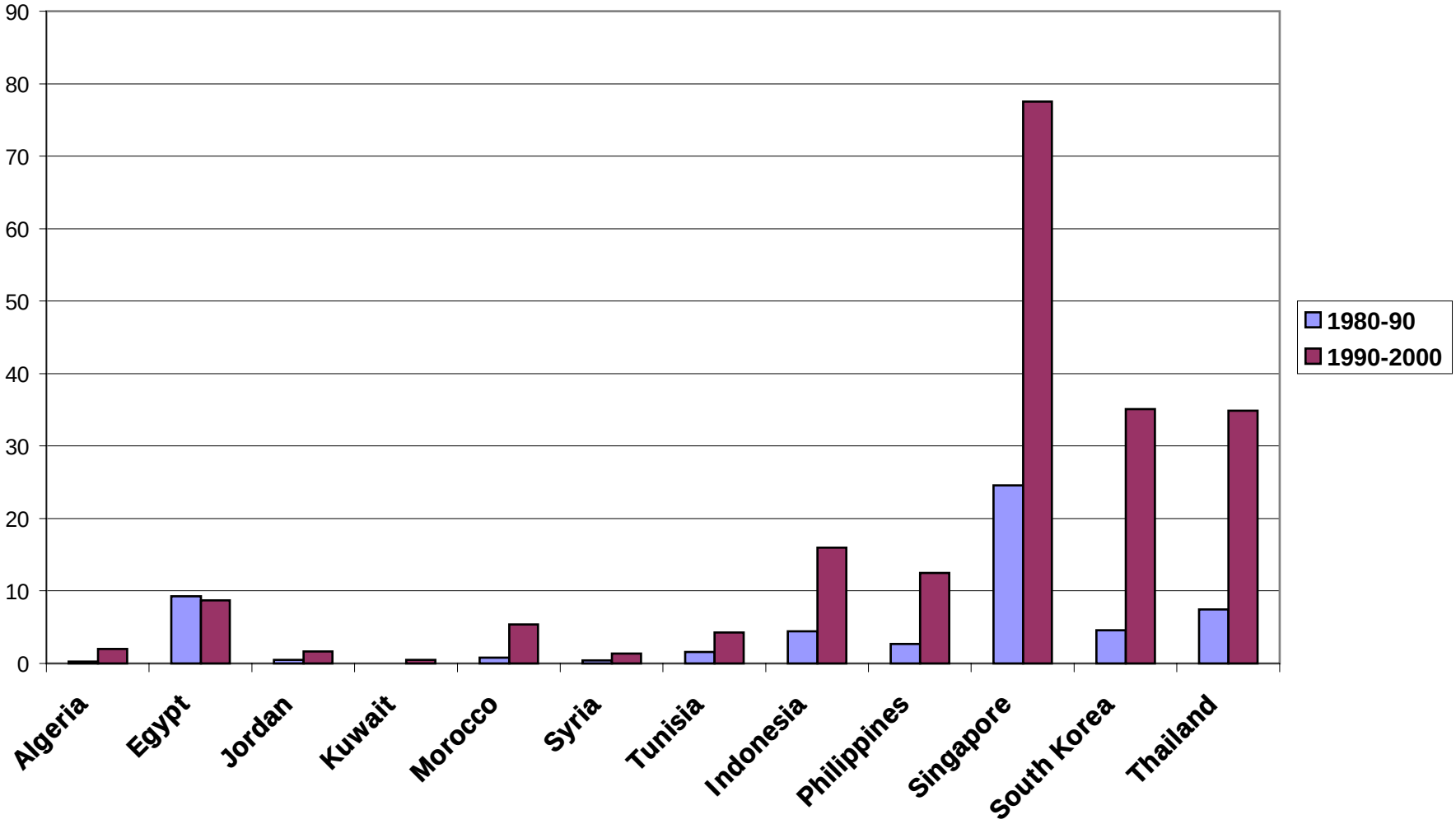
2. implement advanced managerial practices, and provide a marketing network

3. Provide training and experience that benefit local firms – example from Bangladesh

The Arab nations have, however, not availed themselves of this option in the manner of Singapore or China

Comparison with Thailand (Figure 5)

Figure 5
FDI in billions of dollars



Technology Licensing

Alternatives to FDI for acquiring foreign knowledge:

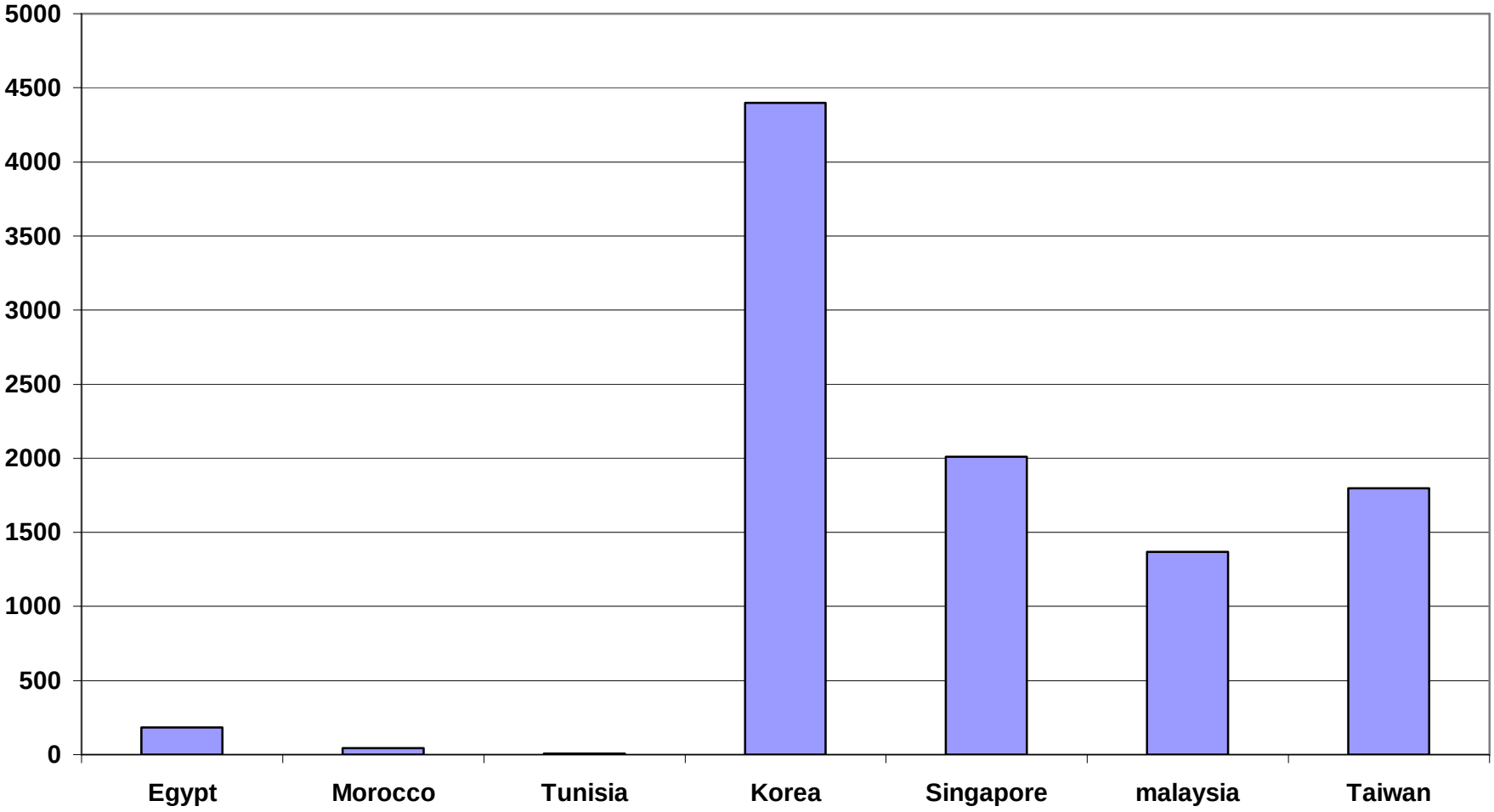
- **licensing of proprietary technology (Figure 6)**

Virtual non-existence of royalty payments in the Arab nations

Compare to Korea and Taiwan

Figure 6

Payments for Technology Licenses - millions of dollars - 2005



Other mechanisms of technology transfer

- ***Technology Transmission From Purchasers of Exports***
  - ***Radio Shack, Sears, K Mart, Walmart***
    - ***but these depend on previous exports***

- ***Returning Nationals***
  - ***Role in Taiwan, Korea, more recently India***

- ***Case studies of individual firms***

Educational requirements for domestic absorption of international technology transfers

- If technology is changing slowly, the payoff to education will be low:
  - A computer scientist pumping gas has a low return to education.
- Flexibility and problem solving abilities yield rewards when:
  - new embodied or disembodied technology is introduced
  - the structure of production shifs towards higher technology

Education and Growth

- **For the Middle East countries:**
  - **Increasing education without an increase in technology imports is unlikely to spur growth**

Managers and technicians must be cognizant of new technologies and have the ability to successfully implement the requisite routines for production

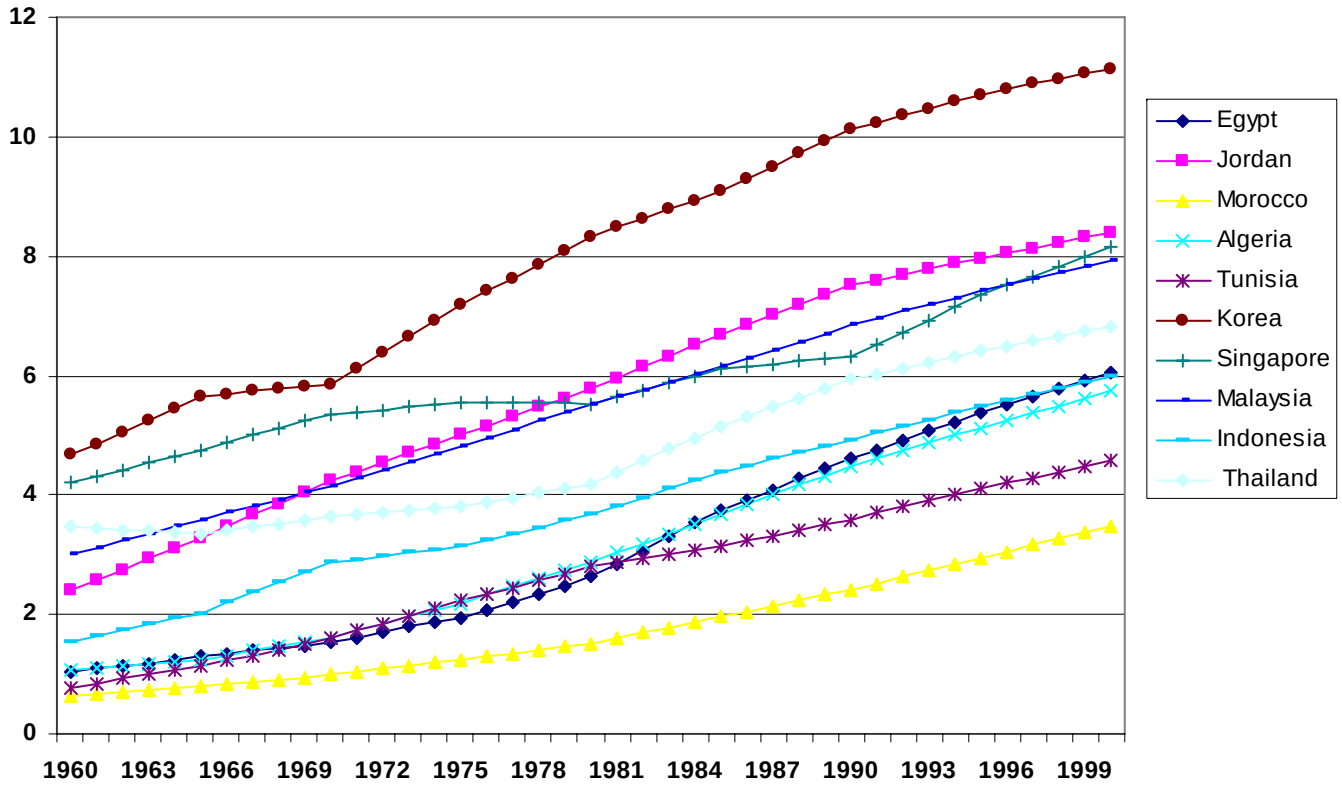
Educational Levels: the evidence

- Figure 7:
  - 1960 education levels in ME and Asia

Common image of super-education in the Asian nations is not confirmed by the data

Figure 7

Average years of education of population 15 and older



Quality of Education

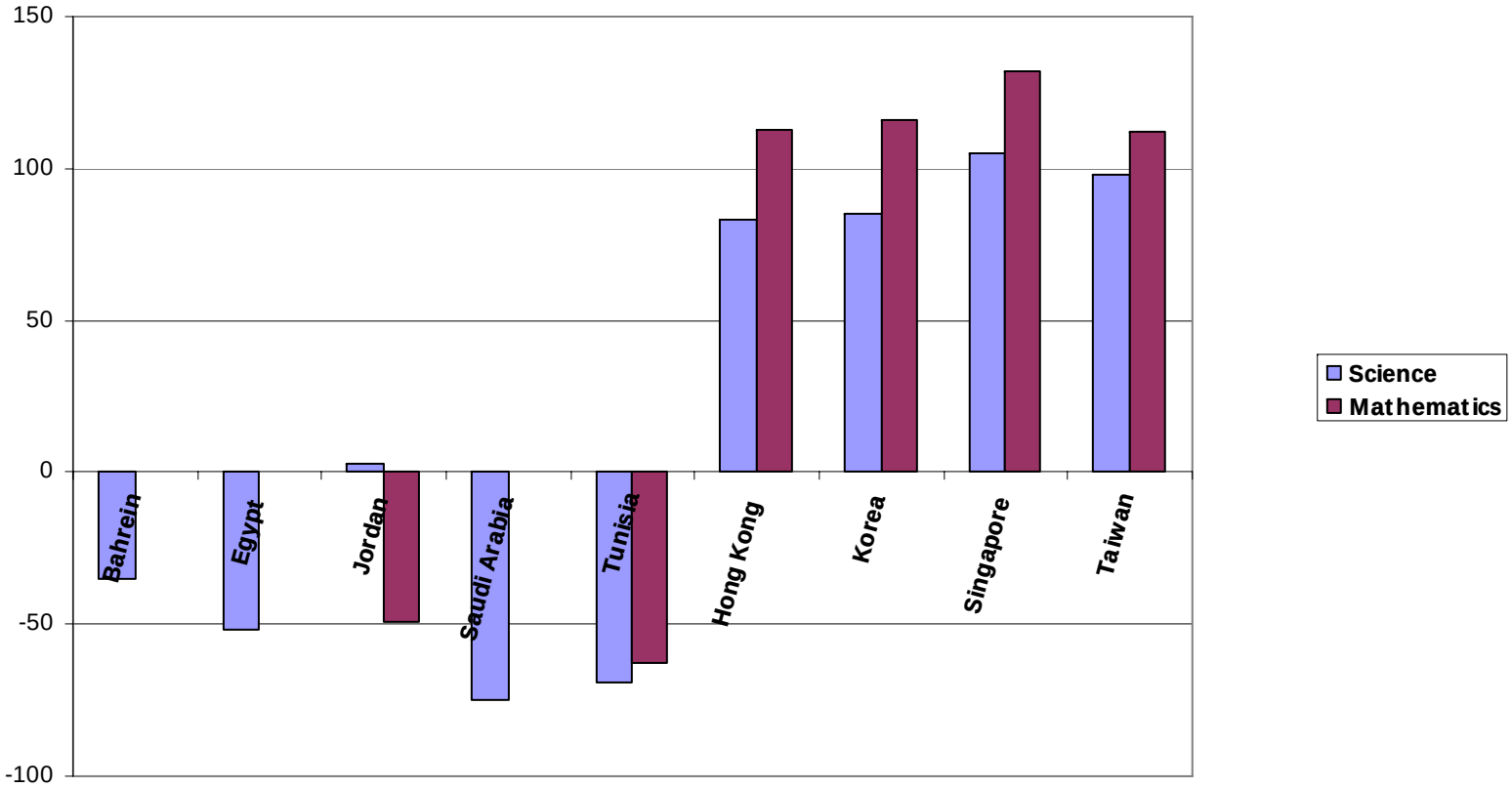
Figure 8: The countries of the Middle East are below average on the international scores

Asian countries are well above average.

Years of education is a misleading indicator

Figure 8

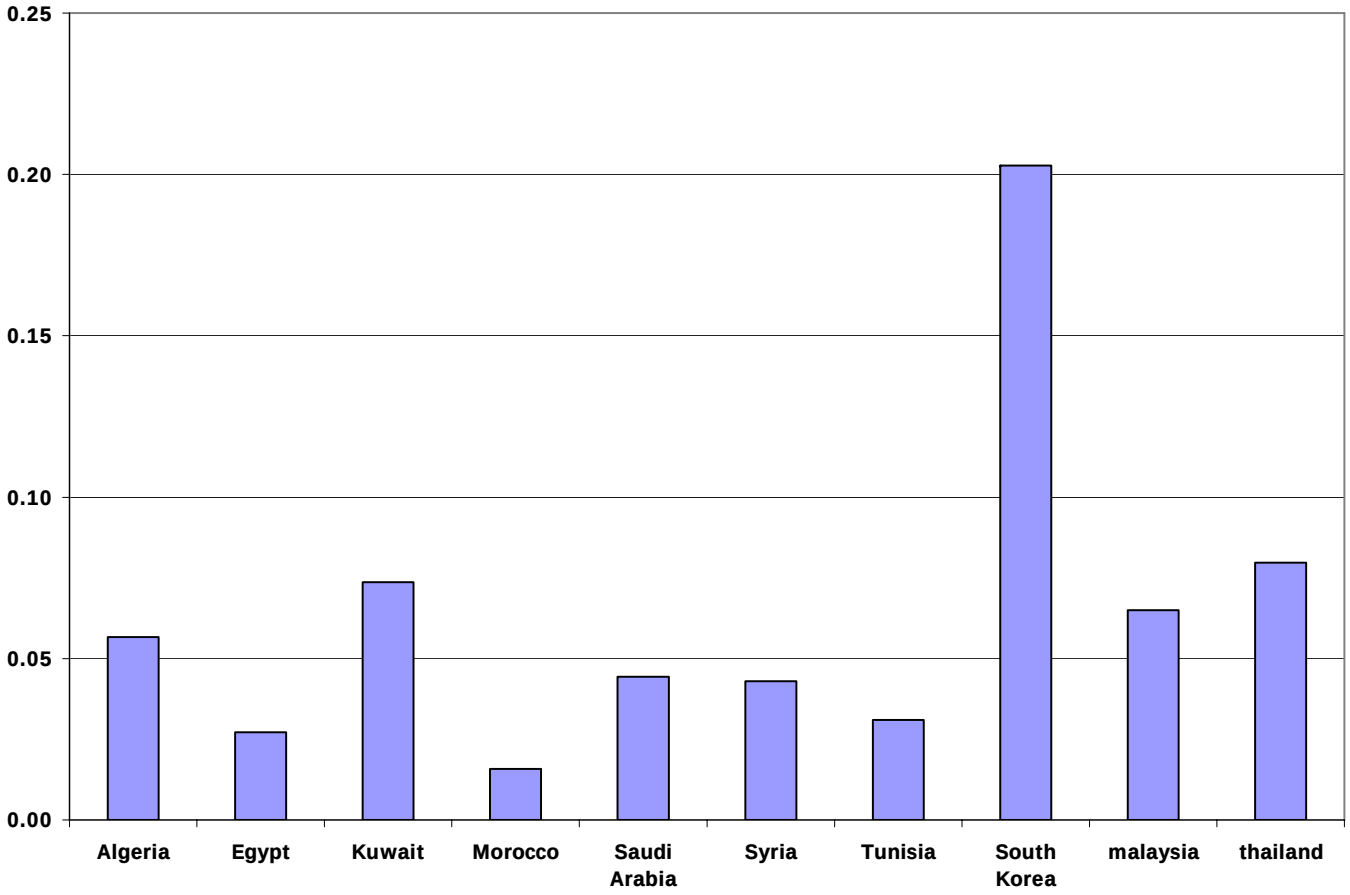
8th Grade Science and Mathematics Scores
Deviation from Mean - 2003



Science and Engineering Education

- Critical to be able to identify and absorb foreign technology
- Student enrollment in science and engineering (Figure 9)
  - More than 20% of university age students in Korea were receiving tertiary education in engineering and science
    - BUT: **proportion was less than 5 percent in most of the Arab countries.**

Figure 9
Percentage of University Age Students Studying Engineering and Science in Universities



Research and Development

Domestic knowledge generation:

- partly substitute for foreign technology.

R & D dependent on education base and physical investment

R&D and Patents (Tables 2,3)

MENA countries barely register on either measure

Research and Development

Table 2

Research and Development Expenditures as Percentage of Gross Domestic Product

Country	2004-05	1991	1986	1981
Egypt	.2			
Morocco	.6			
Tunisia	.6			
Korea	2.6	2.6		
Taiwan		1.7	1.0	1.0
Malaysia	.4			
Thailand	.2			
Singapore	2.3			

Table 3

Patenting Indicators

Country	Average 2001-05	Average 2001-05	2004-05
	Patents Granted – U.S.P.T.O.	Patents per million population	Local Patents
Egypt	5.6	.08	464[1]
Morocco	.8	.03	
Syria	.8	.04	
Tunisia	.6	.06	
Korea	4233	88	74,000[1]
Taiwan	6630	293	2897[2] 5800[3] 13,555[4]
Malaysia	74	303	
Singapore	409	97	

Sources: World Bank, KAS, data tables, Taiwan Statistical Data Yearbook, Various Years, Council for Economic Planning.

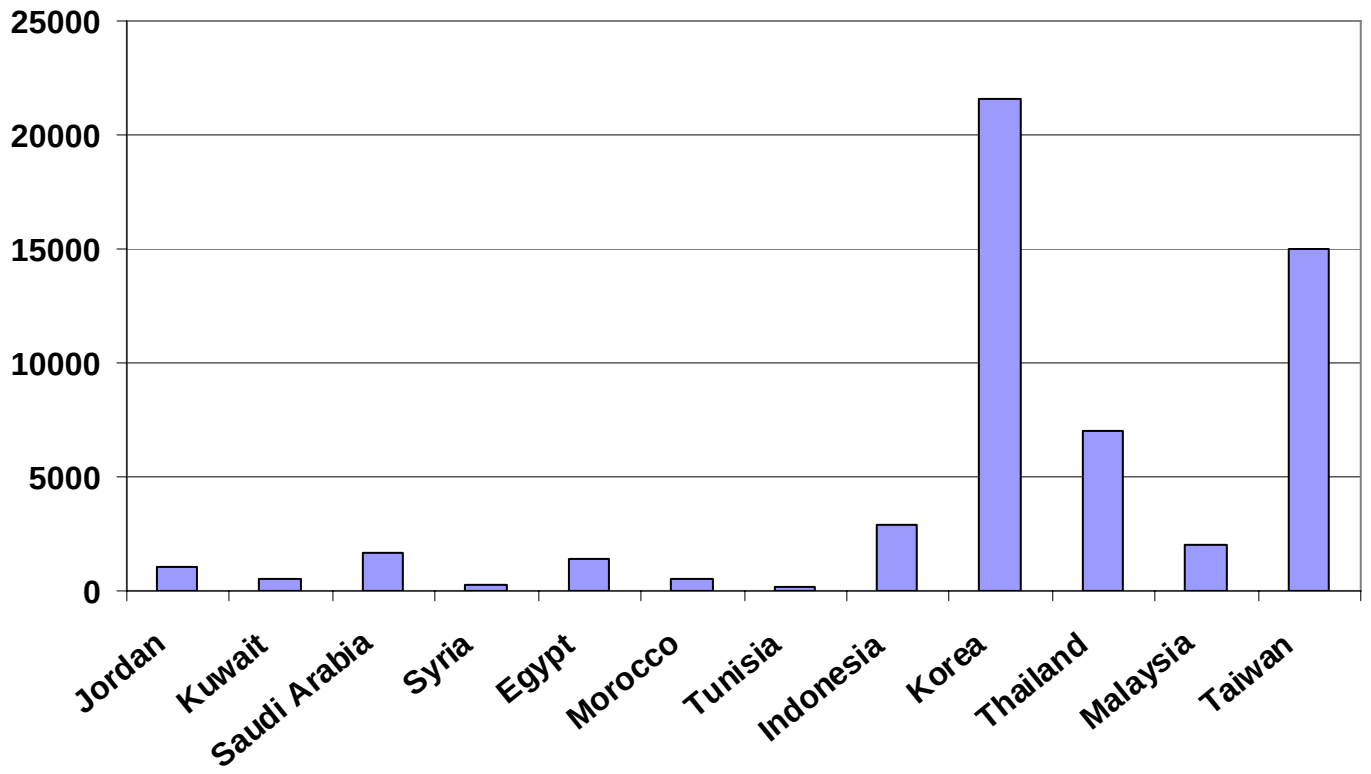
Notes: [1]2001 [2]1981 [3]1986 [4]1991

Other Modes of Int'l Technology Transfer

- **Reverse brain drain:**
  - **India and Taiwan compared to MENA**

- **Graduate student enrollments in 2000 in American universities (Figure 10)**
  - ***Total student enrollment in American universities in 2000 for all of the MENA nations is roughly equal to that of Thailand alone, which has a population roughly equal to Egypt***

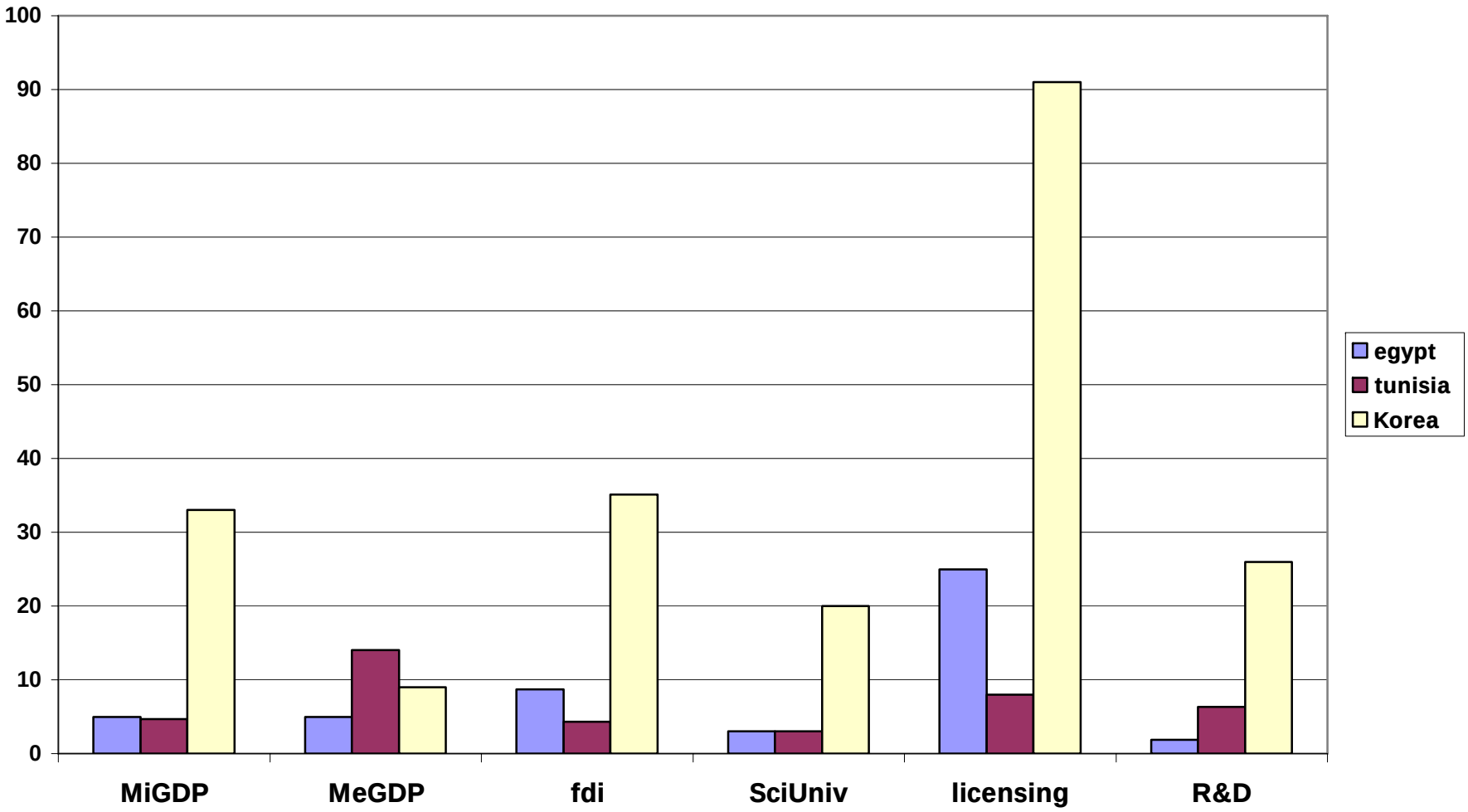
Figure 10
Graduate Students Enrolled in American Universities, 2000



Summary measures

- **On any one or two measures, some of the MENA countries will look almost as good as some Asian counterparts**
  - **But, *overwhelming absence of international interaction***

Figure 11
Potential Contributors to Growth
Recent years



Why so little technology transfer to MENA?

- **Islam not an explanation – Malaysia**
- **Predictable outcome for countries that don't export**
  - **Why so little exporting?**
    - **Relative hostility to globalization.**
- *Necessary reforms such as export orientation and reduced protection of domestic industry are politically challenging.*

Why so little technology transfer?

- Fear that unemployment spurs fundamentalism
- Uncertain political succession increases risk
- **Political Risk: enduring authoritarianism and difficulty in making credible commitments**
  - **Even local investment in technology is risky as the payoffs occur over a long period and risk of instability in the future.**
- **Perception in international business community of risks from terrorism and instability**
  - **limited FDI.**

Conclusions

- Asian success at technology transfer: mind set and economic policy.
- Mind set: openness to ideas and foreign technology
  - Seen as opportunity rather than a threat.
- *But technology transfer also necessitated by Asian emphasis on globalization*.

Conclusions

- Middle East hampered by a negative societal view of foreign ideas
- Lack of technology transfer:
  - the choice to emphasize local markets rather than globalize.
  - Unusual political risk
- *But there is room for optimism:*
  - recent developments in the Gulf : model as Japan was for Asia ...
    - but prospects still up in the air...