Entrepreneurship in Asian High Tech Industries

Stanford University
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Edison Liu, M.D.

Who am I?

- **Physician: Oncologist**
- **Academic: Professor Medicine, Biochemistry, Genetics, Epidemiology**
- **Government: Scientific Director, NCI and Genome Institute of Singapore**
- **Businessman**

This talk will be centered on biomedicine and on the role of government in its development

What we will discuss

The US is the most successful model for The biomedical industry

Why was it successful

Why this strength will be distributed in the future

Why Asia will be one of the major centers

Biomedical Industry:
What are the elements of success?

England had a more advanced academic biomedical research base in the 1950's and 1960's, yet all major biotechnology developments occurred in the US:
Why?

Important Components for the Development of the US Biotech Sector

- ✓ **Strong and persistent government funding;** *policies that foster distributed excellence, organizational experimentation*
- **Availability of a venture capital**
- ✓ **Intelligent, educated, changing, entrepreneurial workforce**
  - *Open immigration*

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Establishment of the NIH as a funding agency

- 27 Billion per year (NIH)
- 52% of total US R&D expenditures (2001) is from the US government
- Operational premise: decentralized and enabling

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Government Contributions to the Development of the US Biotech Sector

- **Concept of "overhead"**

  25-75% of cost of a grant can be further charged as "overhead" to the government.

  Permits local units (universities, institutes) to develop independently

  Encourages local research culture

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Government Contributions to the Development of the US Biotech Sector

- **Peer review, and extramural funding**

  Peer review (vs. directorate) encourages a distributed culture of excellence;

  Reduces cronyism, increases transparency

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Government Contributions to the Development of the US Biotech Sector

- **Bayh-Dole act**

  Institutions receiving US research grants may own the IP generated from this research

Net effect: local ownership generates entrepreneurs, and local expertise in commercialization

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Government Contributions to the Development of the US Biotech Sector

- **Institution based IPR: the right grain-size**

  Universities own IPR, not academics.

  Royalties are split

  Universities therefore have a vested interest in exploiting IPR

  Academics cannot fund or manage IPR in this complex sector

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Government Contributions to the Development of the US Biotech Sector

- **SBIR Grants**

  (Small Business Innovation Research)

  1% of NIH budget to fund small business development of biomedical discoveries.

  Peer reviewed

  Small low-hurdle concept fund, followed by larger development fund

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Important Components for the Development of the US Biotech Sector

- **Open immigration - Importance:**

No country can fuel a knowledge based industry by itself

Speed in thought comes only when new people with new ideas are quickly embraced; not waiting for a generation to pass.

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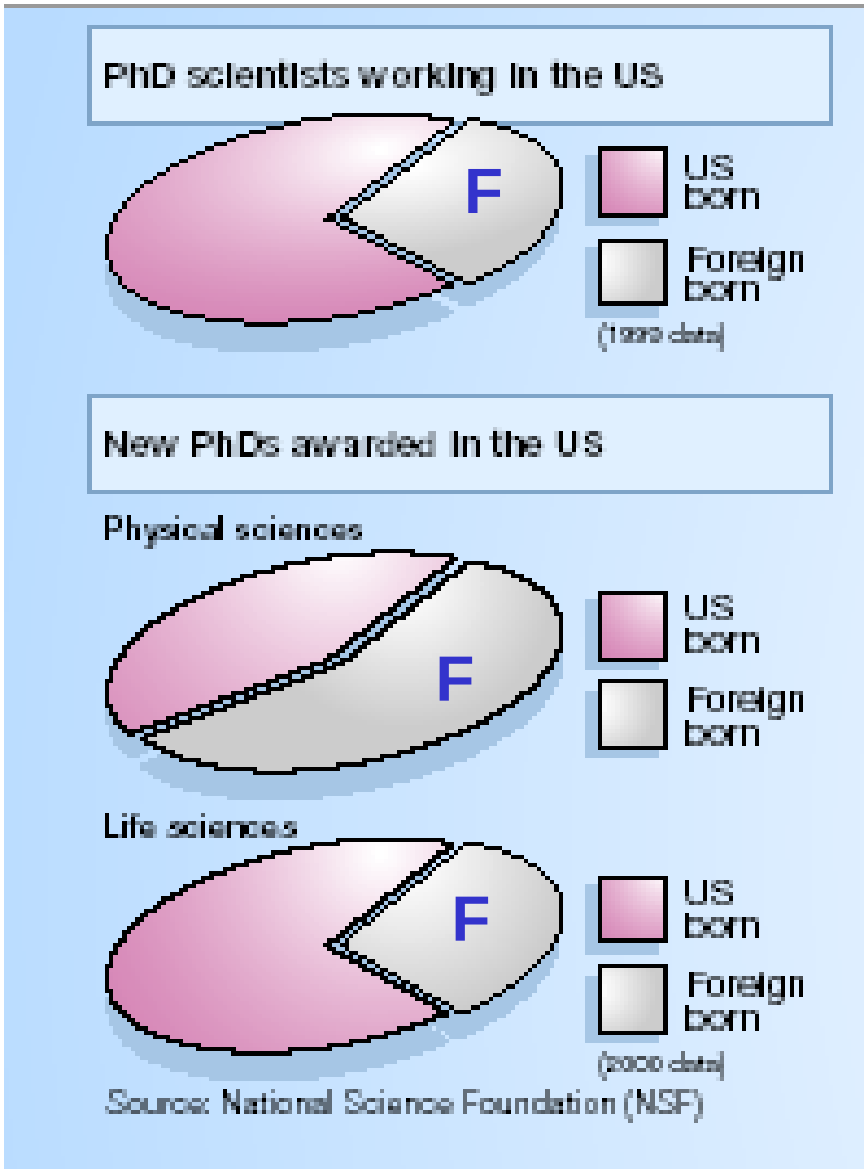
Immigration and the US Biotech Sector



34% of all working PhDs
60% of new PhDs in Physical Sciences
36% of PhDs in Life Sciences are foreign born

From: Nature 427:190 January 2004

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Government Contributions to the Development of the US Biotech Sector

- **Great public domain funding focused on translating science to public health: NIH**
- **Financial encouragement for research distributed at the University level: overhead**
- **Quality control and distributed sense of excellence**
- **Enhance local/distributed biotech expertise: IPR "give-aways" to local institutions**
- **Constant change: Constant movement of investigators - foreign and national**

Times are changing

Declaration

We are entering one of the most profound periods of human advancement. One predicated on the benefits of science

- **Genomics**
- **Informatics**
- **Molecular recombinant engineering**
- **Biological and engineering interface**

Fundamental Realities: 2005

- **Speed of discovery in biology and medicine is profound**

Biomarkers:
HER-2 and prognosis: one marker in 12 years (1989-2001)
Array prognostics: 100-400 markers in 1 year (2004)

Drug development
Target discovery and validation:
1985 – one molecule and a thousand compound
2005 – 40,000 cDNAs and 1 million compounds

Future Terrain:

Medical care: Essential medicine
Lifestyle medicine

Essential medicine
Developed countries: chronic illness, diseases of surfeit
Developing countries: infectious diseases

Global challenges:
Emerging infectious diseases
Burdens of chronic illnesses

What might be in the future:

Medical care: Essential medicine
Treating a serious illness
Regaining lost tissues

Curing cancer or making it a chronic illness
Fundamental prevention: diabetic control
Regeneration medicine: tissue reconstitution

Global challenges:
Targeted therapeutics
Tissue reengineering

What might be in the future:

Medical care: Lifestyle medicine

- How to grow old gracefully
  - Hormone supplements
- Performance enhancement
  - Viagra
  - Cosmetic surgery
  - Memory and mood enhancers

Global challenges:

- Understanding physiologic complexity
- Reducing risk

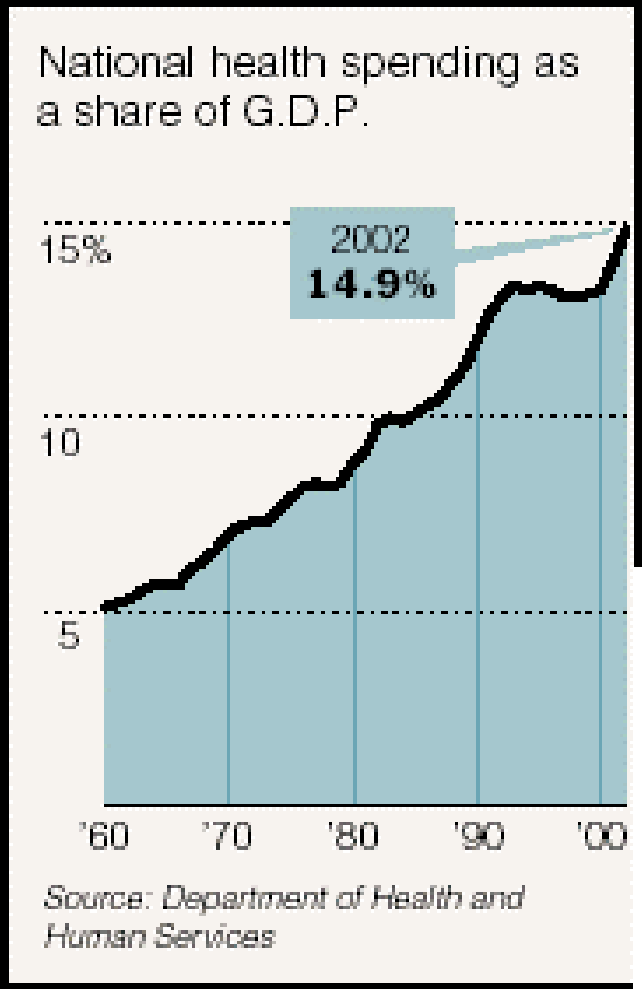
Times are changing: Why the US will not be the only center for the biomedical industry

- Living outside the US is acceptable and even desirable
- Intellectual capital is shifting to other countries
- Global governments are more efficient and effective than ever before
- Cost reduction will become a major factor

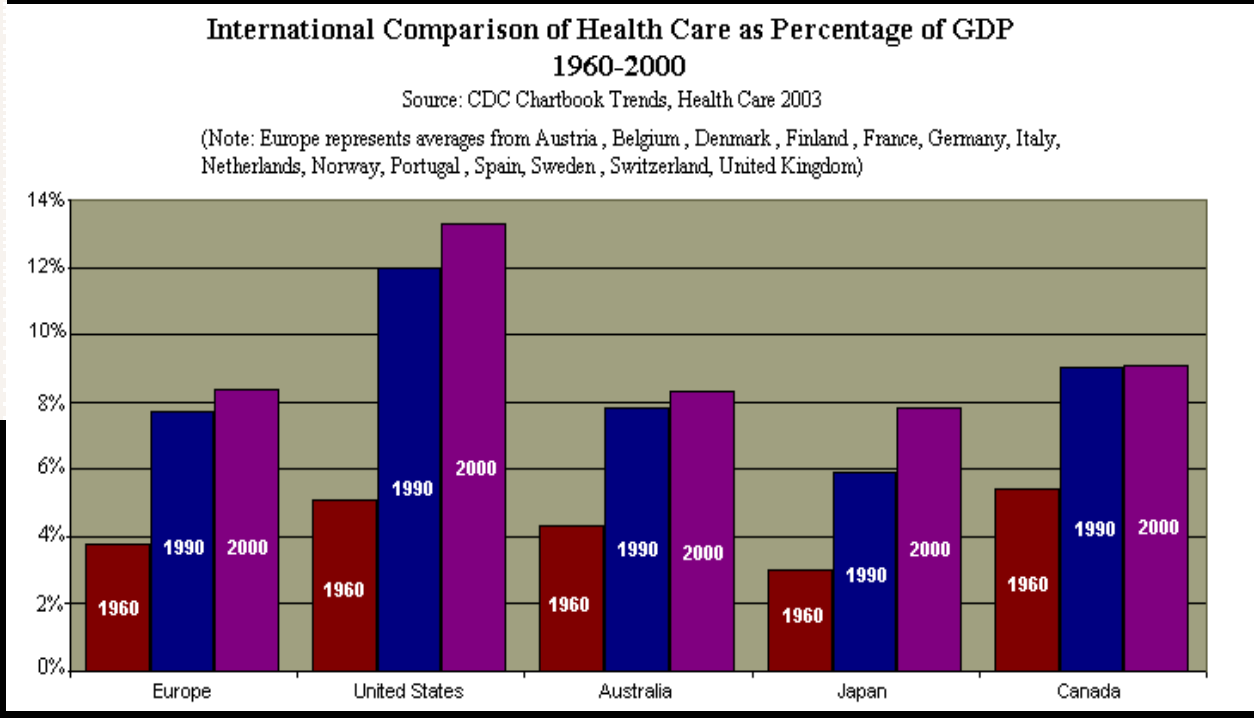
What might be in the future:

Drugs:

Faster to the market, Cheaper, Safer



Growth in health care spending is 2.2% Faster than GDP growth. Estimated by 2012, health care will be 18% of GDP



Costs of Prescription Drugs

Medicines and Related Substances Control Amendment Act in 1997

South Africa

Parallel imports

What the Medicines Act says:

The Minister of Health can prescribe conditions for the supply of more affordable medicines in certain circumstances to protect the health of the public. The law also allows the Minister of Health to import the same medicines made by the same company or someone they had licensed if it is sold at a cheaper price in another country.

The Zantac Example

Glaxo sells Zantac (10 x 300mg) at a very low price in India and at a very high price in the USA or Indonesia.

Glaxo Wellcome prices in rupees (April 1998)

India	Indonesia	Britain	USA
Rs17.39	Rs658.36	Rs603.24	Rs1200.38

The current cost of health care is untenable

Prediction:

There will be significant pressure to reduce all aspects of health care cost, world-wide

What might be in the future:

Drugs: Faster to the market, Cheaper, Safer

- Generics
- New Formulations
- Alternate indications
- Too many targets and combinations
- Faster and cheaper cycle to market
- Distributing research and production to the lowest cost regions

What might be in the future:

Medical information will transform medicine:

- **Medical informatics**
- **Biomarkers**

Faster, Cheaper, **Safer**

- **44,000-98,000 Americans die because of preventable medical errors (8th leading cause of death)**
- **Many can be prevented by better information technologies (est. prevention of 190,000 hospitalizations per year)**
- **Health care redundancy accounts for 25-40% of global health care budget.**
- **US 1/3 of $1.6 trillion health care spending in 2003 go to inappropriate or duplicate procedures**

Economist April 30, 2005

What might be in the future:

Medical information will transform medicine:

Medical informatics

Biomarkers

Consider: Personal medical data on a memory stick

Medical data escrow

Automated diagnosis

All patient data on a screen

What might be in the future:

FollowMe

Online medical records
24/7 availability for physicians
Subscription based

http://www.followme.com/

Declaration II

- **Paradox requirements of bandwidth and accessibility**
- **Privacy and confidentiality are the most important issue and needs resolution**
- **Solutions to these problems are available**

What might be in the future:

Biological challenges:

- BioEnergy
- Environmental remediation
- Harnessing genetic diversity

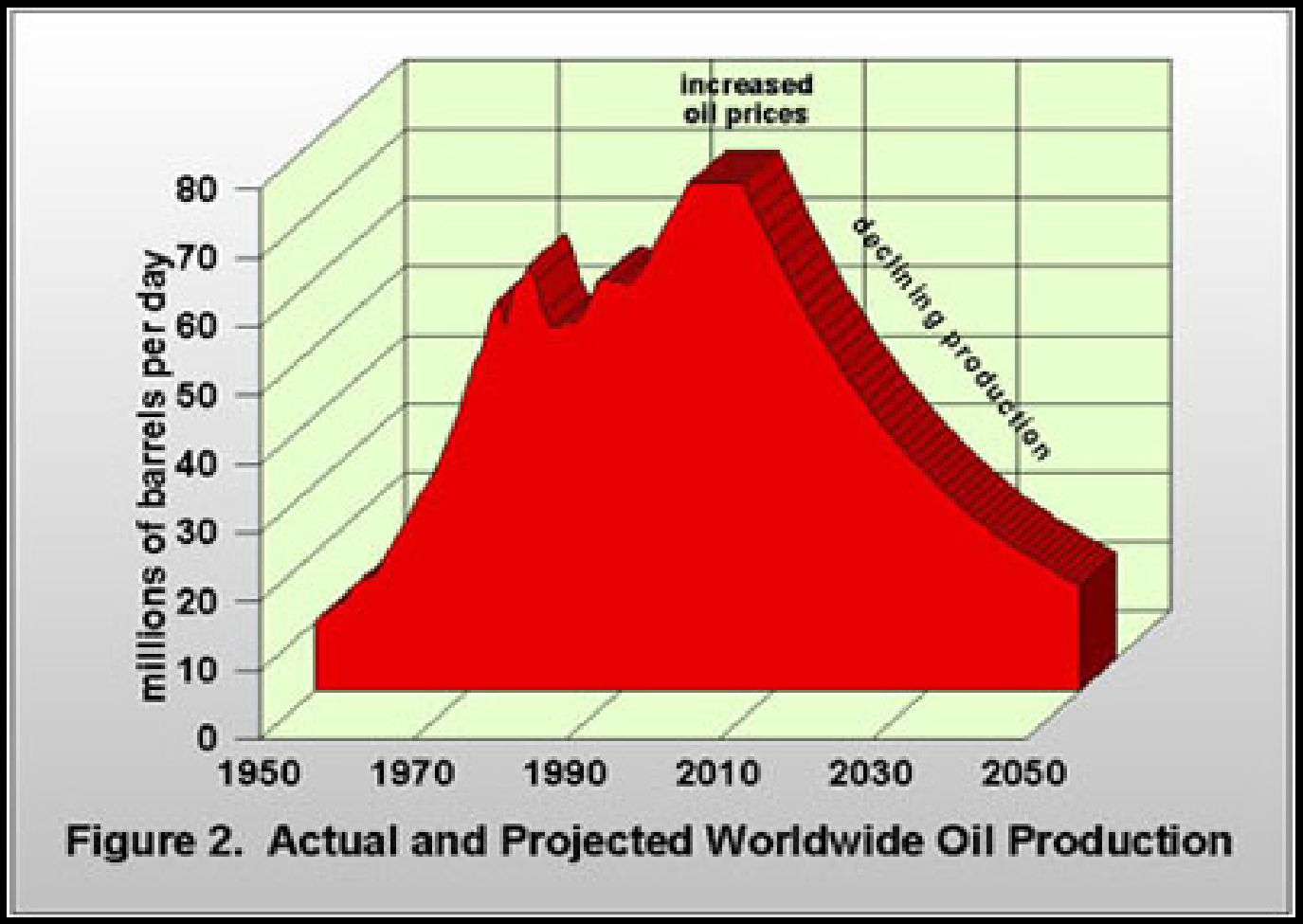


Figure 2. Actual and Projected Worldwide Oil Production

Shortage of portable energy (oil) will demand new sources of hydrocarbon energy

What might be in the future:

- **Hydrogen producing bacteria**
- **Ethanol production through recombinant enzymes**
- **BioDiesel**
- **Methane consuming bacteria**
- **Extremophiles**

In matters of food, energy, cost: Asian nations have a greater sense of urgency

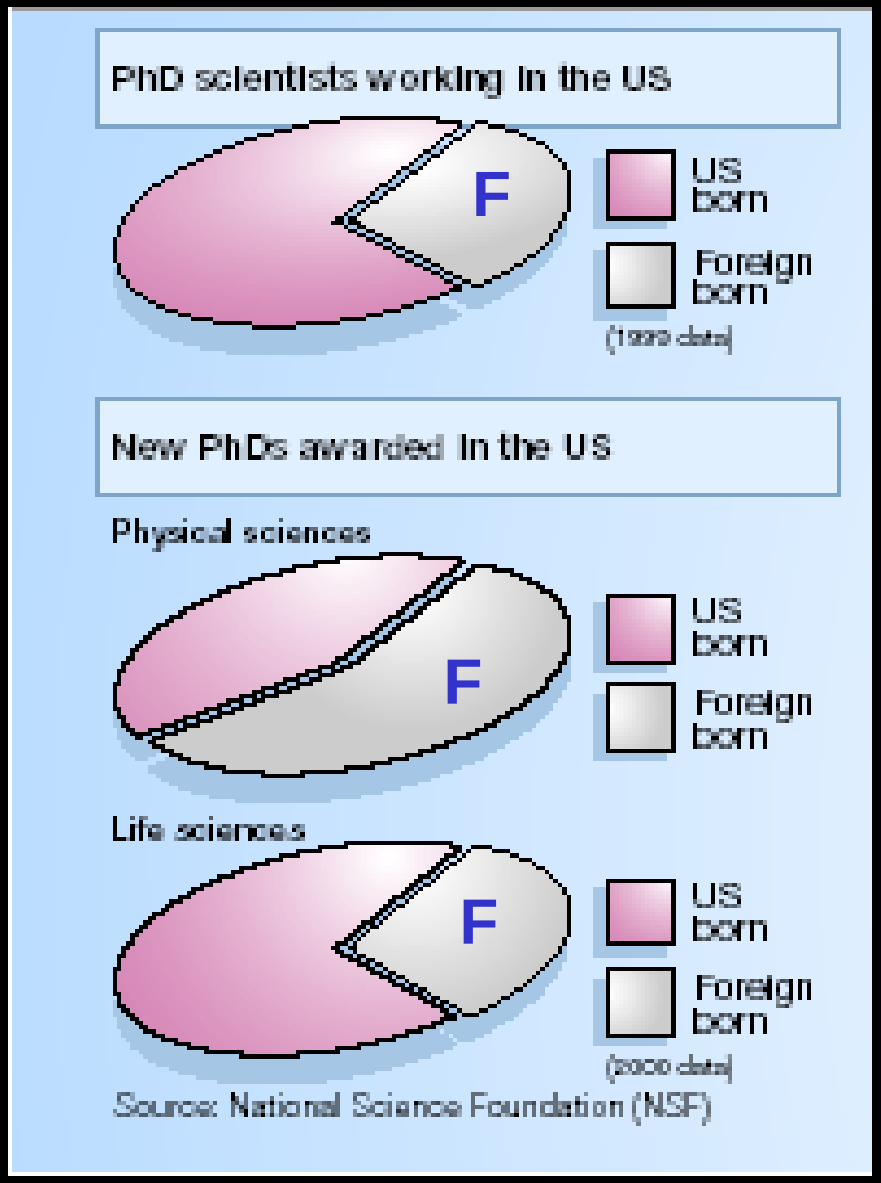
Shift towards Asia

Mindset
Human Resources
Capital
Role of Government

Mindset concerning biomedicine

- **Before 1900 (Europe): Biology as an academic exercise - privileged activity for gentleman scholars (or monks)**
- **1900-2000 (USA): Biology with clinical impact – biological research for public health (NIH model): social service cost center**
- **2001-future (Asia?): Biology with commercial impact – biology for public wealth: revenue generator**

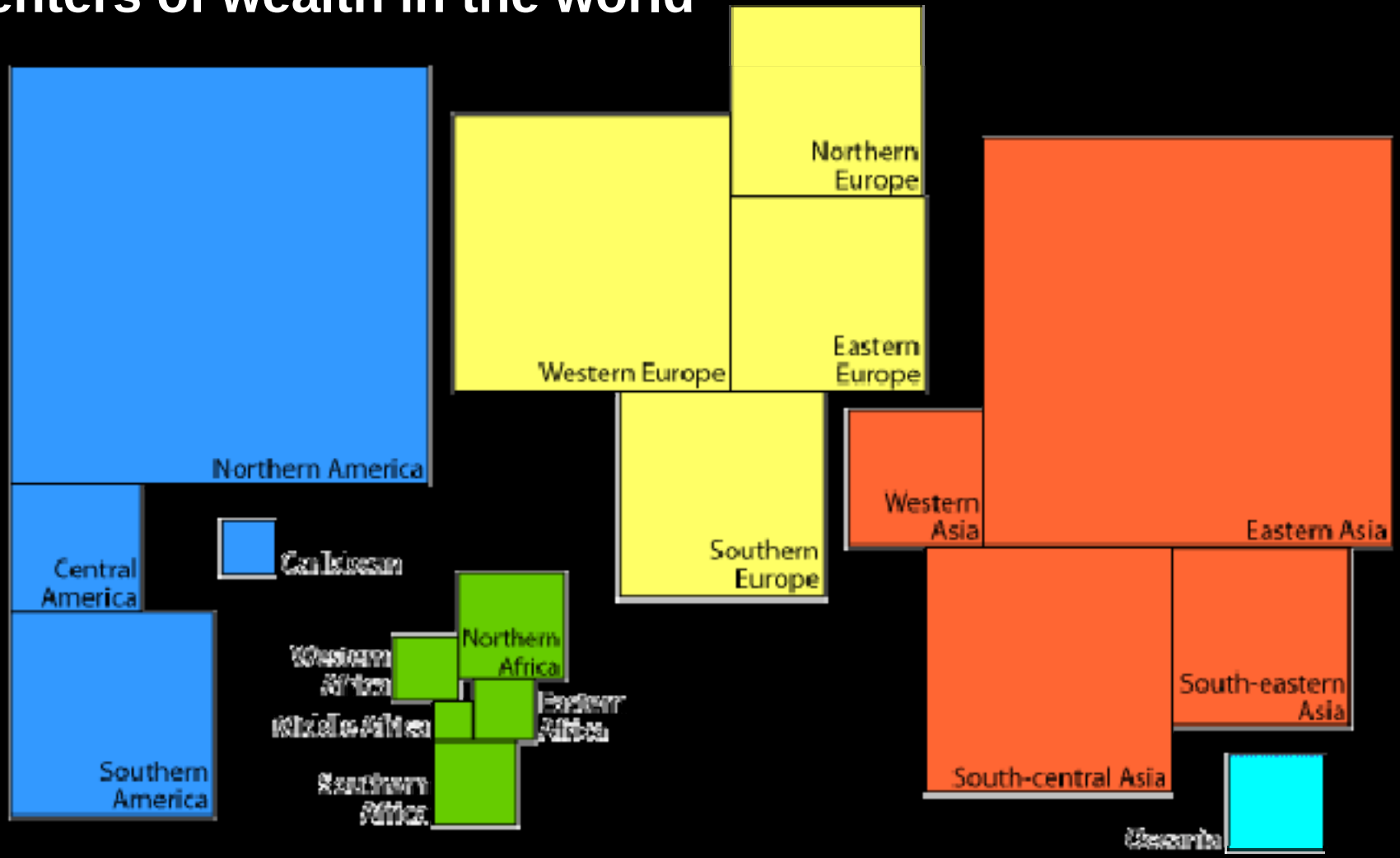
Human capital: returning home, staying home



OneWorld.net

Genome Institute of Singapore
A*STAR

Centers of wealth in the world



Proportion of the world GDP by region

What happens when Asian currencies are Revalued?

Lenovo of China Completes Purchase of I.B.M.'s PC Unit
By THE ASSOCIATED PRESS

Published: May 2, 2005

BEIJING, May 1 (AP) - The Chinese computer maker Lenovo said Sunday that it had completed its $1.75 billion purchase of IBM's personal computer division, creating the world's third-largest PC maker.

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Role of government: Biomedicine

- **The differing concept of conflict of interest and the role of government in direct investment**

Why governments are more important than ever:

Before	After
Observational	Creating
Single investigator	Complex teams
Reductionist	Data mining

Therefore key biomedical discoveries will come from well organized and coordinated national/international efforts.

Biomedical Sciences in Singapore

Vision:

Singapore as a Biomedical Sciences Hub with

world class capabilities across the whole value chain

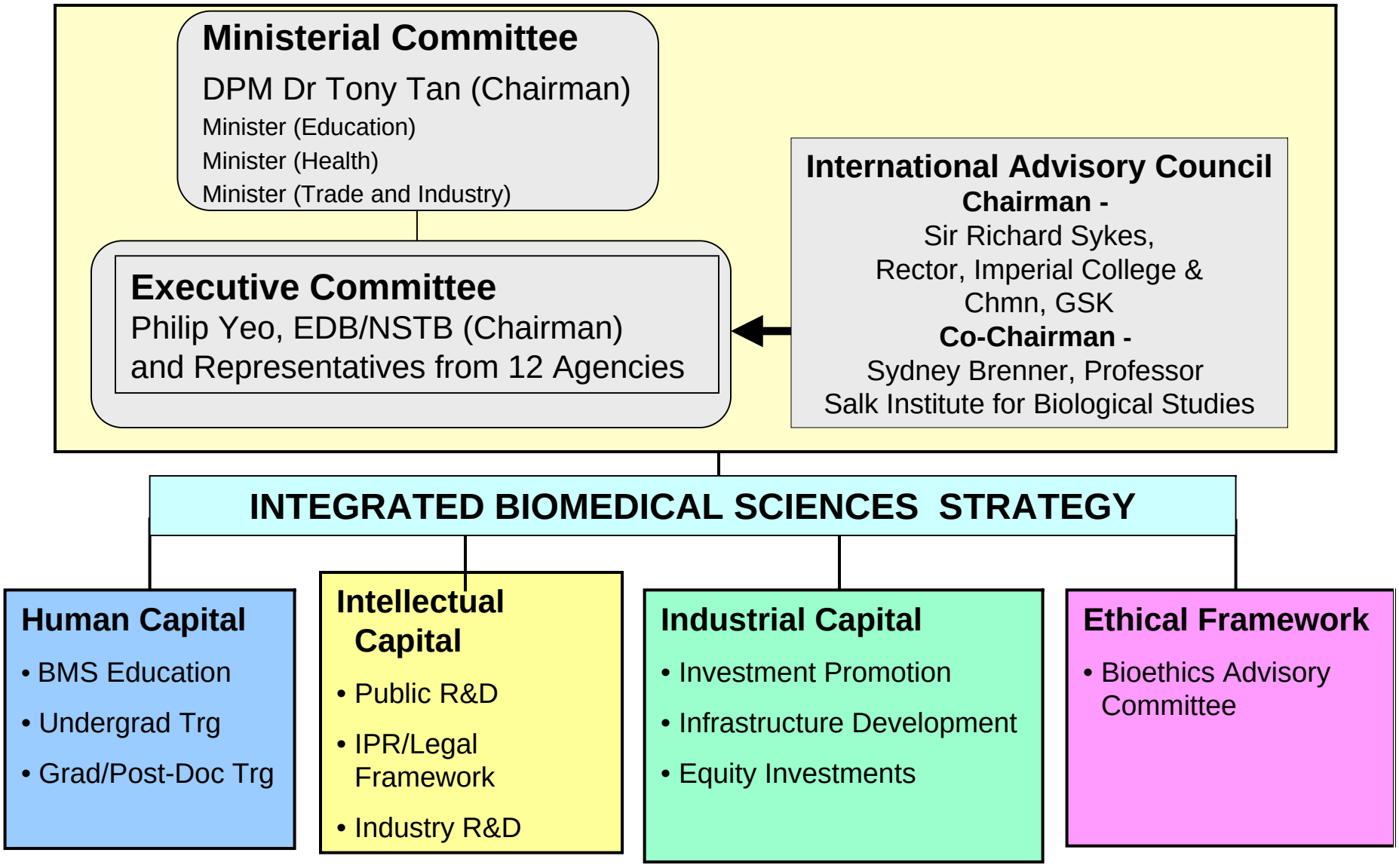



Public and Private Sectors Integration

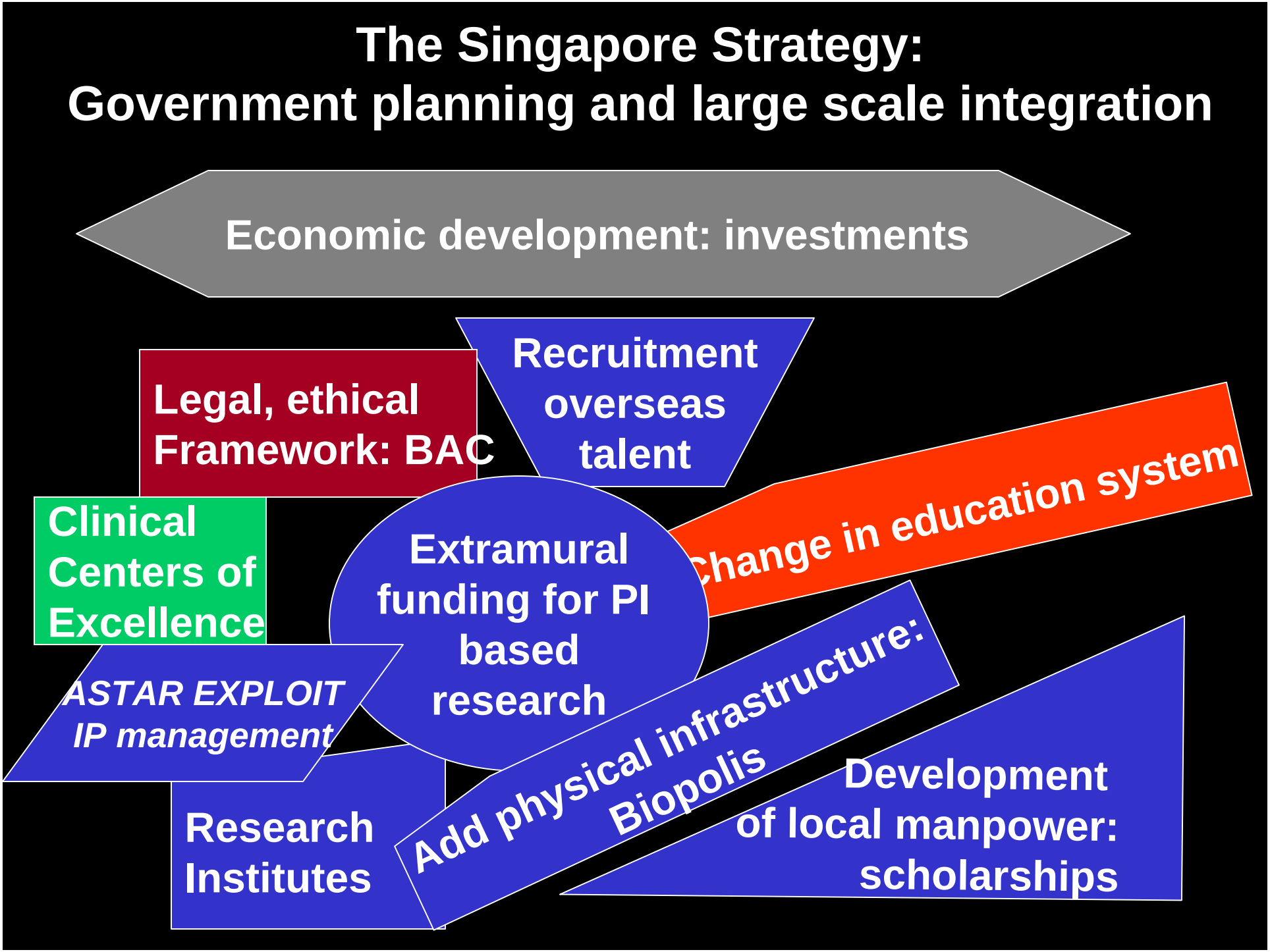
Fundamental Realities: 2003

- The state of the science is remarkable
- Disruptive changes in the industry are happening
- Speed, flexibility, and integration will be more important than size

Singapore Approach: High Level Integration



The Singapore Strategy: Government planning and large scale integration



Intellectual Property:

Europe – until recently patents were the personal responsibility of the professor
(IP as a personal-private function)

US – Bayh-Dole and institutional ownership and exploitation of university IP
(IP as an institutional function)

Asia – government ownership and direct IP from universities and research institutes
(IP as a national aspiration)

Differences in political philosophy: The role of government

- Airbus vs. Boeing
- Cotton subsidies in the US vs. the developing world
- Japan's MITI in post war reconstruction

Is there an unfair advantage or are the rules changing?

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liue@gis.a-star.edu.sg
+65-68478-8007