Developing Biotechnology in Turkey

Turkey faces the same challenges as many US states

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One-slide biotechnology overview

Why did biotechnology flourish in the U.S.
- What can be learned from this history?

Most regions in the USA are struggling to develop biotechnology
- Survey of best practices

International Biotechnology Development Examples
- Survey of best practices

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What do biotechnology companies do?

Use molecular biology to develop useful products and services

Three flavors of biotechnology:

**RED**

**Drugs, diagnostic tests**
Heavy infrastructure requirements: medical schools, hospitals, CROs, etc.
Products likely to be sold/licensed to big pharma / big biotech

**GREEN**

**Enhanced crops, molecular farming (non-drug)**
Development costs similar to drugs, profits are not
Products likely to be licensed through Monsanto / ADM

**WHITE**

**Industrial processes**
Energy production, waste degradation, environmental remediation
Skills and production capacities exist outside of established hubs
Reduced regulatory burden decreases development cost
Biotechnology for Turkey

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How did the U.S. attain leadership in Biotechnology?

Revenues (total: $63B)

- USA 76%
- Asia-Pacific 5%
- Canada 4%
- Europe 15%

Companies (total: 4,203)

- USA 34%
- Europe 38%
- Asia-Pacific 17%
- Canada 11%


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### Key Nobel Prizes Supporting Biotechnology

<table>
<thead>
<tr>
<th>Innovation</th>
<th>Scientist / Inventor</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein Sequencing</td>
<td>Frederick Sanger</td>
<td>UK</td>
</tr>
<tr>
<td>DNA Structure</td>
<td>James Watson, Francis Crick, Maurice Wilkins</td>
<td>USA, UK, UK</td>
</tr>
<tr>
<td>X-Ray Crystallography</td>
<td>Herbert Hauptman, Jerome Karle</td>
<td>USA, USA</td>
</tr>
<tr>
<td>Genetic Code</td>
<td>Robert Holley, Har Gobind Khorana, Marshall Nirenberg</td>
<td>USA, USA, USA</td>
</tr>
<tr>
<td>Restriction Enzymes</td>
<td>Werner Arber, Dan Nathans, Hamilton Smith</td>
<td>Switzerland, USA, USA</td>
</tr>
<tr>
<td>DNA Splicing</td>
<td>Stanley Cohen, Herbert Boyer</td>
<td>USA, USA</td>
</tr>
<tr>
<td>Polymerase Chain Reaction</td>
<td>Kary Mullis, Michael Smith</td>
<td>USA, Canada</td>
</tr>
</tbody>
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Strong research support

R&D Spending ($B)

Source: OECD 2003

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The Bayh Dole act essentially made technology transfer from federally funded labs possible, but it wasn’t enacted until 1980 – several years after the first biotechnology companies formed.

So, what motivated academic researchers to leave their labs and seek commercial applications of the work?
Pathways to commercialize R&D already defined

Venture capital industry grew in tandem with semiconductor industry in the 1950s and 1960s

- Popularized venture capital and demonstrated ability to deliver strong returns
- Demonstrated to researchers the potential to
  a) make money
  b) accomplish significant social and technological change through commercialization of their research
Strong patent protection motivated innovation

Cost of innovation is high, cost of imitation is low
- Patents protect innovation – the scope of patent protection defines the scope of innovation

India and China have not protected patents until recently
- Result is strong generic industries and lack of foreign investment or innovative industries

Limitations on patent scope impede innovation
- High up-front capital costs make protection vital (versus IT where speed to market is a primary factor)
- No incentive to invest time and money
- No ability to recoup R&D investments – follow-ons will have lower R&D costs, and will be able to profitably offer lower prices
Strong exit opportunities

- The U.S. is the world’s largest pharmaceutical market
- Lack of drug price controls in U.S. assured innovators of the ability to recoup R&D investments
- Liquidity provided by supportive stock markets encouraged investors
Although initially reluctant to deal with biotechnology companies, pharmaceutical companies increasingly formed partnerships in the 1980s to fill their pipelines and leverage their extensive sales forces.

These partnerships granted large pharmaceutical companies rapid access to cutting edge technologies.

Pharmaceutical companies had infrastructure and expertise for all post-research activities (clinical trials, manufacturing, distribution, sales, etc.)

How big was the US pharmaceutical industry?

**The US accounted for 113 of the 265 major globally prescribed drugs invented between 1970 and 1992**

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Most regions in the USA are struggling to develop biotechnology

Action is focused in Northeast and Southwest
- California’s economy is larger than most countries
- California and Boston are home to some of the best schools in the world

*Beyond Harvard and Stanford, most schools are *ineffective* at commercializing their technologies*

Central and southern USA suffer from:
- Brain drain
- Lack of R&D and venture funding
- Lack of management expertise
Despite national success, many states are struggling to develop their biotechnology industries.

Number of biotechnology companies: top 12 states

Source: Ernst & Young
Turkey needs to focus on discrete niches

Need to assess strengths and coordinate efforts around a discrete set of high-value opportunities
Why locate in Hawaii?

- **U.S. ‘Pacific outpost’**
  - Monitor / study emerging epidemics
  - Research unique marine, agricultural resources
  - Clinical trials
- **Proximal access point to access American market**
  - Health Tourism
  - Clinical trials
  - Research

Leveraging local opportunities

- **Asia-Pacific Institute of Tropical Medicine and Infectious Diseases**
  - Virtual institute performing basic laboratory, field epidemiologic, clinical and biobehavioral research
- **Pacific Research Center for Marine Biomedicine**
  - Research on harmful algal blooms, water- and vector-borne diseases, and marine-derived pharmaceuticals
West Montana has tourism, Central Montana has farming
East Montana has neither

- One university
  - MSU-Northern has the ONLY four-year diesel program in the country – 10 jobs for each graduate
- Can’t compete with other states on popular crops
  - Uniquely positioned to grow camelina – may be critical for clean coal technologies
- >95% of railroads owned by one company
  - Can’t afford to transport low-cost commodities
- No venture capital
Three unique opportunities

• **Bio-based Fuels and Lubricants**
  • Continue work on bio-based lubricants – higher value than fuels, can offset transportation costs
  • Position engine-testing suite at MSU-Northern as NREL high-altitude, cold-weather testbed to vet quality of lubricants and fuels

• **Alternative Uses for Co-products**
  • Federal funding to develop clean-burning coal technologies – camelina meal to upgrade coal BTUs and sequester mercury
  • Fatten livestock in MT, sell high omega-3 meat, eggs

• **Forest, Straw, other Farm Waste**
  • Expand fuel for schools to use pyrolysis or other advanced technologies
  • Turn forest management into a profit center by processing forest waste into value-added products
Look Locally For Partners / Resources

The First U.S. Virtual Discovery-Development-Distribution Regional Network
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France

Reduce cost of early-stage biotechnology development

Young Innovative Company status
Social security tax exemption on employment linked with R&D
  - Estimated savings of €10,000 per employee
  - Applies to companies < 8 yrs old investing > 15% on R&D
Full local business tax exemption for the first 8 years
Full income tax exemption for the first three profitable years and partial relief for two years thereafter
Typical biotechnology firm wage costs
Equity guarantees

SOFARIS Technology Development Fund (France)
- Equity investment guarantees of 50-70%
- Eligibility is restricted to venture capital firms with successful track records
- Decisions made by eligible VC firms

FGG Capital Guarantees program (Austria)
- Dual goals of promoting equity investments and developing national venture capital
- FGG guarantees are reviewed by an in-house team of experts
- The typical guarantee level is 50%

BTU Program (Germany)
- Provides financing and equity guarantees simultaneously
- Guarantees 50% of investments
- May or may not use in-house experts to review guarantees
European multi-national Clusters
Pre-existing Strengths

**Medicon Valley**

1993 report:
- Home to 60% of Scandinavian pharmaceutical companies
- Ranked third in Europe on the basis of number of medical publications by researchers in the region
- Medicon Valley Academy established in 1997

**BioValley**

- Houses operations of 40% of the world’s pharmaceutical industry
- Almost 400 biotechnology companies and more than 150 academic or public institutions. 15,000 scientists and 70,000 students
- One of the top three densest European bioregions
- BioValley concept originated in 1973, not acted upon until 1997
Funding Systems Provide Incentives

**INTERREG funding**
- Initiated by the European Commission in 1990
- Support regional, cross-border activities especially in the fields of **business, science**, culture and tourism
- Medicon Valley received INTERREG funding
- BioValley received €4.6M in two rounds of INTERREG funding

**Lesson:** Interreg funding provided incentives to tap existing strengths
- Find regional synergies and focus on *logical* incentives
"Why does Europe feature multinational biotech clusters whereas the U.S. has so few multi-state clusters?"
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Closing Thoughts

The US biotechnology industry emerged from a supportive infrastructure.

• Don’t blindly mimic current US regulatory and incentive schemes

Do:

• Look beyond drug development – find a niche
  • CA, MD, and NC have established competencies in drug development – like France/Italy/Switzerland in luxury goods
• Focus on building a strong supportive environment
  • Workforce
  • Patents
  • Commercial laws
  • Supportive infrastructure
What You Can Do

Identify local assets, strengths, gaps
- Build a comprehensive plan which people can rally behind
- Develop logical synergies, fill gaps

Develop an expatriate network
- Tap expatriates on their visits to family
- Help expatriates come home

Connect with ‘foreign’ assets that have local connections
- Help them expand their local involvement
  - Streamline due diligence for VCs / commercial partners
  - Help them find additional local opportunities

Provide forums and incentives for collaboration
- Collaboration, not transactions, fosters growth