



INNOVATION MARKETS and NETWORKS

George Neofotistos

Lambrakis Research Foundation
Physics Department, University of Crete
Economics Department, University of Athens



Main issues

- 1) Cooperation vs Competition: determinants of commercialization strategy
- 2) Valuation issues
(example: valuation of a biotech company)
- 3) “Economies of scale” in R&D with block-busters
- 4) Country-specific “risks”: drivers/inhibitors
- 5) Market size and quality



Cooperation or Competition?

Impact of start-up innovation on existing sources of market power:

- Biotechnology industry: cooperation is the norm (through licensing, strategic alliances, acquisition)
- Electronics industry: product market entry and competition with more established firms

[Reference: Joshua Gans, David Hsu and Scott Stern (2000): “*When Does Start-up Innovation Spur the Gale of Creative Destruction?*”, NBER paper]



Cooperation or creative destruction?

Determinants of commercialization strategy for start-up innovators:

- Strength of IPR
- Presence of intermediaries (reducing search and transaction costs associated with finding and contracting with incumbents)
- Importance and Effectiveness of complementary asset ownership ([sunk] costs of market entry)



Biotech: Science meets Commerce

Diverse cast of organizations:

- Universities
- Public research institutes
- Venture capital (VC) firms
- Large multinational pharma corporations
- Smaller dedicated biotech firms (DBFs)

Asymmetric distribution of tech, org, and financial resources

- Key factor in driving early collaborative arrangements in the industry

No single organization has been able to internally master and control all the competencies required to develop a new medicine



Valuation of a Biotech company

Peak annual revenue by category (in millions):

Breakthrough	\$1,323,920,000	(prob. 10%)
Above average	\$ 661,960,000	(prob. 10%)
Average	\$ 66,200,000	(prob. 60%)
Below average	\$ 7,440,000	(prob. 10%)
Dog	\$ 6,620,000	(prob. 10%)

Source: Myers and Howe (1997); US Congress, Office of Technology Assessment



Pretax costs, durations, and conditional probabilities of success for R&D stages

<i>R&D phase of success</i>	<i>Total cost</i>	<i>Years in stage</i>	<i>Conditional probability</i>
Discovery	\$ 2,200,000	1	0.60
Preclinical	\$13,800,000	3	0.90
Clinical			
Phase I	\$ 2,800,000	1	0.75
Phase II	\$ 6,400,000	2	0.50
Phase III	\$18,100,000	3	0.85
FDA filing	\$ 3,300,000	3	0.75
Post-approval	\$31,200,000	9	1.00



Valuation issues

Valuation of a biotech company:

- ENPV = \$775,000
- Real options

Issues (general)

- Boom and bust in equity prices (valuation of firms in the equity markets, overshooting expectations, swings in sentiment)
- Firm-specific firms (soft factors)
- Risk-reward profile of firms may change quickly and in an unpredictable way
- Need for capital that bears business risk



Economics returns of research: The Pareto law and its implications

Example from movie industry:

Quantitative analysis in terms of the Pareto or power law distribution:

$$P(W)dW \propto W^{-(1+\mu)} dW$$

where $P(W)dW$ is the probability for a movie to be viewed by W and dW movie-viewers (box-office).

The exponent μ represents the frequency of large numbers of viewers: the smaller the exponent μ , the more probable are large numbers of viewers relative to smaller ones.

The exponent is determined by least-square fit of the rank-ordering plot of the n th movie income W_n as a function of the rank n .



Country-specific risks: DISTANCE TO WORLD TECHNOLOGY FRONTIER

-accounts for differences in the organization of firms between technologically advanced and technologically lagging societies [Reference: ACEMOGLU, D., AGHION, P., and F. ZILIBOTTI (2002): "Distance to Frontier, Selection, and Economic Growth," *NBER paper*]

Laggard economies:

- there are more long-term relationships between firms and banks,
 - high average size (larger, more vertically integrated firms),
 - higher age of firms,
 - large average investments,
 - little selection,
 - less competition,
 - greater state intervention, and
 - generally more "rigid" institutions.
- Managers engage mainly in copying and adopting technologies from the world frontier.
- Investment-based growth strategy maximizes investment by channeling money to existing firms but sacrifices innovation.



Country-specific risks: DISTANCE TO WORLD TECHNOLOGY FRONTIER

Closer to the technology frontier:

- there is less room for copying and adoption of well-established technologies,
- a switch to an innovation-based strategy with
- short-term relationships,
- younger firms,
- less investment and
- better selection of managers.

Innovation-based strategy encourages innovation and corresponds to a more fluid and competitive market.

Although the investment-based strategy can increase the growth rate at early stages, an economy might end up in a non-convergence trap if it does not switch out of the investment-based strategy.



Country-specific risks: THE POLITICAL REPLACEMENT EFFECT

Accounts for political elites blocking technological and institutional development and “openness” of the educational systems [Reference: ACEMOGLU, D., and J. A. ROBINSON (2002): “Economic Backwardness in Political Perspective,” *NBER paper*] :

- Innovations often erode elites’ incumbency advantage, increasing the likelihood that they will be replaced.
- Feeling replacement, political elites are unwilling to initiate change, and may even block economic development.



Country-specific risks: CULTURE

Culturally quantifiable characteristics such as *uncertainty avoidance*, *individualism*, *materialism*, and *power distance*, and *culture* in general, *openness to international trade*, and the *legal system*, affecting investor protection, creditor and shareholder rights.

For example, the U.S. is

- high in individualism,
- medium in materialism, and
- low in power distance and uncertainty avoidance,

thus, shaping an entrepreneurship environment mainly by the results of the individualistic activity (resource accumulation, venture experience, diagnostic ability) and less by uncertainty avoidance and power distance (willingness variables, “access”, protecting ideas).



Country-specific risks: CULTURE

Cultures change and adapt in response to economic changes, but they generally do so slowly.

If predominant values in some countries are less supportive of market interactions than in other countries, one would expect investor rights to be less well protected for reasons such as the existence of institutions that make financial markets less valuable (for example, extended families limit the use of markets since many transactions take place within the extended family that otherwise would require the use of markets) or have different economic fundamentals that make market interactions less valuable.



Country-specific risks: FINANCE

Availability, appropriateness and accessibility to finance, especially finance for small firms, ensuring that the types of finance on offer and the finance providers themselves are efficient and effective.



Market size and product quality

Distribution of product quality & market size: depends on the process for producing quality.

- In markets where quality is created largely through variable costs, markets fragment as they grow large, and the number of varieties – including levels of quality – increases.
- In markets where the cost of creating quality is largely fixed with respect to output, markets do not fragment as they grow large and average product quality increases in market size.

[Reference: BERRY S., and J. WALDFOGEL (2003): "Product Quality and Market Size," *NBER paper*]