Technological Innovation: Winners and Losers

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Key Questions

How does uncertainty around technological progress affect equity markets and investors?

Why may value stocks earn higher returns than growth stocks on average?
Introduction

Technological innovation is an important source of economic growth.

2010

$5,000

1960

$160,833,333
Innovation cycles are not business cycles

Different horizon: innovation cycles occur at lower frequency

Different timing: innovation cycles do not coincide with business cycles


“The years 1929-1941 were, in the aggregate, the most technologically progressive of any comparable period in U.S. economic history.”

- chemical engineering (petrochemicals and synthetic rubber), aeronautics, electrical machinery and equipment, electric power generation and distribution, transportation, communication, …
Technological advances create winners and losers

Creative destruction (Schumpeter, 1942)

Benefits and costs are asymmetrically distributed

- Innovators versus investors in existing firms
- Growth versus value firms
“The early opinion that railroads could not compete with waterways gave ground before practical proofs to the contrary... during the last few years of rapid progress in railroad building no new canals were planned, and those which existed near railroads had decreased in their receipts from 33 to 66 percent.”

_Balthasar H. Meyer, 1917, Transportation in the United States before 1860, Ch. 17 p. 553_
“The triumph of the private passenger car over rail transportation in the United States was meteoric. Passenger miles traveled by automobile were only 25 percent of rail passenger miles in 1922 but were twice as great as rail passenger miles by 1925, four times as great by 1929.”

James J. Flink, 1990, The Automobile Age, Ch. 19 p. 360
Innovation poses risk to investors in old-technology firms

- In 1900, railroads account for over 50% of market cap of all NYSE firms
- Between 1927 and 1975, go from 23% to 2% of NYSE market cap
Growth firms can help hedge innovation shocks

Firms and investors are exposed to disruptive innovation shocks

Public market index does not protect investors from displacement by innovation

Growth firms derive more value from growth opportunities; value firms -- from assets in place

Innovation shocks are beneficial to growth opportunities, increase prices of growth firms relative to value firms

Growth tilt can be a hedge
Innovation risk can give rise to value premium

Growth firms can provide a hedge

Growth firms trade at higher valuations

Positive value premium in the cross-section of stock returns
Use patents to measure innovation

Cover patented innovations

Patents differ in economic value -- most patents have little value

In the literature it is common to weigh patents by forward citations

➤ We need an economic measure of private value

Follow approach similar to Kogan, Papanikolaou, Seru and Stoffman, “Technological Innovation, Resource Allocation, and Growth,” 2012

➤ Infer value added associated with a patent by firm's stock market reaction to patent issue
Construct patent data

Build a measure of innovation from the ground up, by combining a database of patent filings and issues with stock return data.

Download the entire history of U.S. patent documents from Google Patents (7.8 million patents):

- Google provides text (OCR) version of patent documents

Match 1.9 Million patents to publicly traded firms using text analysis algorithms.
Value patents using stock market reaction

Every Tuesday, the USPTO publishes the Official Gazette describing newly granted patents

- Focus on 3-day window around patent grant day

On patent grant day market learns application is successful

- Assume that quality of patent is public information prior to patent grant

On issue day, stock price should increase in proportion to patent value
A broad patent is spurring the shares of Protein Design Lab.

SHARES of Protein Design Labs Inc. have gained nearly 25 percent since the company disclosed on Monday that it had been awarded a broad patent covering the production of so-called humanized antibodies in mice.

Despite the sharp rise, some analysts say the company's shares are still a compelling buy, based not only on the prospect for royalties created by the patent, but also on Protein Design's own product pipeline.

The awarding of the patent, which could affect as much as a fourth of all biotechnology drugs currently in clinical trials, is the second recent hit for Protein Design after a big miss last year. In September, the company, based in Mountain View, Calif., reported that a drug it developed with Hoffmann LaRoche, a unit of Roche Holding, had proved effective in preventing the rejection of transplanted kidneys in human trials. The same drug had failed an earlier trial for graft versus host disease, a common complication of bone marrow transplants.

Shares in Protein Design Labs rose 53.125 cents yesterday, to $34.25, in Nasdaq trading. On Wednesday, the stock rose $2.21875, and gained $4 on Tuesday. The stock had traded as low as $12 after last summer's disappointment.

Matthew Geller, an analyst with Oppenheimer & Company, has maintained Protein Design Labs as a strong buy. He said that the company had both broad enabling technology that could produce drugs for many different diseases and a sound business strategy of using multiple corporate partners, which has allowed it to build a pipeline of several drug candidates while conserving its financial resources.

"It is one of the few companies with a platform," Mr. Geller said. "It's one of the few biotech companies with sufficient backbone to become a major pharmaceutical company." He noted that the stock had traded in the mid-30's two years ago, and since then the company had added nine corporate partners and had a drug that could reach the market as soon as next year.
Protein Design: Cumulative Abnormal Return
Example: IBM

United States Patent
Boies et al.

System and Method for Providing Reservations for Restroom Use

Inventors: Stephen J. Boies, Mahopac, NY (US); Samuel Dinkin, Austin, TX (US); Paul Andrew Moskowitz, Yorktown Heights; Philip Shi-Lung Yu, Chappaqua, both of NY (US)

Assignee: International Business Machines Corporation, Armonk, NY (US)

Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

Appl. No.: 09/639,254
Filed: Aug. 14, 2000

Int. Cl. 7 ................................. G08B 23/00
U.S. Cl. ................................. 340/573.1; 340/825.28; 340/825.29; 705/5; 705/6
Field of Search .......................... 340/539, 573.1, 340/540, 531, 825.28, 825.29; 705/5, 6; 701/201; 707/100; 395/205

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5,978,770 * 11/1999 Waytena et al. ................ 705/5

* cited by examiner

Primary Examiner—Benjamin C. Lee
Attorney, Agent, or Firm—Morgan & Finnegan, L.L.P.

Abstract

The present invention is an apparatus, system, and method for providing reservations for restroom use. In one embodiment, a passenger on an airplane may submit a reservation request to the system for restroom use. The reservation system determines when the request can be accommodated and notifies the passenger when a restroom becomes available. The system improves airline safety by minimizing the time passengers spend standing while an airplane is in flight.

64 Claims, 4 Drawing Sheets
IBM: Cumulative Abnormal Return
Stock market forecasts
future citations

![Graph showing the relationship between log forward citations and log patent market value.](#)
Rotating leadership

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<thead>
<tr>
<th>Decade</th>
<th>Industry Description</th>
<th>Companies</th>
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<tr>
<td>’30s</td>
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<td>General Motors, AT&amp;T</td>
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<td>Computer hardware and software</td>
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Firm characteristics and growth opportunities

Firms with rich growth opportunities have higher exposure to innovation shocks

- But growth opportunities are unobservable

Growth opportunities are positively correlated with observable firm characteristics

- Market-to-book, investment rate, ...
Average excess returns

1950-2008

- Market-to-book
- Past investment

Lo 2 3 4 5 6 7 8 9 Hi
It is not all about market risk

CAPM alphas, 1950-2008

- Market-to-book
- Past investment
Value firms are more vulnerable to innovation risk

Innovation betas, 1950-2008

- Market-to-book
- Past investment
Future directions: understanding household investment

Everyone cannot have the same tilt: investors collectively hold the market.

Growth tilt makes sense for some, value tilt for others.


“Value investors are substantially older, tend to have higher financial wealth, higher real estate wealth, lower leverage, lower income risk, lower human capital...”

“By contrast, entrepreneurs and educated investors are more likely to invest in growth stocks.”
Innovation and human capital

INNOVATION
If It Can Make Your Job Easier, It Can Probably Make It Irrelevant.