Global Innovation and Jobs

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Game Plan

- Global division of labor
- Lack of job growth in innovative industries
- Global innovation shortfall
- Corporate offshoring of R&D
- Communications and life sciences boom?
- Inflection point in U.S. and global economic development

Where were the jobs supposed to come from?

In the late 1990s, it was clear that **production and routine innovation** were being shifted to low-wage countries

The U.S. focused on **new product design** and pursuing **breakthrough innovation**

Global Division of Labor: The Theory

The U.S., as the leading innovator, would use **breakthrough innovations** to create **advanced products**

In return, the rest of the world would supply the U.S. with **low-priced goods and services**

Expectation

U.S. job growth would be driven by **innovation**, not production of existing products and services

.

Innovation is the answer to the question:
Where are the new jobs going to come from?

From electricity to autos to airplanes to computers, **the introduction of compelling new products and services** has created entire new industries, and the jobs to go along with them

In the late 1990s, the Bureau of Labor Statistics projected **2.8 million** net new jobs in leading-edge industries such as pharmaceuticals, software, semiconductors, communications and aerospace over the next ten years

(1998-2008)

Job Change in Leading-edge Industries: Actual and Projected

	1998-2008 change in jobs (thousands)	
	Actual	1999 BLS forecast
Infotech hardware	-493	155
Communications	-150	298
Aerospace	-72	135
Instruments	-59	19
electronic instruments	-68	
medical equipment and supplies	10	
Pharmaceuticals	44	30
Scientific research	133	247
Infotech services	529	1873
software	49	
data processing	-22	
info systems design and related	465	
internet publishing and web search	27	
other information services	12	
All leading-edge industries	**-68**	**2757**

The reality: Leading-edge industries **lost 68,000 jobs** in this ten-year stretch.

A Decade of Surprisingly Weak Innovation

The innovation-intensive strategy turned out to be **riskier than expected**

Yes, we saw big innovation in communications and IT (think iPhone). But in virtually every other area, potentially-powerful innovations fell short of promise (think biotech)

The global economy became unbalanced, leading to massive **trade deficits** and a debt build-up in the U.S—followed by the financial crisis

In the short run, the **innovation shortfall** was not obvious

The excitement of the Internet, and a series of scientific advances such as **the sequencing of the human genome** in 2003

But a long-term look clearly shows the innovation shortfall

1998: A New Era of Innovation, A Decade Later

Cancer Treatments: In 1998, scientists reported several big breakthroughs, including cutting off blood supply to tumors. **What happened?** Tackling cancer was far trickier than expected. There were some successes, like Avastin, but many more failures.

Cloning: After the cloning of Dolly the sheep was announced in 1997, the cloning of humans for medical-research purposes seemed plausible. **What happened?** Today there is no human cloning. And while over 20 animal species have been cloned, businesses to clone livestock or pets have not taken off.

Fuel-cell-powered cars: In January 1998 GM Chair John Smith promised a production-ready fuel-cell car by “2004 or sooner.” **What happened?** Production-ready fuel-cell cars are just now reaching the market.

Gene Therapy: In 1998, researchers were ready to put "replacement" genes into patients with illnesses such as cystic fibrosis. **What happened?** An experimental gene therapy treatment killed a patient in 1999, and research slowed down dramatically. No gene therapies have been approved by the FDA for sale.

1998, continued

Biotech and new drugs: Conventional wisdom was that biotechnology would speed discovery of new drugs. **What happened?** Despite the 2003 sequencing of the human genome, successful drug discovery was much harder than envisioned.

Miniaturized silicon-based machines (MEMS): That year venture firms began pouring billions into MEMS startups, "the next semiconductor revolution." **What happened?** Mass production of micromachines was far more complicated than expected.

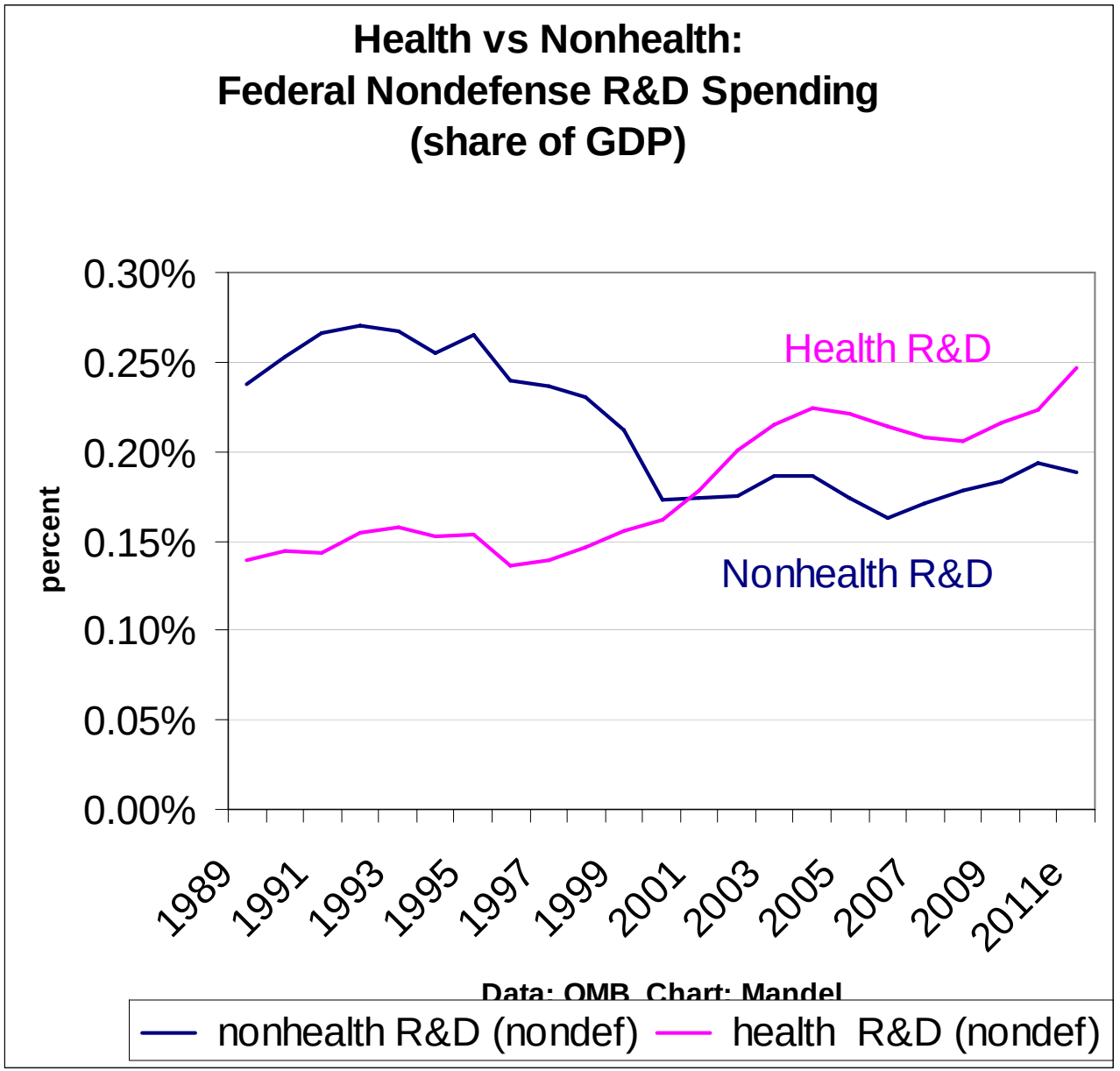
Satellite-based Internet: Big money backed Teledesic, a space-based Internet service intended to have 800-plus satellites in low orbit for fast response. **What happened?** Teledesic never got off the ground as low-orbit broadband systems turned out to be far too costly.

Speech technology: Improved speech recognition was supposed to be a "killer app," allowing people to interact naturally with computers. **What happened?** Relatively few people use speech for Web browsing or creating documents.

Tissue engineering: Artificial organs seemed imminent when the FDA approved Apligraf, a skin substitute from living cells. **What happened?** Apligraf turned out to be tricky and expensive to produce and ship.

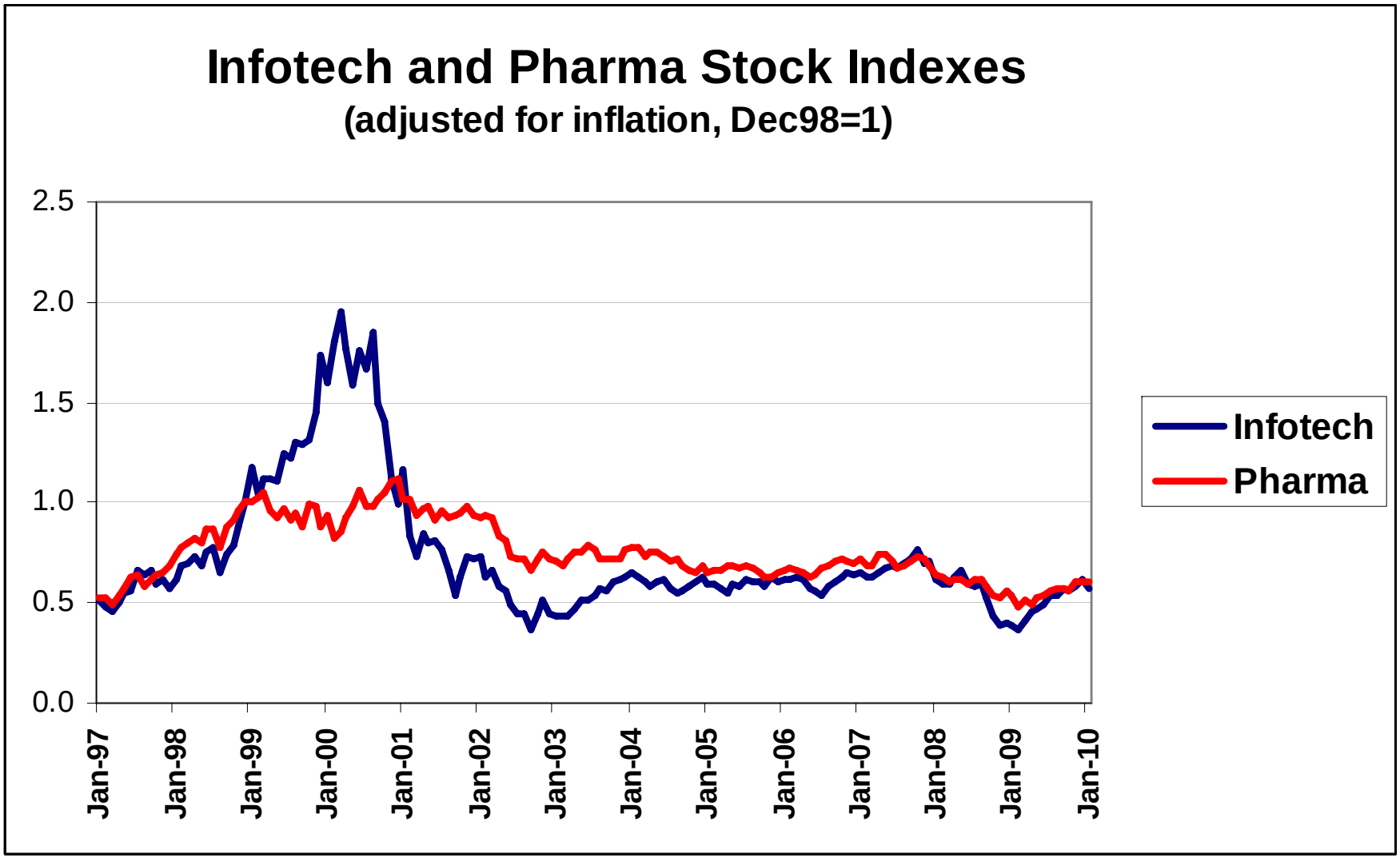
The innovation shortfall, relative to spending, is particularly acute in **life sciences**

Life sciences has been the focus of R&D spending **by government and by universities** (71% of academic research spending in 2008, up from 69% in 2001)

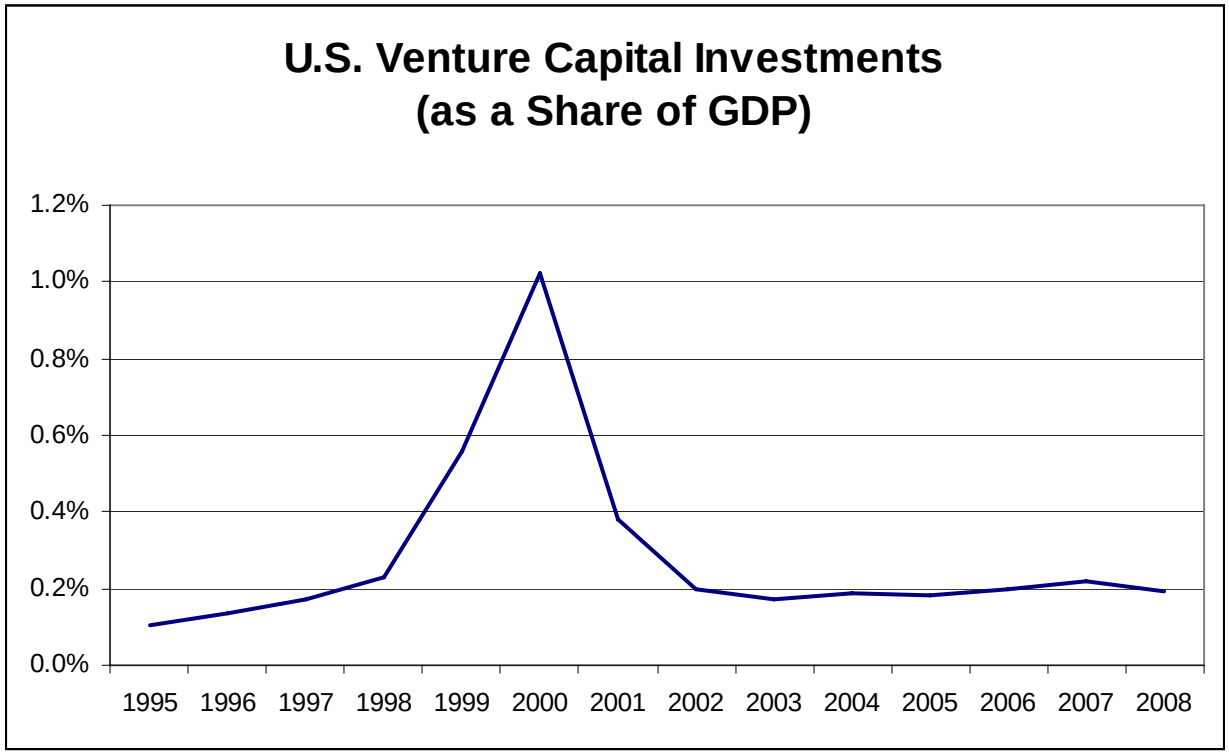

Health vs Nonhealth:
Federal Nondefense R&D Spending
(share of GDP)
0.30%
0.25%
0.20%
0.15%
0.10%
0.05%
0.00%
percent
Health R&D
Nonhealth R&D
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011e
Data: OMB, Chart: Mandel
nonhealth R&D (nondef)
health R&D (nondef)

From the end of 1998 to the end of 2007, the stock index which tracks large **pharma/biotech/life sciences** firms **fell by 32%,** adjusted for inflation.

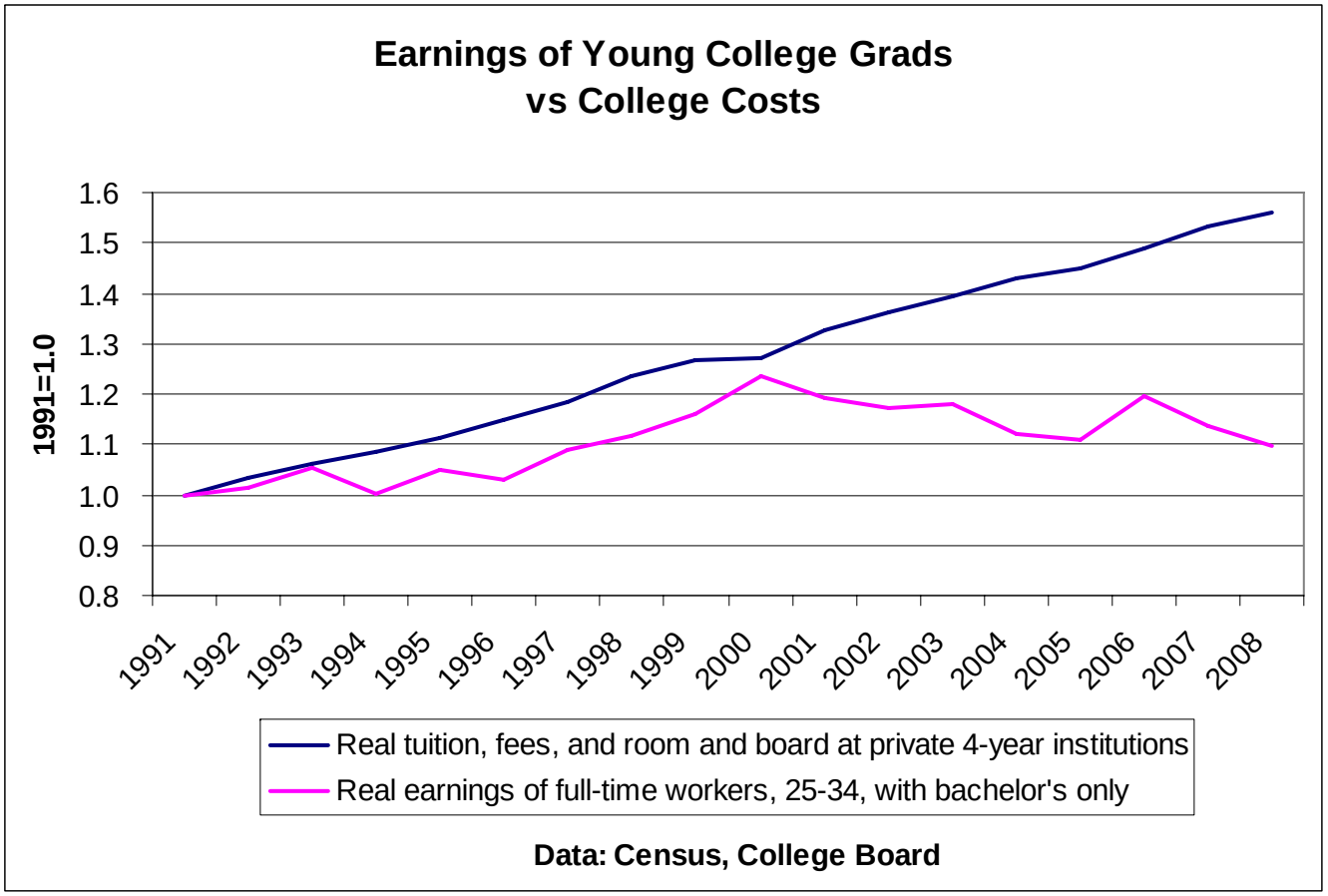
The stock index which tracks large **info-tech** firms **fell by 29%,** adjusted for inflation. By comparison, the overall market fell by only 7% in real terms.

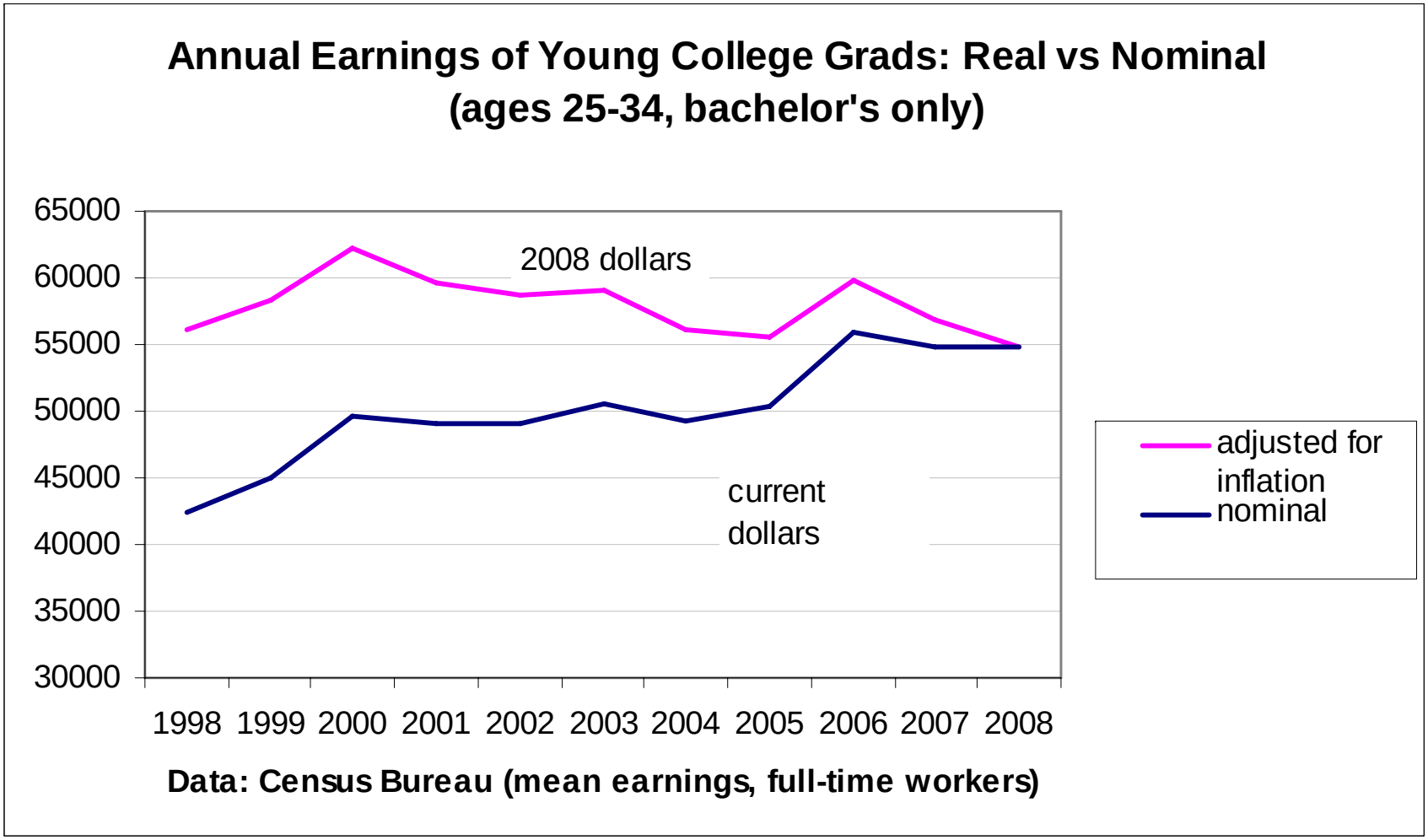

Infotech and Pharma Stock Indexes
(adjusted for inflation, Dec98=1)
2.5
2.0
1.5
1.0
0.5
0.0
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Infotech
Pharma

VC Investments Show No Sign of Breakthrough Innovations



A Clear Sign of Weak Innovation




Annual Earnings of Young College Grads: Real vs Nominal
(ages 25-34, bachelor's only)
65000
60000
55000
50000
45000
40000
35000
30000
2008 dollars
current
dollars
1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
adjusted for inflation
nominal
Data: Census Bureau (mean earnings, full-time workers)

Earnings of Young Adults by Education

percent change, 2000-2008

Ages 25-34	Nominal	Adjusted for inflation
High school only	14%	-9%
Associate Degree only	22%	-3%
Bachelor's degree only	10%	-12%

Data: Census Bureau
Mean earnings, full-time workers

Corporate R&D Offshoring

Explosive growth of **borderless** or global innovation

Perhaps 2000 MNC R&D centers in China and India alone

Novartis announcement--$1.25 billion to build up Changshu and Shanghai R&D centers

Conventional Wisdom

Borderless innovation takes advantage of improved global communication and better-educated workers in China, India, and elsewhere.

Implication: Acceleration of global innovation, as MNCs take advantage of new opportunities and capabilities. Whee!

Two Questions

- Are MNCs moving R&D to cheaper countries in response to the innovation shortfall in developed countries?

"If you expensive scientists and engineers can't produce breakthroughs, we might move your jobs overseas and pay less"

- Is borderless innovation capable of producing the sort of "breakthrough innovations" that create new industries, jobs, and corporate profits?

Key Distinction

Routine innovation

Improvements in existing processes and products.

Time-consuming and expensive but relatively straightforward

Breakthrough innovation

Big jumps in capabilities

Not predictable in advance and not easy to recognize

Reinterpreting the Internet Decade

U.S. was challenged by low-wage, relatively efficient producers around the world

Two potential strategies:

Accept a **fall in living standards** to retain production jobs, or;

Move ‘upmarket’ and emphasize **innovation-intensive activities**

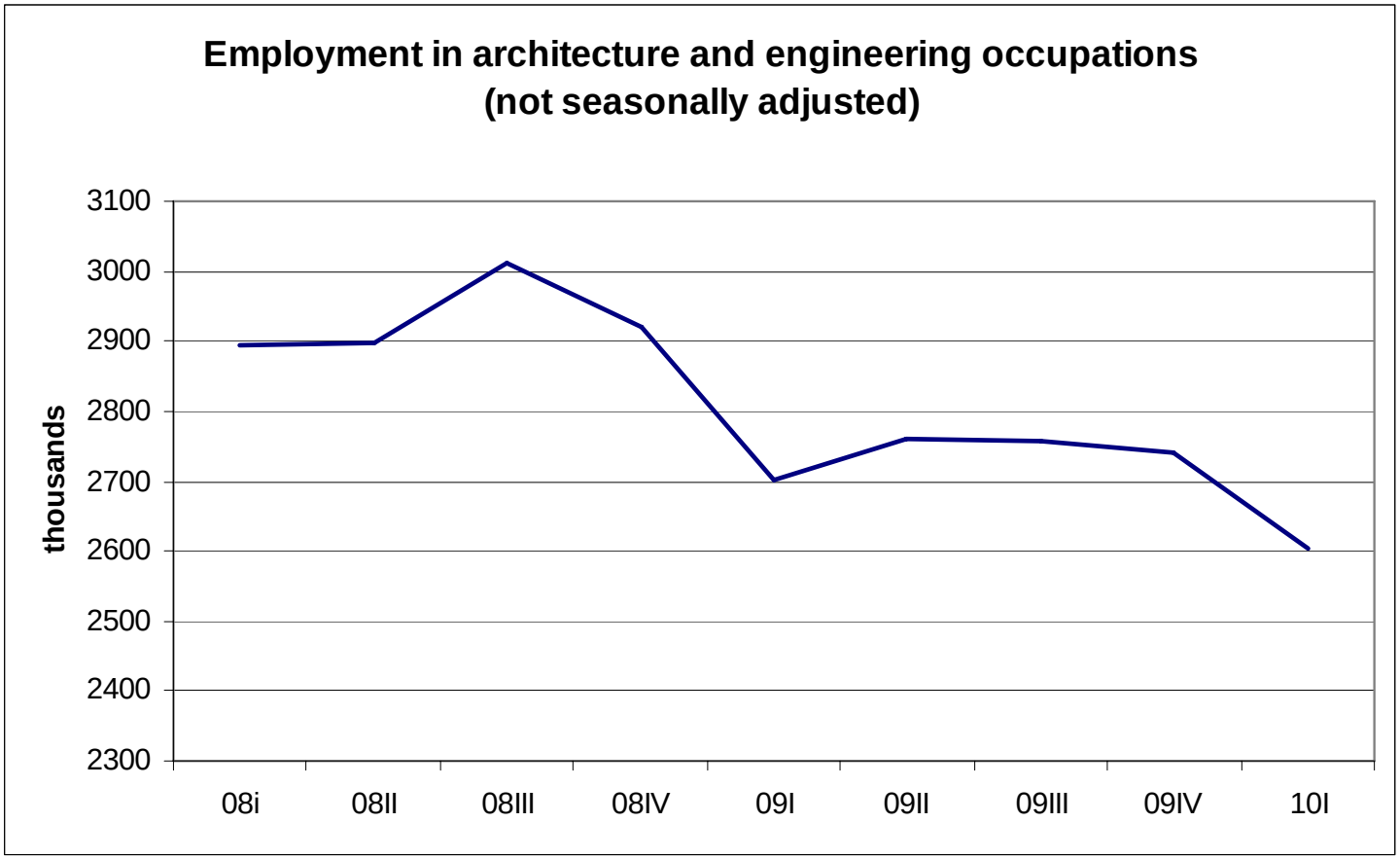
Reinterpreting--2

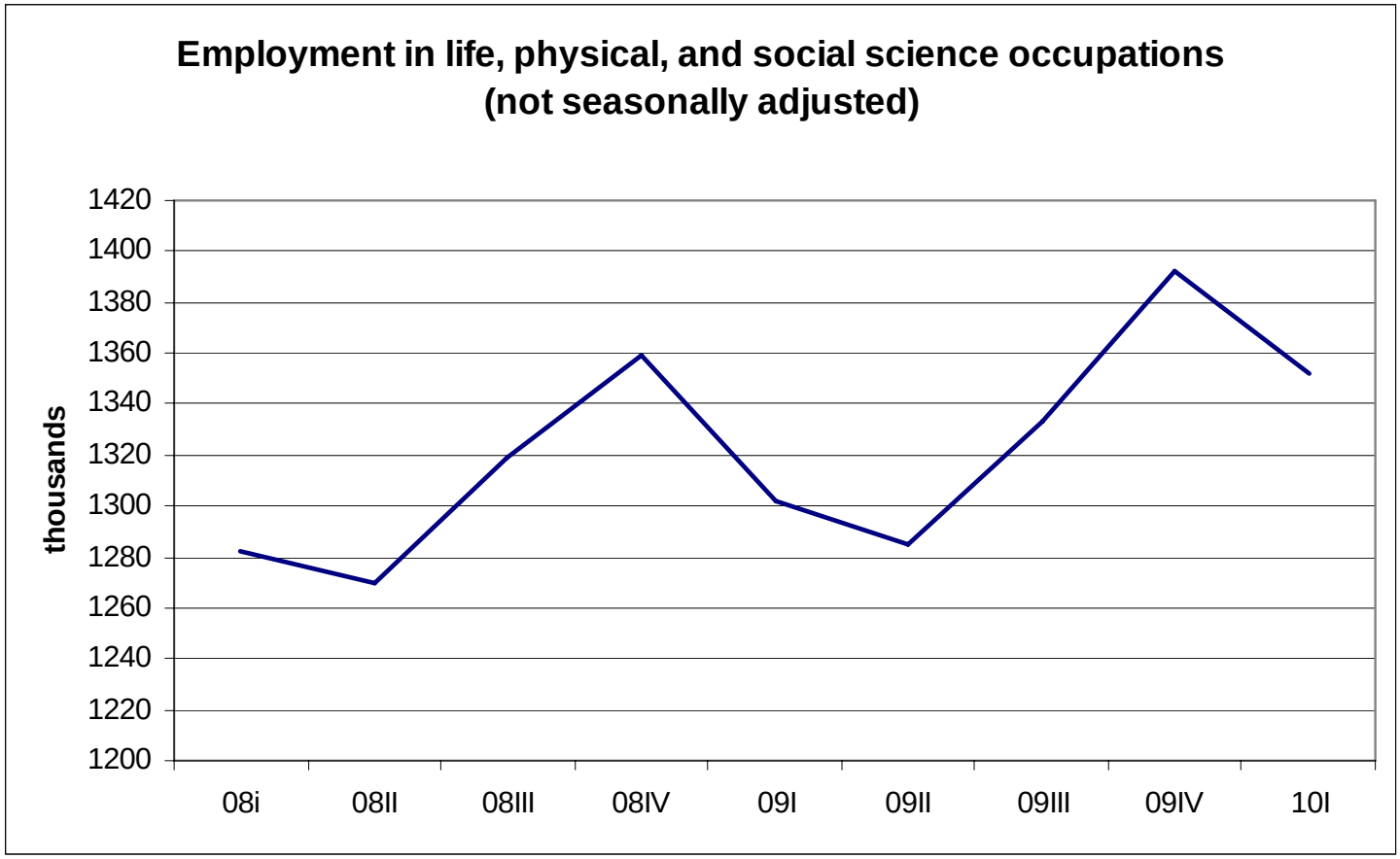
- Companies tried to go for home runs, especially in the life sciences. Huge investments in R&D and in VC.
- But breakthrough innovations were rare. High-risk innovative strategy broke down.
- Competitive pressure intensified. Offshoring routine innovation to less expensive countries began to look much more appealing.
- Sure-fire singles rather than scarce home runs.

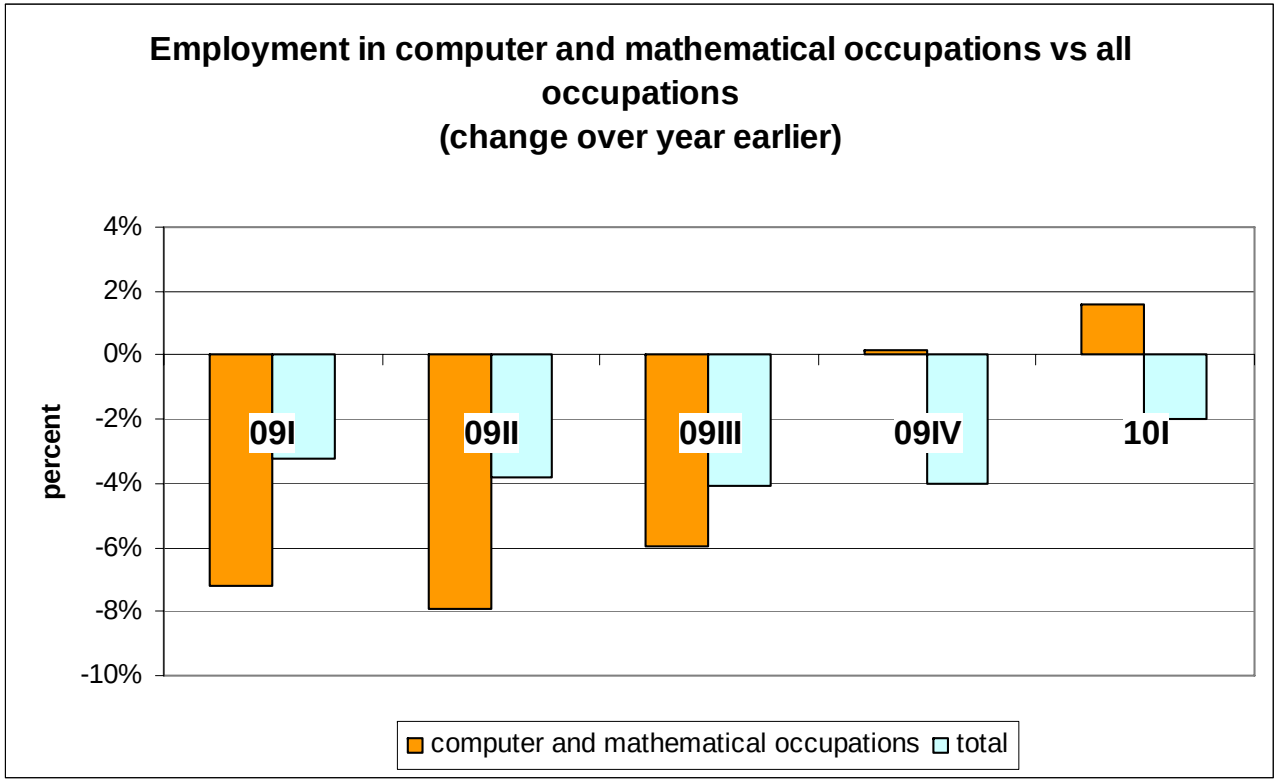
Current Situation

Shift to borderless or global innovation has accelerated

Mixed signals on innovative workforce— employment of **scientists** is up, employment of **engineers** is down, employment of **computer/mathematical professions** plunged but is recovering.


Employment in architecture and engineering occupations
(not seasonally adjusted)
thousands
3100
3000
2900
2800
2700
2600
2500
2400
2300
08i
08II
08III
08IV
09I
09II
09III
09IV
10I


Employment in life, physical, and social science occupations
(not seasonally adjusted)
thousands
1420
1400
1380
1360
1340
1320
1300
1280
1260
1240
1220
1200
08i
08II
08III
08IV
09I
09II
09III
09IV
10I


Employment in computer and mathematical occupations vs all occupations
(change over year earlier)
percent
4%
2%
0%
-2%
-4%
-6%
-8%
-10%
09I
09II
09III
09IV
10I
computer and mathematical occupations
total

An Inflection Point

To what extent does the offshoring of R&D depend on the shortfall of breakthrough innovations? Would the U.S. look more appealing if the returns to R&D were higher?

Can borderless innovation networks produce breakthrough innovations?

Assessing the Immediate Future

Signs of a communications-led boom. i.e. Apple, mobile in general

Good news, but not enough to lift U.S. economy or create enough jobs.

Will vast investments in life sciences pay off with **breakthrough products and services**, and the jobs that come along with them? Current news flow is still bad, but that's not even a short-term indicator

Possible Futures

	Developing countries lead	Developed countries lead
Breakthrough innovations	China Ascendant Technology transfer back to the developed world--so living standards rise but U.S. job growth struggles.	U.S. Revival High-end job growth returns, as living standards rise. Return to the global division of labor.
Incremental or slow innovation	Zero-sum world Trade wars, and a policy choice between jobs and cheap imported goods and services.	Emerging Market Bust Stability becomes a main virtue in the developed countries. Ossification?

For now, I’d vote for the upper right hand corner…..

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