Lecture 7 – Sales Pitches vs Real Estimates of Private and Social Returns From R&D

"If we want to make the best products, we also have to invest in the best ideas. **Every dollar we invested to map the human genome returned $140 to our economy.** Today, our scientists are mapping the human brain to unlock the answers to Alzheimer's … Now is not the time to gut these job-creating investments in science and innovation. Now is the time to reach a level of research and development not seen since the height of the Space Race." President Obama State of the Union Feb 2013

Obama announces $100M for brain mapping project AP: April 2 WASHINGTON — President Barack Obama on Tuesday proposed an effort to map the brain's activity in unprecedented detail, as a step toward finding better ways to treat such conditions as Alzheimer's, autism, stroke and traumatic brain injuries. He asked Congress to spend $100 million next year to start a project that will explore details of the brain, which contains 100 billion cells and trillions of connections. That's a relatively small investment for the federal government — less than a fifth of what NASA spends every year just to study the sun — but it's too early to determine how Congress will react.

President Obama's Proposal to Double Federal Funding for the BRAIN Initiative March 11, 2014
Last week, President Obama announced his budget proposal to double the Federal investment in the BRAIN Initiative from about $100 million in Fy 2014 to approximately $200 million in FY 2015. Read the fact sheet to learn more about the proposed investments at various agencies to support groundbreaking research and meet the audacious goals of this initiative. Universities like to claim that their R&D brings great benefits to the locality in which they located.

Published online 11 May 2011 | Nature | doi:10.1038/news.2011.281

News

What is the human genome worth?

Economists sceptical over study's estimate of massive financial return.

Nadia Drake

A high-profile claim that the Human Genome Project and associated research generated almost US$800 billion in economic benefits has been questioned by economists.

The estimate comes from the Battelle Memorial Institute, headquartered in Columbus, Ohio. A team of researchers used an 'input–output' economic model to calculate a 141-fold return on each dollar invested in the Human Genome Project. The team's report concludes that a $3.8-billion federal investment (equivalent to $5.6 billion in 2010 dollars) produced $796 billion in economic output between 1988 and 2010 and, in 2010 alone, supported 310,000 jobs.

Critics of the report say that the methods used to calculate these numbers, despite being common practice in such studies, are flawed. For example, some of the costs of the project — such as the salaries of those working on it — are counted as benefits.

The Human Genome Project has brought many benefits, but can we put a dollar value on them?
Purestock

Some Previous estimates and related claims: 2010: Nature Vol 465|10 June "What science is really worth?": Collins has recently cited a report by Families USA, a Washington DC-based health advocacy group, which found that every US$1 spent by the NIH typically generates $2.21 in additional economic output within 12 months. Hmm. Costs as benefits.

Would smart people in top universities engage in the same nonsense?.

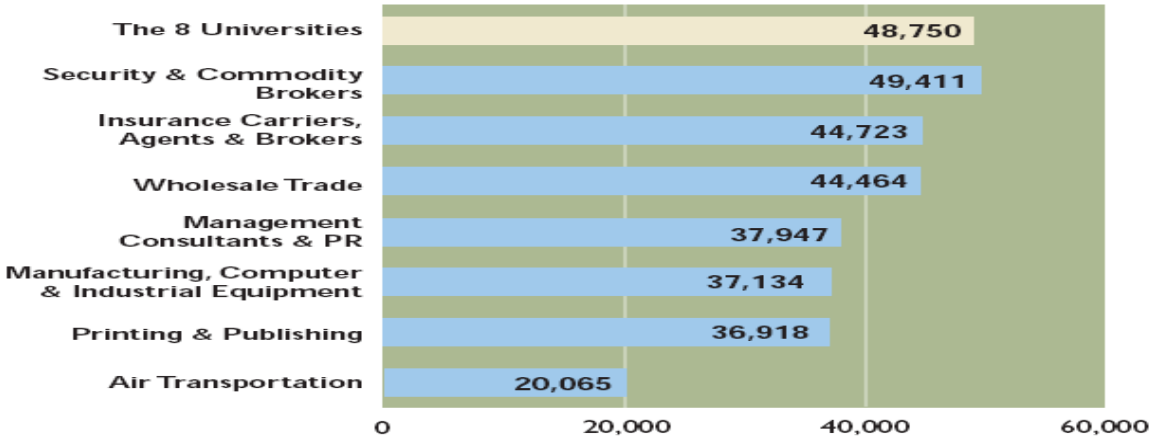
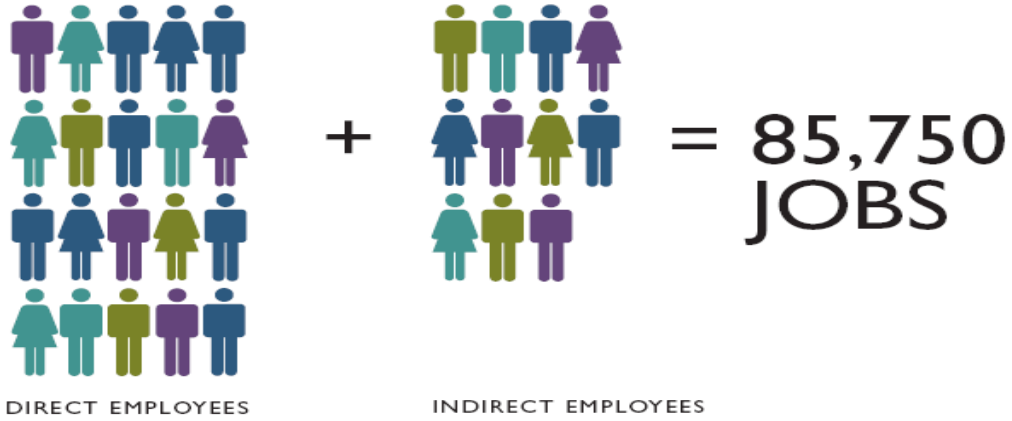


Figure 4
In 2000, the research universities collectively employed more people than a number of other leading industries in the Boston area, including banking, insurance, management consulting and computer manufacturing.

Figure 5
In addition to the 48,750 employees of the eight major universities in 2000, it is estimated that spending by the universities in their local communities support another 37,000 full-time equivalent jobs. This total does not include the people employed by the universities' affiliated hospitals and research centers.



Where do these numbers come from?

From input-output "impact studies" based on Leontief's I-O tables that show the interrelationships of purchases and sales among sectors assuming fixed coefficient production relations. The BEA's Industry Economic Accounts prepares benchmark I-O accounts for years ending in 2 and 7 from detailed quinquennial economic censuses. The benchmark accounts provide data on the flows of goods and services between some 500 or so industries who provide input to, and use output from, each other to produce gross domestic product.

NIH/GENOME/UNIVERSITY is a final user who buys Research Services. The purchase of services shows up as purchase of intermediate inputs and as Value Added in labor compensation. The producers of the intermediate inputs use other inputs, and those producers use other inputs.

Input-output equations are written in a square matrix of technical coefficients, A, where a_{cr} measures the ratio of purchases that column industry c makes from the row industry r: how much of 1$ of construction output goes to services from transportation. Let X be a column of total outputs of each industry, and Y a column of final demand. Then **X=AX +Y** shows how the total-output-of-each-industry (X) is either used as intermediate good in production or as final-demand (Y). Rewrite as (I—A)X=Y. Then solve for total output: $X=(I—A)^{-1}Y$, where $(I—A)^{-1}$ is the inverse of I-A. This equation determines the full output consistent with the sector A uses sector B uses sector A etc equation.

Given total output of a sector, you can derive the value added from labor and employment. This provides way to determine the total employment, outputs attributable to a given final demand – such as government spending for Human Genome, NIH research, etc.

Here are more impact studies:
An NIH study using the Department of Commerce' RIMS II model, projected that $26.6 billion in NIH extramural funding in 2010 directly and indirectly supported 487,900 jobs nationwide, leading to fifteen states experiencing job growth of 10,000 or more. The $23.7 billion spent by NIH extramurally in the fifty states and the District of Columbia in 2011 directly and indirectly supported 432,094 job. NIH spending in 2011 alone produced $62.132 billion in new economic activity (NIH'S ROLE IN SUSTAINING THE U.S. ECONOMY A 2011 summary of May, 2011, United For Medical Research report entitled, "An Economic Engine: NIH Research, Employment, and the Future of the Medical Innovation Sector,")

Economic Impact of the Human Genome Project

How a $3.8 billion investment drove $796 billion in economic impact, created 310,000 jobs and launched the genomic revolution

Battelle measured economic impact using an input/output model that differentiated three different impacts:

Direct impact means the specific expenditures, such as each year's NIH and DOE funding on genomics, or specific spending by a given economic sector such as pharmaceuticals on genomics-related research.

Indirect impacts are from suppliers to those industries, such as companies that provide services, reagents, equipment and so on.

Induced impacts are the follow-on effect of the suppliers and employees spending in the economy.

Battelle used IMPLAN, a software platform that is widely used for calculating economic impacts, and focused on six economic sectors that were mapped to the closest economic sectors in IMPLAN.

Figure ES-1: The Structure of Forward and Backward Linkage Impacts Sequencing

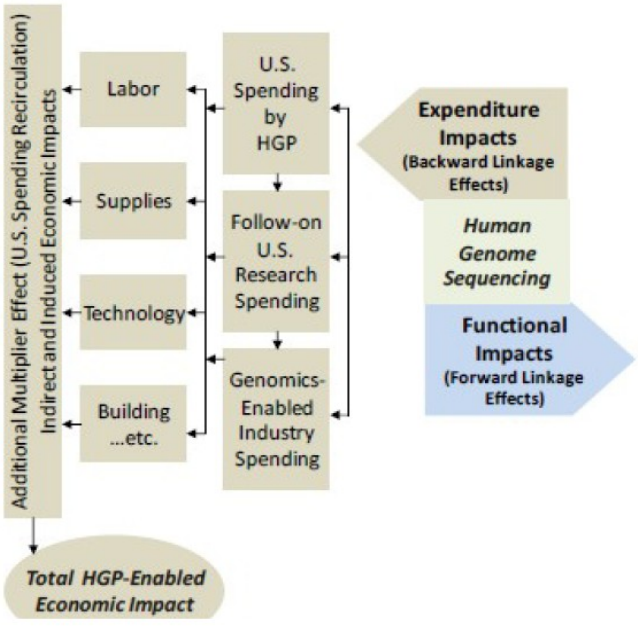


Table ES-1: Cumulative Economic Impact of Human Genome Sequencing, 1988–2010 (in Billions, 2010 $)

Impact	Employment (Job-Years)	Personal Income	Output	State/Local Tax Revenue	Federal Tax Revenue
Direct Effect	710,819	71.4	264.8	3.5	13.0
Indirect Impacts	1,298,216	89.2	265.8	10.8	18.0
Induced Impacts	1,818,459	83.3	265.7	15.2	17.9
Total Impact	3,827,495	243.9	796.3	29.5	48.9
Impact Multiplier	5.38	3.42	3.01	8.37	3.75

Table 4: Cumulative Economic Impact of HGP Federal Funding, 1988–2003 (in Millions, 2010 $)

Impact	Employment (Job-Years)	Personal Income	Output	State/Local Tax Revenue	Federal Tax Revenue
Direct Effect	43,536	3,164.2	5,647.9	90.6	520.3
Indirect Impacts	24,842	1,307.7	3,785.1	154.3	261.4
Induced Impacts	50,660	2,319.7	7,393.1	422.3	498.3
Total Impact	119,037	6,791.6	16,826.1	667.2	1,280.1
Impact Multiplier	2.73	2.15	2.98	7.36	2.46

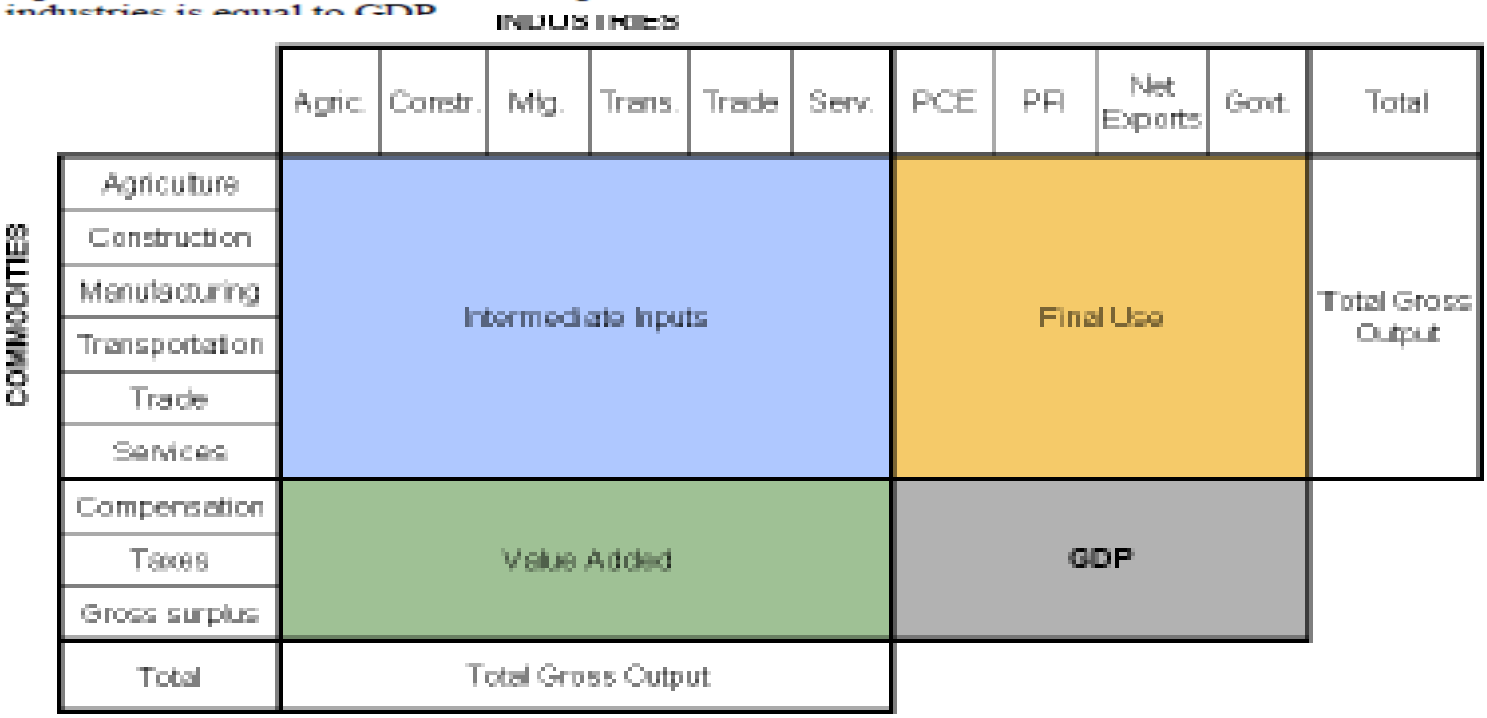
Table 9: Economic Impact of the Genomics-Enabled Industry, 2010 (in Millions, 2010 $)

Impact	Employment (Jobs)	Personal Income	Output	State/Local Tax Revenue	Federal Tax Revenue
Direct Effect	44,372	4,889.0	21,401.3	266.4	924.4
Indirect Impacts	104,126	7,309.2	21,904.2	889.0	1,466.0
Induced Impacts	138,173	6,331.5	20,185.5	1,152.2	1,360.1
Total Impact	**286,672**	**18,529.7**	**63,491.0**	**2,307.6**	**3,750.5**
Impact Multiplier	6.46	3.79	2.97	8.66	4.06

The model and accounting are valid as representation of flows of intermediate goods and services

Total Gross Output and Value Added in the Use Table

The diagram below illustrates the relationship between total gross output, value added, and gross domestic product (GDP). As shown in the table, commodities are consumed by industries—these are the intermediate inputs—and by final use. Value added is equal to the income earned in production—this includes labor earnings. Total gross output is equal to the sum of intermediate inputs and value added. Value added summed across all industries is equal to GDP



But its use to measure benefit-cost of policies is not valid..

1)**More people hired, resources used → bigger effects.** If hiring 710,819 leads to 4.38 times as many jobs, just hire another 700,000 and we will be at full employment with bigger GDP. Impact includes "cost of project", which in sensible only if resources are unemployed. If genome solved at once, estimated value would have fallen!

2)Problem of counter factual: where else might govt have spent money? If comes out of taxes, people reduce demand for something else... SHOULD BE NET CALCULATION. In general, all indirect and induced for given spending are of same order of magnitude so unlikely that any net would show great differences in types of spending

3)Federal is much smaller than headline … huge industry effect that is "due" to federal, but industry employment is not massive. It is industry induced and indirect. Not sure why that is so high.

4)Missing is measure of "sales"/value of output – knowledge – say in terms of improved health.

"Real Payoffs" through:

1) Higher Productivity/ Reduced Cost/Price of Technology

We measure technological change:

By improved productivity in production function – GDP' = aL' + bK' +c Other inputs' + d RDK'

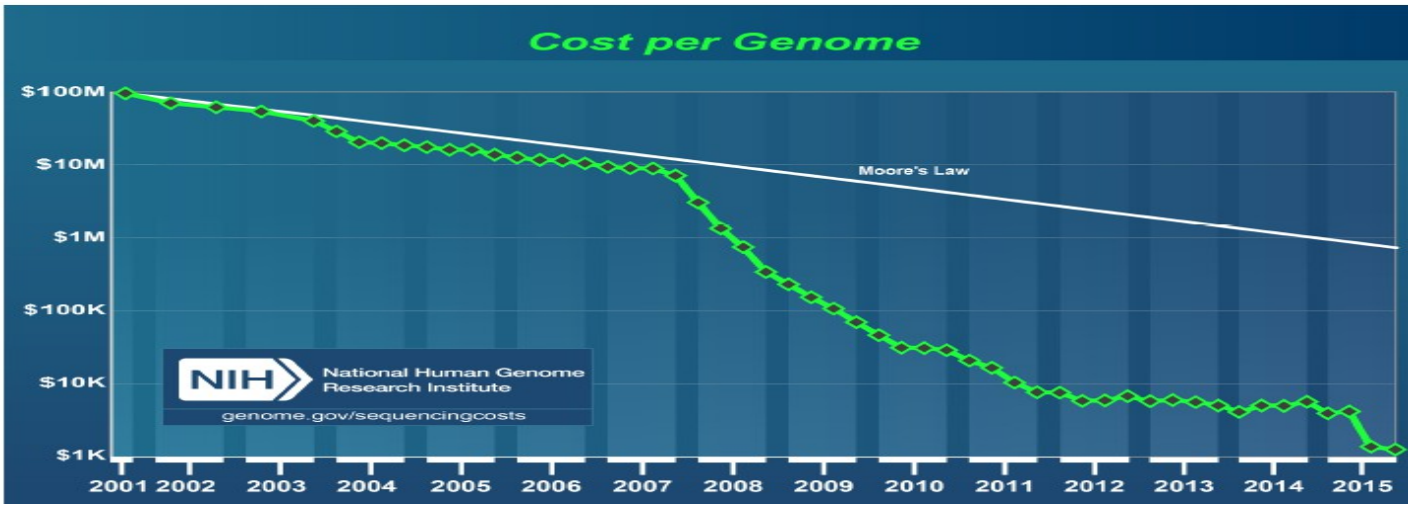
By dual price change – P' =aW' + b Pc' + c Potherinputs' .

Take a major input into future medicine – cost of sequencing human genome.

YOUR FULL GENOME CAN BE ANALYZED FOR JUST $1,000 IT USED TO COST $100 MILLION JUST A FEW YEARS AGO

By Alexandra Ossola Posted POPULAR SCIENCE September 30, 2015

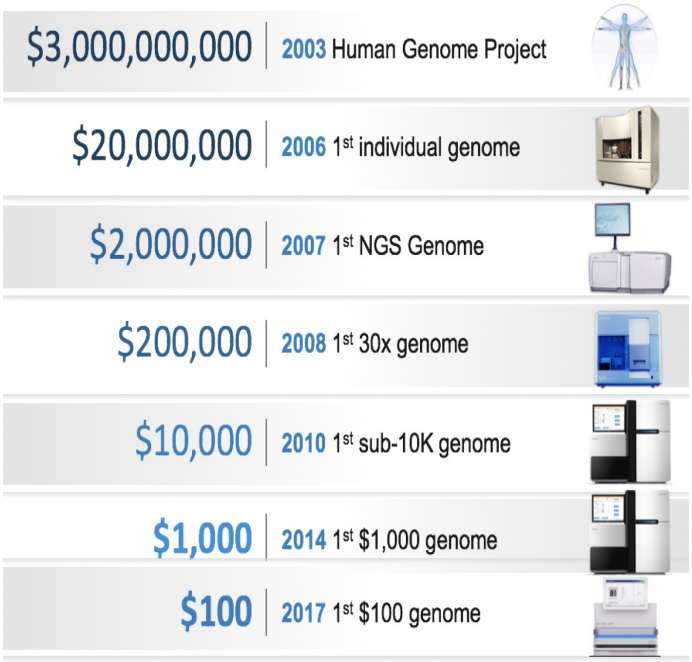
Veritas Genetics announced that it had reached a milestone: participants in its limited, but steadily expanding Personal Genetics Program can get their entire genome sequenced for just $1,000.

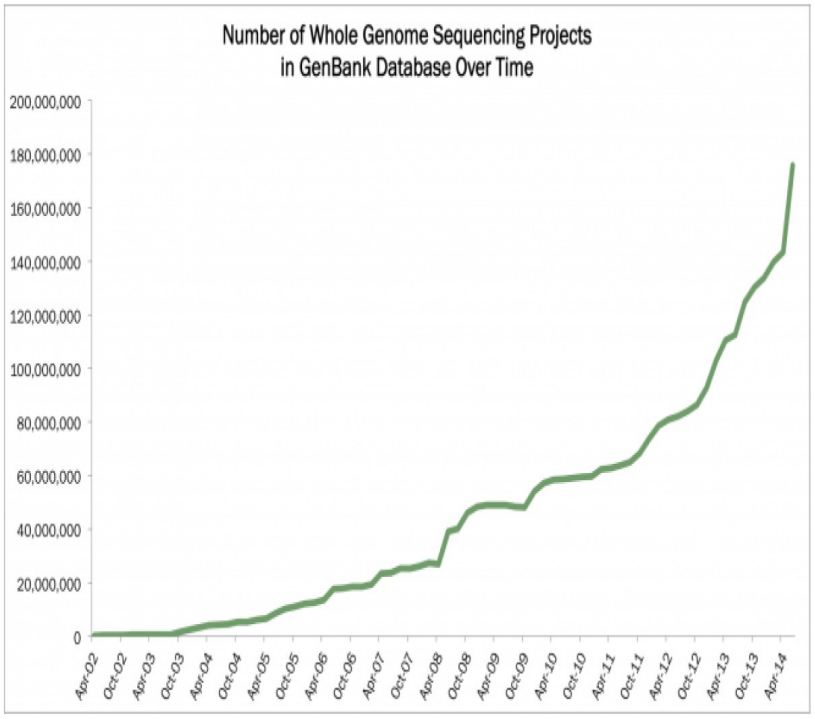


Forbes / Pharma & Healthcare / #WhoaScience

JAN 9, 2017 @ 05:30 PM 29,790

Illumina Promises To Sequence Human Genome For $100 -- But Not Quite Yet



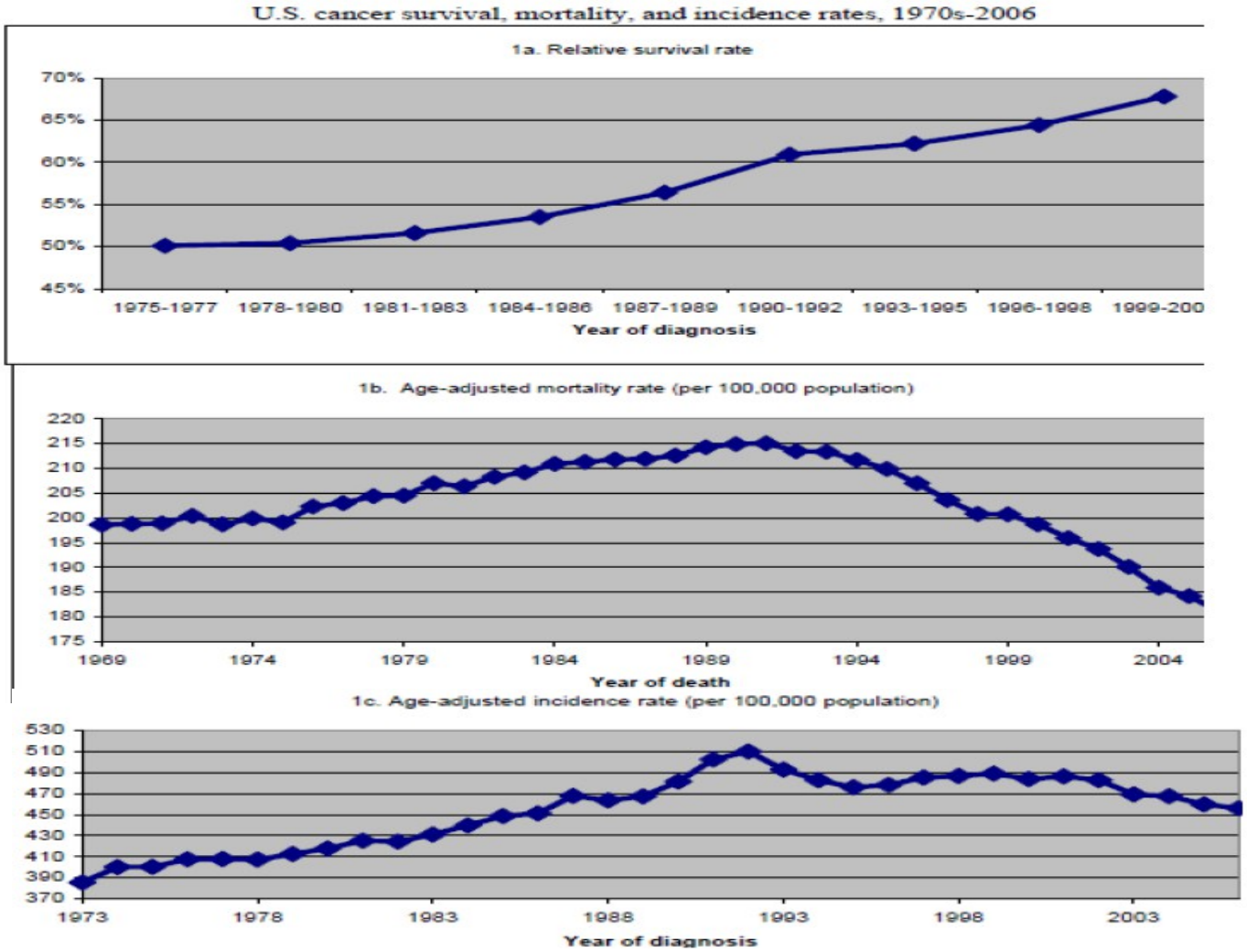


But US has only one official price index for biomedical R&D – BRDPI, which measures the annual change in the Biomedical Research and Development Price Index (BRDPI) indicates how much the NIH budget must change to maintain purchasing power. The BRDPI was developed and is updated annually by the Bureau of Economic Analysis (BEA), Department of Commerce under an interagency agreement with the NIH. BRDPI is weighted-average of the prices of all the inputs (e.g., personnel services, various supplies, and equipment) purchased with the NIH budget to support research. The weights used to construct the index reflect the proportion of total NIH expenditures on each of the types of inputs purchased. Theoretically, the annual change in the BRDPI indicates how much NIH expenditures would need to increase, without regard to efficiency gains or changes in government priorities to maintain NIH-funded research activity at the previous year's level. Input cost price index rather than output price measure of improved productivity!

TABLE A
HISTORICAL ANNUAL PERCENT CHANGES

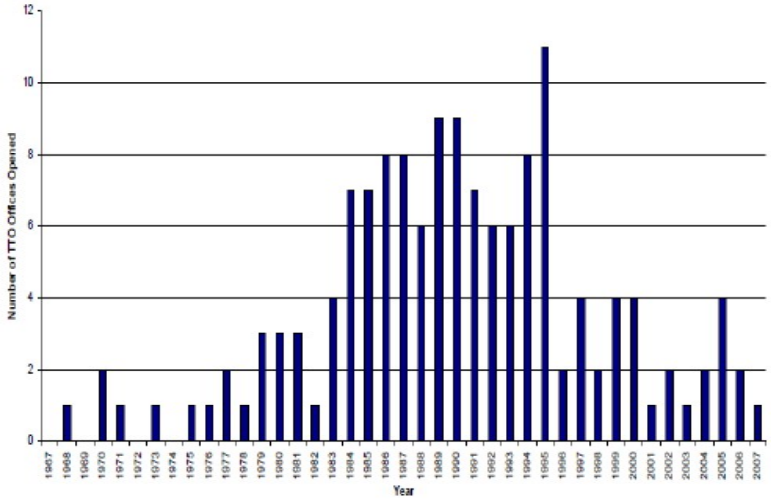
Fiscal Year	GDP Price Index	BRDPI
Col.(1)	Col.(2)	Col.(3)
1985	3.3%	5.6%
1986	2.3%	4.2%
1987	2.2%	5.3%
1988	3.2%	5.0%
1989	4.0%	5.2%
1990	3.6%	5.4%
1991	3.5%	4.8%
1992	2.4%	4.4%
1993	2.4%	3.4%
1994	2.2%	3.9%
1995	2.1%	3.5%
1996	1.9%	2.6%
1997	1.8%	2.8%
1998	1.2%	3.4%
1999	1.3%	3.2%
2000	2.1%	3.7%
2001	2.4%	3.3%
2002	1.6%	3.3%
2003	1.9%	3.5%
2004	2.5%	3.7%
2005	3.1%	3.9%
2006	3.3%	4.6%
2007	2.7%	3.8%
2008	2.1%	4.7%
2009	1.2%	2.9%
2010	0.9%	3.0%
2011	2.0%	2.9%
2012	1.9%	1.3%
2013	1.7%	1.9%
2014	1.7%	2.2%
2015	1.1%	2.2%

2) Through disease reduction: Lichtenberg, "Has Medical Innovation Reduced Cancer Mortality?" NBER WP 15880 Outcomes: survival rate for people diagnosed with disease, mortality rate with disease as cause; incidence rate



3)**Through Spillovers: Hausman** UNIVERSITY INNOVATION, LOCAL ECONOMIC GROWTH, AND ENTREPRENEURSHIP CES 12-10 June, 2012: identifies U.S. universities effect on economic activity using the interaction of a national shock to the spread of innovation from universities - the Bayh-Dole Act of 1980 - with pre-determined variation of university academic strengths and federal R&D. Using Census longitudinal establishment data, she finds that long run employment and payroll per worker around universities rise rapidly after Bayh-Dole in industries closely related to local university innovative strengths and with greater impact closer proximity to the university. Spillover studies credible because it is the other guys' R&D that benefits you, so there is less problem of endogeneity and you are counting the "knowledge magic" as opposed to measuring the normal flows.

FIGURE 1
Openings of University and Hospital Technology Transfer Offices
1967 - 2007



Source: Association of University Technology Managers (AUTM) Licensing Activity Survey, 2007.
Note: Bars represent the number of university technology transfer offices (among AUTM members) opened in each year from 1967 to 2007.

FIGURE 2
University Patents Granted by Year, 1976-1997

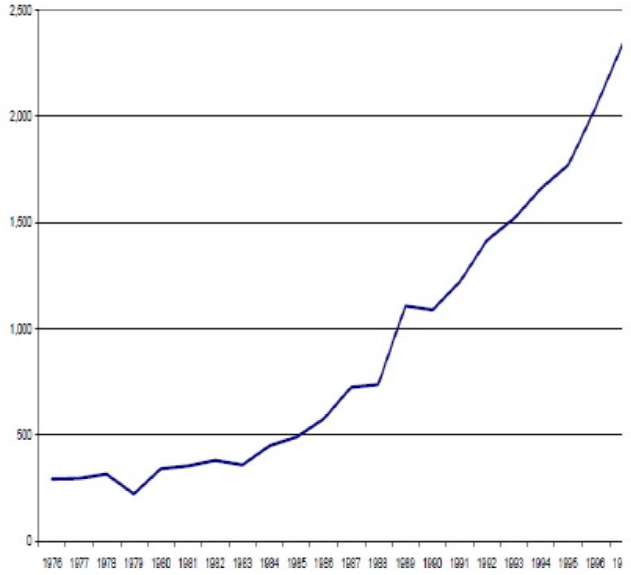
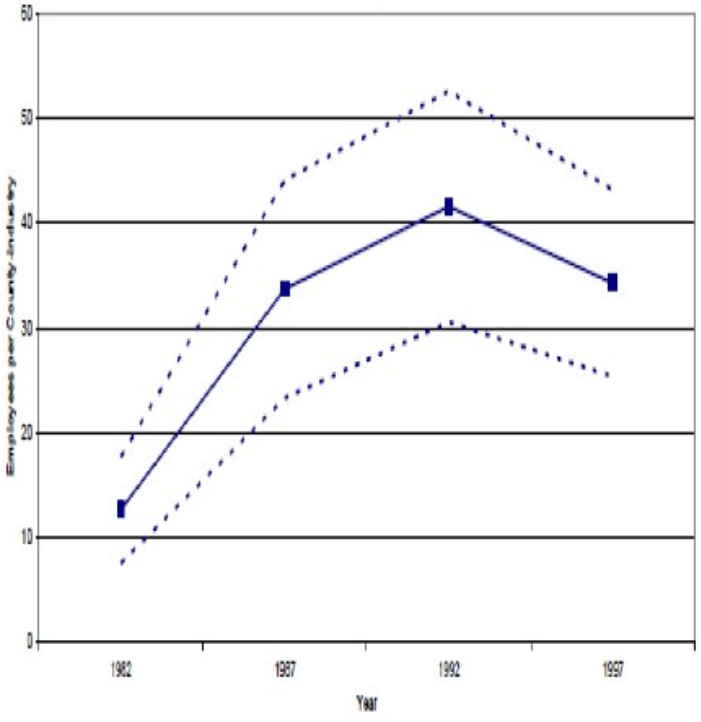


FIGURE 4
Employment Effects by Year After Bayh-Dole
1982 – 1997



Notes: Points represent coefficients on the interaction term of industry intesity and year indicators from a regression predicting total employment in a county-industry-year, with county and industry-by-year fixed effects. Estimates for this regression are shown in Table 4, column 2. Error bands represent the 95% confidence interval around these point estimates.

TABLE 7
Effects of Federal University Research Funding
on Industry Employment

	(1)	(2)	(3)
Dependent Variable: Employment	**5 Yr Sum: Total Funding**	**5 Yr Sum: DOD Funding**	**5 Yr Sum: NIH Funding**
After Bayh-Dole * Fed Funding * univ cnty	0.061 ***	0.104 ***	0.140 ***
	(0.012)	(0.032)	(0.027)
Industry * Year Fixed Effects	Yes	Yes	Yes
Observations	4,814,860	4,814,860	4,814,860
R-squared	0.11	0.11	0.11

Notes:

1. Robust standard errors are clustered at the county level.
2. After Bayh-Dole is an indicator equal to 1 after 1980, and univ cnty is an indicator equal to 1 for counties near a university.
3. Federal funding is measured in millions of dollars. The 5 year sum of federal funding includes the years 1976-1980, inclusive. Col. 2 uses the 5 year sum of funding from the Department of Defense. Col. 3 uses the 5 year sum of funding from the National Institutes of Health.
4. In all columns, the dependent variable is total employment in the county-industry-year, while the measure of federal funding changes across columns.
4. Main effects of After Bayh-Dole * univ cnty and Fed Funding * univ cnty are included in all

4) Stock Market and financial measures

1- **Tobin's Q** – measures stock market value/book value – If stock market values a firm more than estimated replacement value on books, this could reflect unmeasured contribution of knowledge, goodwill, technology and other intangible assets that a company may have but aren't recorded by accountants. Griliches initiated this research in 1980s. Here is result from that analysis.

TABLE 2

THE STOCK MARKET'S RELATIVE VALUATION OF R & D AND PATENTS
DEPENDENT VARIABLE: LOG (Q)

SP/A	0.493	0.111	0.246
	(0.165)	(0.094)	(0.082)
K/A		1.374	0.741
		(0.182)	(0.152)
NR/A			11.99
			(1.556)
R^2	0.027	0.125	0.258

Source: Cockburn and Griliches (1987), table 3.
V = market value of the firm.
A = total net assets at replacement cost.
Q = V/A.
K = "stock" of R & D using 15 percent depreciation rate.
NR = "news in R & D": current R & D less depreciation of the R & D stock.
SP = "stock" of patents using 30 percent depreciation rate.
N = 722. Mean of the dependent variable = −0.272; standard deviation = 0.697.
Heteroscedasticity-consistent standard errors in parentheses.
All equations also contain an intercept term and the logarithm of assets, whose coefficients was small but consistently significant, on the order of −0.03 (0.01).

Sandnerc and Blocka "The market value of R&D, patents, and trademarks", Research Policy vol 40 2011

Table 5
Market value regressions of knowledge assets and trademark stocks.

Variables(Dependent variable: Tobin's *q*)	Model M0	Model M1	Model M2	Model M3	Model M4	Model M5
Log (assets)	−0.0107	−0.0155*	−0.0126	−0.0226**	−0.0121	−0.0022
	(0.0095)	(0.0094)	(0.0010)	(0.0096)	(0.0101)	(0.0103)
R&D stock/assets		0.6333***	0.6342***	0.5292***		0.3188*
		(0.1848)	(0.1847)	(0.1893)		(0.1898)
Patent stock/R&D stock			0.0006	−0.0012		−0.0026
			(0.0032)	(0.0034)		(0.0044)
Citation stock/patent stock				0.1553***		0.1485***
				(0.0286)		(0.0284)
Trademark stock/marketing assets					13.5040***	11.816***
					(2.5929)	(2.6212)
Control variables						
No R&D		−0.0055	−0.0200	−0.0221		−0.0366
		(0.0355)	(0.0351)	(0.0355)		(0.0346)
No patents			0.0881	0.1337***		0.1307***
			(0.0432)	(0.0437)		(0.0429)
Patent stock/R&D stock			0.0001	0.0002		−0.0005
			(0.0006)	(0.0006)		(0.0008)
Citation stock/patent stock				0.0637***		0.0591***
				(0.0110)		(0.0106)
Trademark stock/marketing assets					0.0628***	0.0506***
					(0.0113)	(0.0108)

Notes: *N* = 6757 observations from *N* = 1216 companies. Estimation method: NLLS. Clustered standard errors in parentheses. Reference group for industry: 'electronics ar components'. Reference country: US. Reference year: 2002.

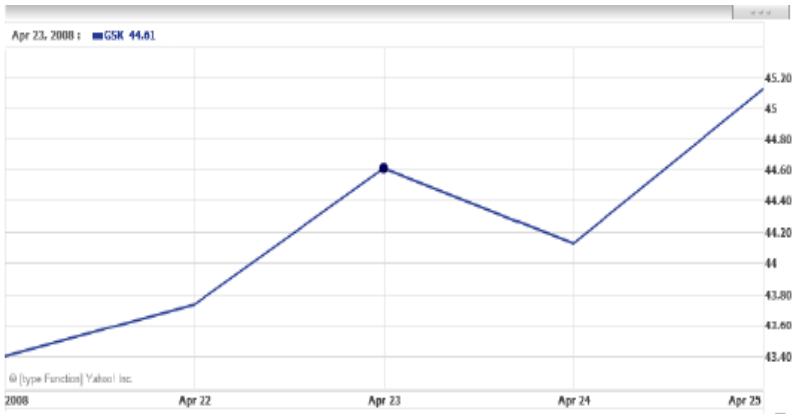
5.Event Studies

A firm announces some some R&D /innovative activity --bought a small R&D startup; completed project; expanding R&D activity. The announcement is a surprise to the stock market. To the extent that the market makes a good assessment of the prospects of the firm, the increase in its value represents the best "informed judgment" of the likely future payoff from this R&D

GlaxoSmithKline to acquire Sirtris Pharmaceuticals, a world leader in 'Sirtuin' research and development – Tuesday 22 April 2008: GlaxoSmithKline and Sirtris Pharmaceuticals Incorporated (Nasdaq: SIRT) announced today that they entered a definitive agreement pursuant to which GlaxoSmithKline will acquire Sirtris Pharmaceuticals for approximately USD720 million through a cash tender offer of USD22.50 per share.

What happened to the Glaxo share price? With 2.54B shares outstanding a change in share of 2.8 cents would "pay for the purchase"

	Adj	Close	Adj	Close
April 21	39.2	43.40		
April 22	39.5	43.73		
April 23	40.29	44.61	2.0%	+2.0%
April 24	39.85	44.12		
April 25	40.75	45.12		



PAPER TOPIC: How responsive are the shares of big pharmaceuticals firms when they buy start-ups.

The event study methodology.

Identification of effect of event (new R&D, purchase, whatever), about which people did not know beforehand, comes from **narrow time period**. The period is narrow so that other confounding factors do not operate, so no need to control for other factors as in standard regression models. An event study is good if

1)Market rapidly reacts to news;

2)Properly identified and isolated event. Critical to get appropriate WINDOW during which information disseminated.

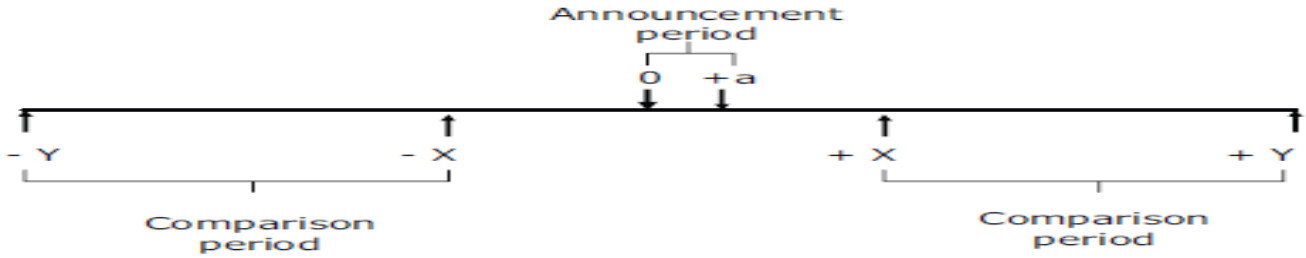
Surprisingly there is a lot of variability in the choice of a window and variation in when analysts find effects. Consider the labor area: Many studies that use the event study methodology find that the stock market evaluates labor events within the short window used to isolate those events. These studies include announcements of staff reductions and shutdowns (Abowd, Milkovich, and Hannon, 1990), announcements about work-family personnel policies (Arthur and Cook, 2004), news of anti-sweatshop corporate campaigns (Rock 2003) and news about union-initiated boycotts (Pruitt, et al 1988) that resemble in part the corporate campaign against Smithfield. In each case, the studies report that some labor event affected share prices in a short window when there was little time for anything else to impact the price.

But other studies have found that some labor events affect share prices over a longer period but not in a short event window (Abowd, 1990, Lee and Mas, 2008). Economists are uncertain about the reasons why announcements about some activities impact share prices immediately, per the classic event study, while other pieces of news do not have such an effect.

Initially labor analysts thought the problem was that stock market concern over labor issues is modest but there are also studies of non-labor events in which abnormal returns begin around the time of an event and increase over time and note that experts in financial markets view this pattern as "an open puzzle". It is a puzzle because it runs counter to what one expects in an efficient financial market.

Event Study begins by finding announcement of event from some source (with recognition that could have been leakage of information beforehand. Before 1976 US firms did not have to disclose RD on their 10-K forms so an announcement would be disclosing "secret information". Studies use day 0 or day -1 as the announcement period, with the day-1 reflecting some belief that announcement itself leaked.

- Event studies — the measurement of an abnormal stock return



Chan, Martin, Kensinger study, Journal of Financial Economics, 26, 1999, 255-276

Category I. *Pure announcements of plans to increase corporate R&D expenditures, with no additional contemporaneous information.*
For example: 'Varian Associates Inc. said it plans to increase its spending on research and development to $50 million for 1983, up 20% from $41 million' (*WSJ*, 2/25/83). This category also includes announcements of plans to build or expand R&D centers or facilities. *Also:* 'General Electric Co. announced plans for a $50 million expansion of its research and development center in Schenectady, New York' (*WSJ*, 11/20/79).

Category II. *R&D announcements that also release management's forecast of earnings.*
For example: 'Medtronic Inc.'s earnings and revenue growth in fiscal 1983, ending April 30 should be at or near 20%, Dale Olseth, chief executive, said after the annual meeting.... He added that the company plans to spend at least $35 million on research and development this year, up from $30 million last year' (*WSJ* and *DJNW*, 8/25/82).

Category III. *R&D announcements that also release quarterly earnings reports.*
For example: 'Esterline Corp. posted first quarter net earnings of 28 cents a share versus the prior period's net of 26 cents.... After the annual meeting, the president and chief executive also said research and development spending will rise to about $19 million from $16.4 million in the prior year' (*WSJ* and *DJNW*, 2/27/85).

Category IV. *R&D announcements that also report increases in capital expenditures.*
For example: 'Texas Instruments said it will increase its capital expenditures for 1982 to $390 million from $350 million in 1980 and will spend $244 million on research and development compared with $219 million last year' (*WSJ* and *DJNW*, 4/15/82).

Strategy: 1) Find announcements of increased research spending from Dow-Jones New Retrieval Service database, which covers Dow-Jones NewsWire, WSJ, and Barrons2) Go to CRSP (Center for Research in Security Prices) data base http://www.crsp.com/ for share prices and calculate:

(1) $R_{i,t} = (D_{i,t} + P_{i,t} - P_{i,t-1})/P_{i,t-1}$

where $D_{i,t}$ = dividend per share over day t for security i and $P_{i,t}$ = price (ex dividend) of security i at the end of day t; and

(2) $R_{i,t} = \alpha_i + \beta_i R_{m,t} + AR_{i,t}$

(3) *ABNORMAL RETURN is Ari,t*

(4) *CUMULATED AVERAGED ABNORMAL RETURN. SUM THE ABNORMAL RETURNS OVER different periods and take an average:*

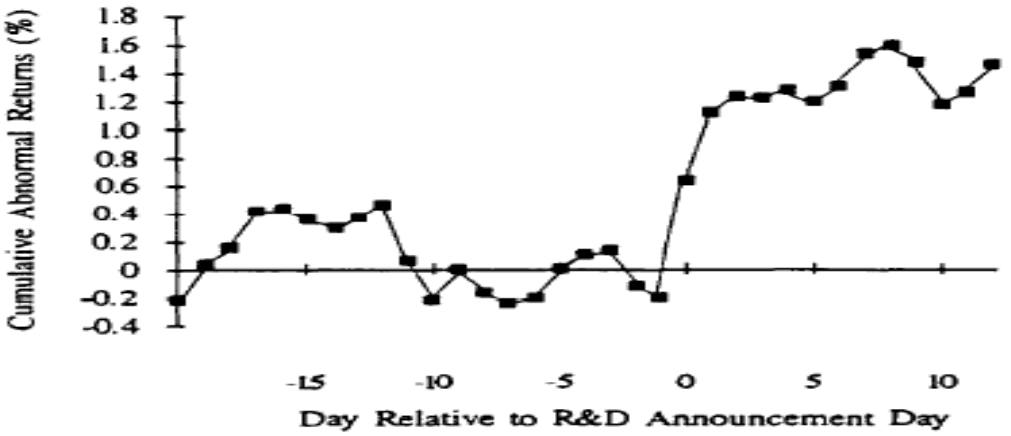


Fig. 1. Cumulative abnormal returns (%) in the period from 20 days before through 12 days after the 95 R&D spending increase announcements in the period 1979–1985.

Table 4

Abnormal stock returns for 95 announcements of R&D spending increases by NYSE and AMEX firms in the period 1979–1985.

Panel A: Average and cumulative abnormal returns

Day relative to R&D announcement	Average abnormal return (in percent)	Cumulative average abnormal return (in percent)	Percent of positive abnormal returns
−30	0.10	0.10	45.3
−25	0.10	−0.39	50.5
−20	−0.03	−0.23	45.3
−19	0.26	0.03	50.5
−18	0.14	0.16	49.4
−17	0.24	0.41	57.9
−16	0.03	0.43	48.4
−15	−0.10	0.34	49.4
−14	−0.05	0.29	44.2
−13	0.07	0.36	45.3
−12	0.08	0.45	45.3
−11	−0.40[a]	0.05	37.9
−10	−0.28[b]	−0.23	41.1
−9	0.21	−0.02	52.6
−8	−0.15	−0.17	50.5
−7	−0.09	−0.25	46.3
−6	0.05	−0.20	53.7
−5	0.20	−0.00	49.4
−4	0.10	0.10	49.4
−3	0.03	0.13	50.5
−2	−0.23	−0.10	41.1
−1	−0.11	−0.21	48.4
0	0.85[a]	0.64	61.1
1	0.53[a]	1.17	57.9
2	0.14	1.31	53.7
3	−0.05	1.27	52.6
4	0.08	1.35	50.5
5	−0.11	1.24	49.4
6	0.13	1.37	50.5
7	0.27	1.64	56.8
8	0.07	1.72	52.6
9	−0.14	1.58	49.4
10	−0.34[b]	1.24	36.8
11	0.09	1.33	50.5
12	0.23	1.57	51.6

Panel B: Distribution of two-day announcement-period abnormal returns

Magnitude of two-day abnormal returns for the day of and the day after the announcement (CAR)	Number of observed abnormal returns
$11.0\% < CAR$	2
$8.0\% < CAR <= 11.0\%$	3
$6.0\% < CAR <= 8.0\%$	3

Additional concern: If announcement is really new information then firms that increased R&D might have done so because they expected positive response. Perhaps other firms that increased R&D did not do so because they expected negative response. Then the results would not indicate response to RD but response to RD announcement but firms that self-selected for positive analysis. They do some "selectivity correction" by creating matched set of firms that increased RD without announcements, using Business Week and