

The value of new healthcare-related technologies in the context of HTA

Frank R. Lichtenberg

Columbia University
and
National Bureau of Economic Research
frank.lichtenberg@columbia.edu

HTA is usually based on a concept known as the incremental cost-effectiveness ratio

- The incremental cost-effectiveness ratio of an intervention is the ratio of the change in costs of a therapeutic intervention (compared to the alternative, such as doing nothing or using the best available alternative treatment) to the change in effects of the intervention.
- Often, the change in effects is measured in terms of the number of quality-adjusted life years gained by the intervention.

HTA theory

A technology is cost effective if and only if

$$\frac{\Delta \text{COST}}{\Delta \text{QALY}} < \text{VSLY}$$

Definitions:

$$\Delta \text{COST} = \text{COST}_1 - \text{COST}_0$$

$$\Delta \text{QALY} = \text{QALY}_1 - \text{QALY}_0$$

COST_1 = cost of using new technology

COST_0 = cost of using old technology

QALY_1 = quality adjusted life-years from using new technology

QALY_0 = quality adjusted life-years from using old technology

VSLY = value of a statistical life year

Theory vs. practice

- In principle, this is a reasonable decision rule.
- But for HTA to yield valid decisions in practice, it is necessary to have reliable estimates of:

ΔCOST

ΔQALY

VSLY

(The devil is in the details!)

- In my opinion, incorrect estimates of some or all of these key inputs are often used:
 - ΔCOST is frequently overestimated
 - ΔQALY and VSLY are frequently underestimated
- Due to these estimation biases, health technologies that are truly cost-effective may often be rejected as cost-ineffective.
- Now I will offer support for my hypothesis that ΔCOST is frequently overestimated and that ΔQALY and VSLY are frequently underestimated

Δ COST

$$\begin{aligned}\Delta \text{COST} = & \\ & \Delta \text{COST}_{\text{drug}} \\ & + \Delta \text{COST}_{\text{other_med}} \\ & - \Delta \text{PRODUCTIVITY}\end{aligned}$$

Problems:

$\Delta \text{COST}_{\text{drug}}$ overestimated

$\Delta \text{COST}_{\text{other_med}}$ overestimated

$\Delta \text{PRODUCTIVITY}$ underestimated

Overestimation of
increase in drug costs

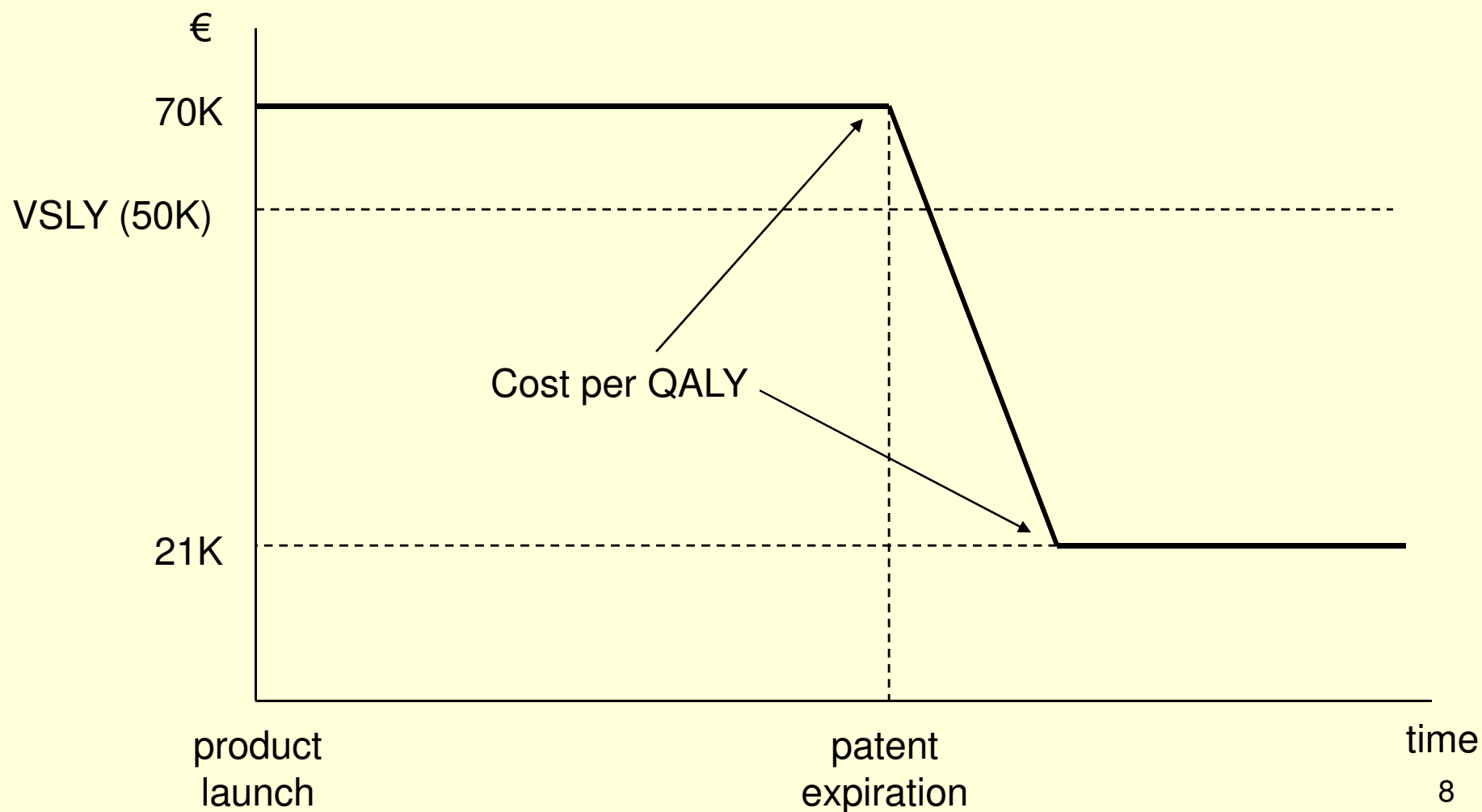
Average drug price vs. price at time of launch

- Incremental cost-effectiveness ratio is usually evaluated using the price of the drug at the time of launch
- In the U.S., average drug prices typically decline by 70% within 3 years of patent expiration

Suh, Dong-Churl, Willard G. Manning, Jr., Stephen Schondelmeyer, Ronald S. Hadsall, "Effect of Multiple-Source Entry on Price Competition After Patent Expiration in the Pharmaceutical Industry," *Health Services Research*, June, 2000,
http://findarticles.com/p/articles/mi_m4149/is_2_35/ai_64721122/pg_1

- HTA should be based on the average price over the drug's life-cycle, not the price at the time of launch

Incremental cost per QALY: pre vs. post patent expiration



Cost offsets

Cost offsets are often not accounted for in HTA

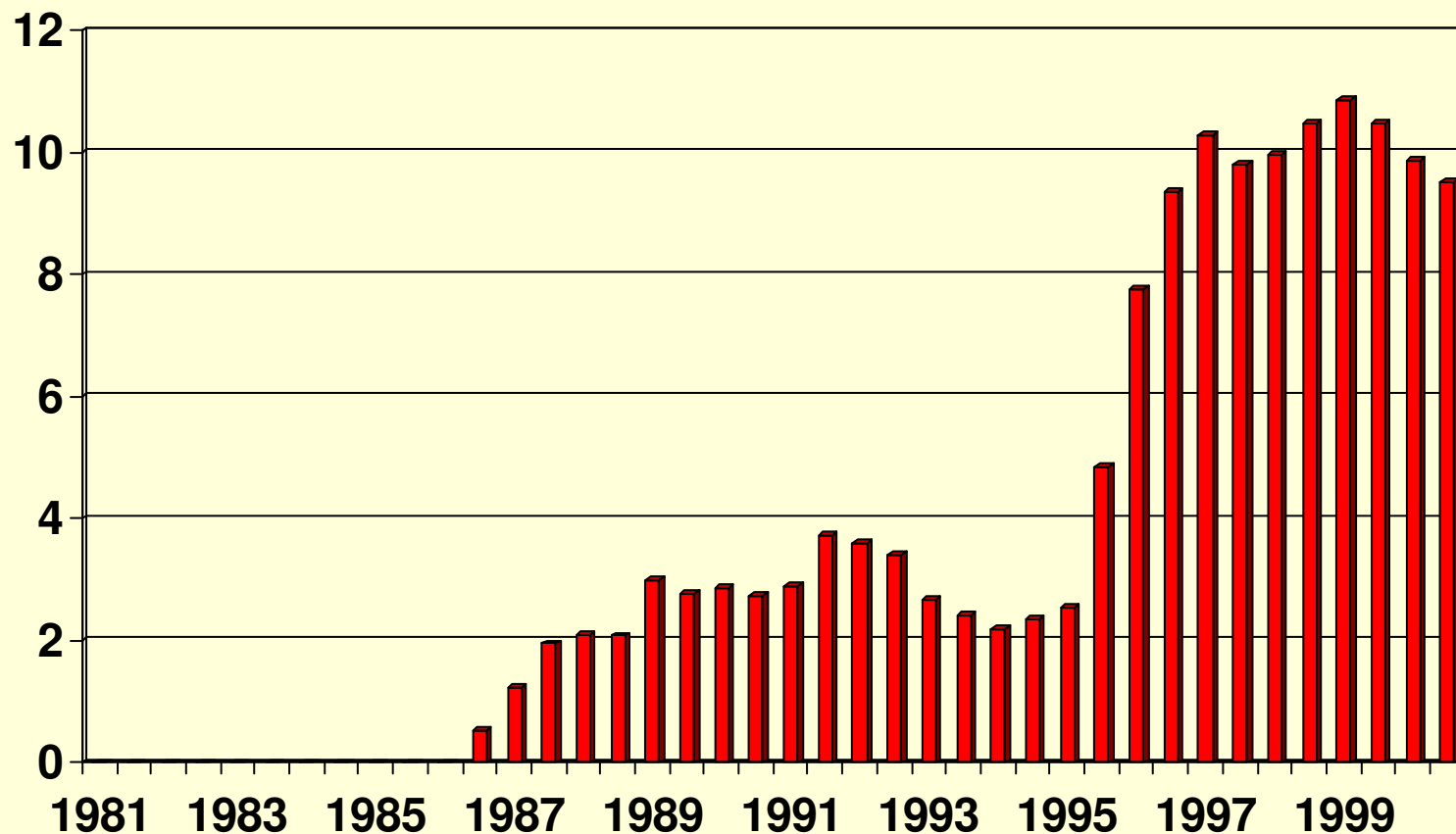
- Example: Evaluation of cost-effectiveness of etanercept and infliximab for rheumatoid arthritis

“The clinical effectiveness and cost-effectiveness of new drug treatments for rheumatoid arthritis: etanercept and infliximab,” Report commissioned by: NHS R&D HTA Programme, on behalf of the National Institute for Clinical Excellence,

<http://www.nice.org.uk/nicemedia/pdf/RAAssessmentReport.pdf>

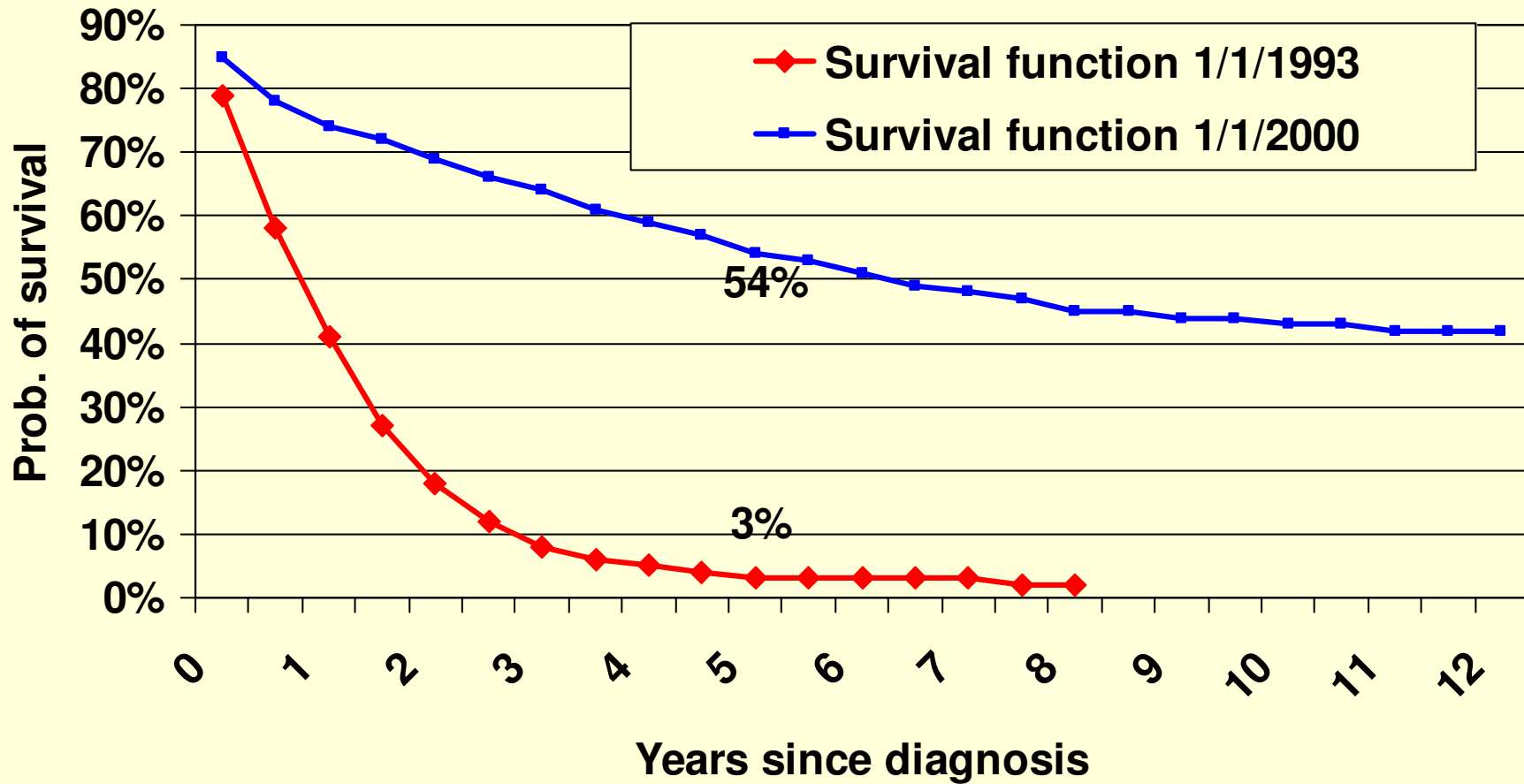
- The estimated base-case incremental cost effectiveness ratio (ICER) was £83,000 per QALY for etanercept and £115,000 per QALY for infliximab.
- “It should be stressed that *these figures do not include all potential benefits of these agents. For instance no account is taken of the possible reduction in the need for joint replacement surgery, hospitalisation or needs for aids and appliances.*”

No. of HIV/AIDS Rx's per person with HIV/AIDS

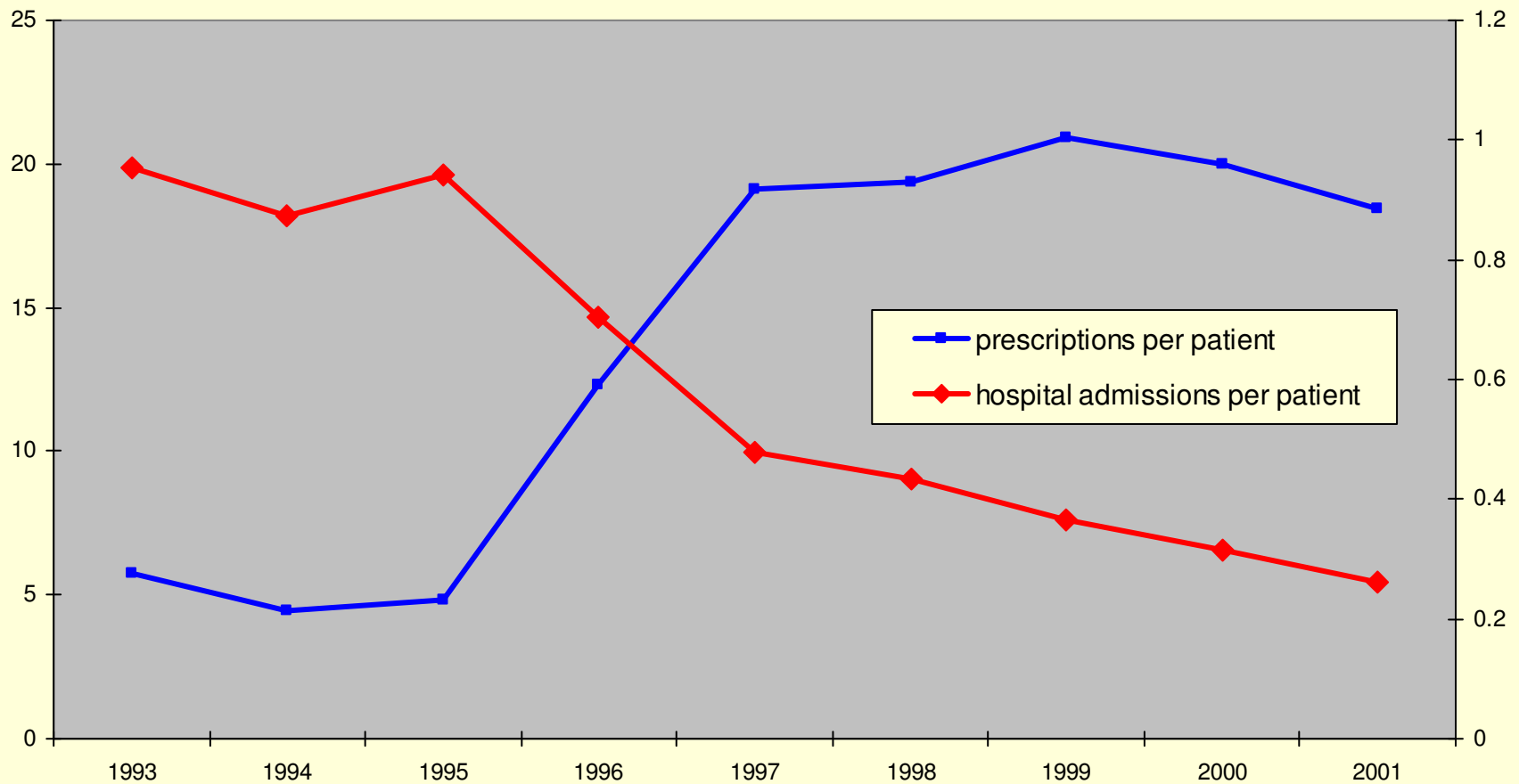


Between 1995 and 1997, seven new molecules and two new drug classes for treating HIV were introduced

HIV/AIDS Survival functions: 1993 vs. 2000

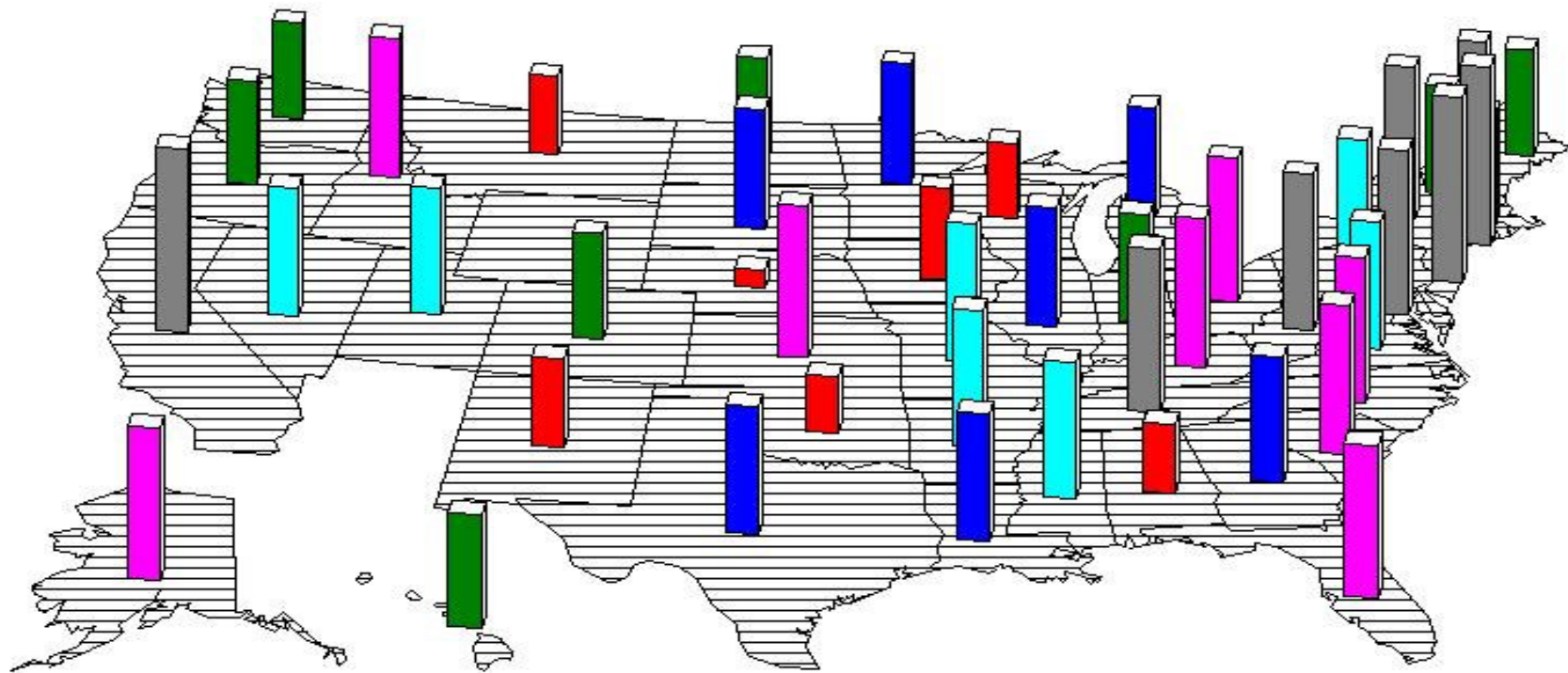


Drug utilization and hospital utilization by AIDS patients

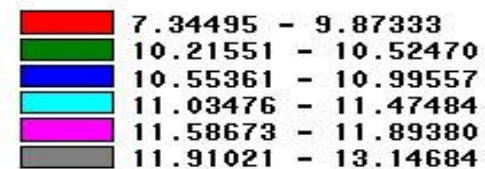


- Life expectancy of AIDS patients in 2001 was 13 years higher than it would have been if the drug utilization rate had not increased from its 1993 level. About 60% of the total 22.6-year increase in life expectancy during 1993-2001 is attributable to the increase in drug utilization.
- Increased utilization of HIV drugs caused hospital utilization to decline by .25 to .29 discharges per person per year. About one-third of the total decline in hospital utilization during 1993-2001 is attributable to the increase in drug utilization; *56% of the increase in HIV drug expenditure was offset by a reduction in hospital expenditure.*

Increase in drug vintage index 1991-2004, by state



increase in fixed-weighted vintage index, 1991-2004



The effect of using newer drugs on admissions of elderly Americans to hospitals and nursing homes: state-level evidence from 1993-2003

- I examined the effect of pharmaceutical innovation on admissions of elderly Americans to hospitals and nursing homes during 1997-2003, using longitudinal state-level data on 12 states.
- States that had larger increases in drug vintage had smaller increases in the number of hospital and nursing-home admissions per elderly person, controlling for other factors (income, education, BMI, etc.)
- Use of newer drugs (increase in mean vintage):
 - increased drug expenditure per person by \$284-\$778 in 2003
 - reduced the number of hospital admissions by 6.1 per hundred people in 2003; this was worth \$785 per person
 - reduced the number of nursing home admissions by 2.7 per hundred people in 2003; this was worth \$1166 per person

Lichtenberg, Frank, "The effect of using newer drugs on admissions of elderly Americans to hospitals and nursing homes: state-level evidence from 1997-2003," *Pharmacoeconomics* 24 Suppl 3, 2006, 5-25.

Productivity gains

**Availability of new drugs and
Americans' ability to work**

Research objectives

- Investigate the extent to which the introduction of new drugs has increased society's ability to produce goods and services, by increasing the number of hours worked per member of the working-age population.
- Attempt to determine whether the value of the increase in goods and services resulting from new drugs exceeds the cost of the drugs.

Previous evidence re. the impact of new drugs on ability to work

Numerous case studies of specific drugs

- *Terbutaline (approved by the FDA in 1974) for asthma*
- *Glipizide (1984) for diabetes*
- *Sumatriptan and rizatriptan (1992 and 1998, respectively) for migraines.*

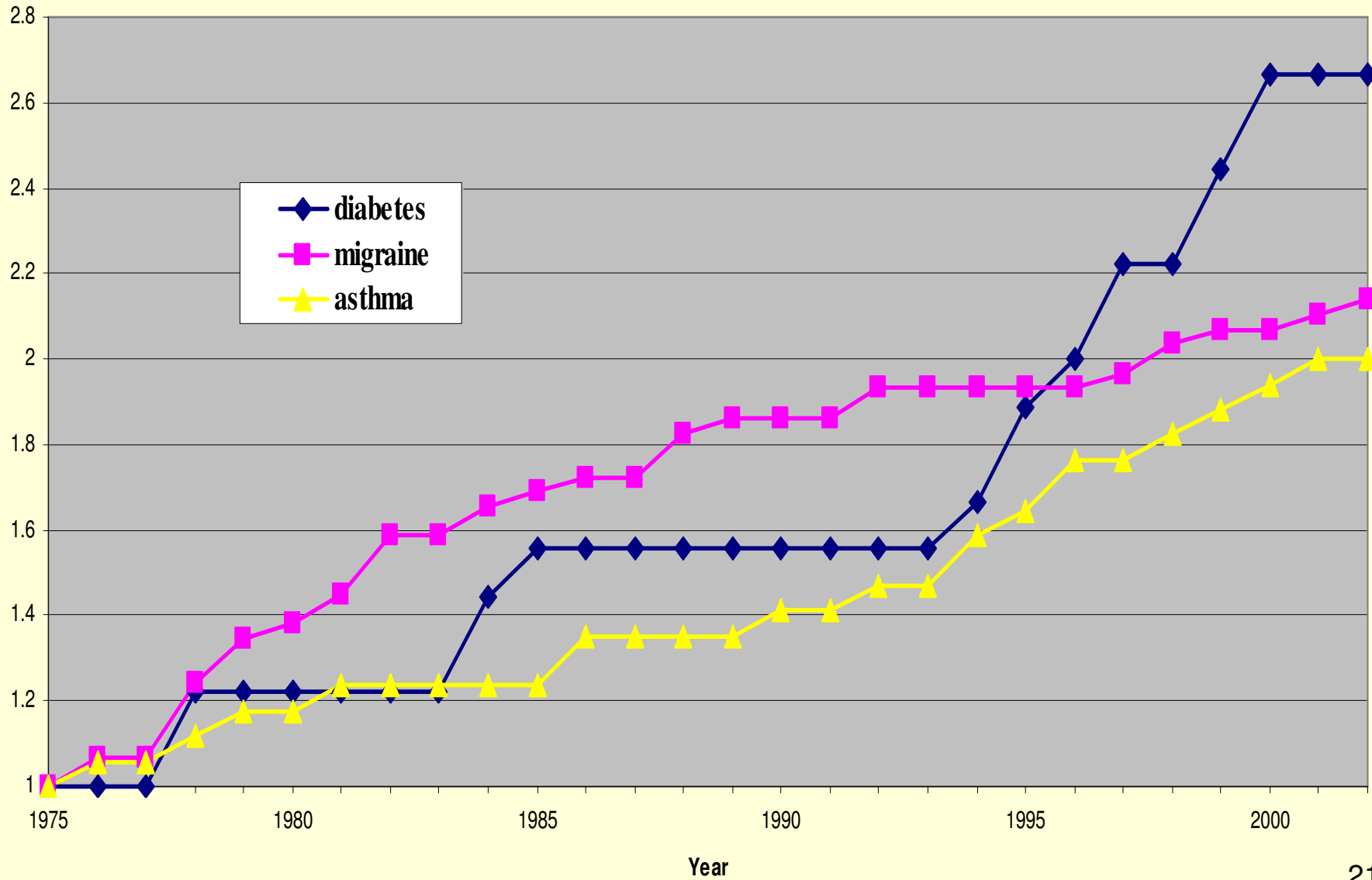
However, it is difficult to estimate from case studies the average or aggregate effect of new drugs on ability to work

A new approach

- I examined whether medical conditions for which many new drugs were introduced exhibited greater increases in ability to work than conditions for which few new drugs were introduced, controlling for other factors.
- My analysis was based on data on about 200,000 individuals with 47 major chronic conditions observed throughout a 15-year period (1982-1996).
- A government survey collected information about:
 - whether each person was unable to work, mainly due to one of the chronic conditions, and
 - the number of work-days missed in the two weeks preceding the interview due to each chronic condition (for currently employed persons)

Lichtenberg, Frank, "Availability of new drugs and Americans' ability to work," *Journal of Occupational and Environmental Medicine* 47 (4), April 2005, 373-380.

Cumulative number of drugs approved for three conditions
relative to the cumulative number of drugs approved for that condition in 1975



Summary of estimates

- The introduction of new drugs reduces:
 - The probability of being unable to work
 - The probability of being limited in work
 - The probability of having ever been hospitalized
 - The number of work-loss days
 - The number of restricted-activity days
- If no new drugs had been introduced during 1982-1996, the probability of being unable to work in 1996 would have been 29% higher than it actually was—5.2% instead of 4.0%.
- The estimated benefit of the new drugs, in terms of the value of the increase in workforce participation and hours, is almost nine times as great as the estimated cost of the new drugs.

States that adopted new drugs more rapidly had higher productivity growth

- States with larger increases in Medicaid drug vintage had faster productivity growth, conditional on income growth and the other factors.
- The increase in Medicaid drug vintage is estimated to have increased output per employee by about 1% per year.
- This is consistent with my previous study, where I found that pharmaceutical innovation reduced the number of work-loss days per employed person by 1.0% per year.

Estimation of $\Delta QALY$

Case study: cancer

Conventional wisdom

“The effect of new treatments for cancer on mortality has been largely disappointing.”

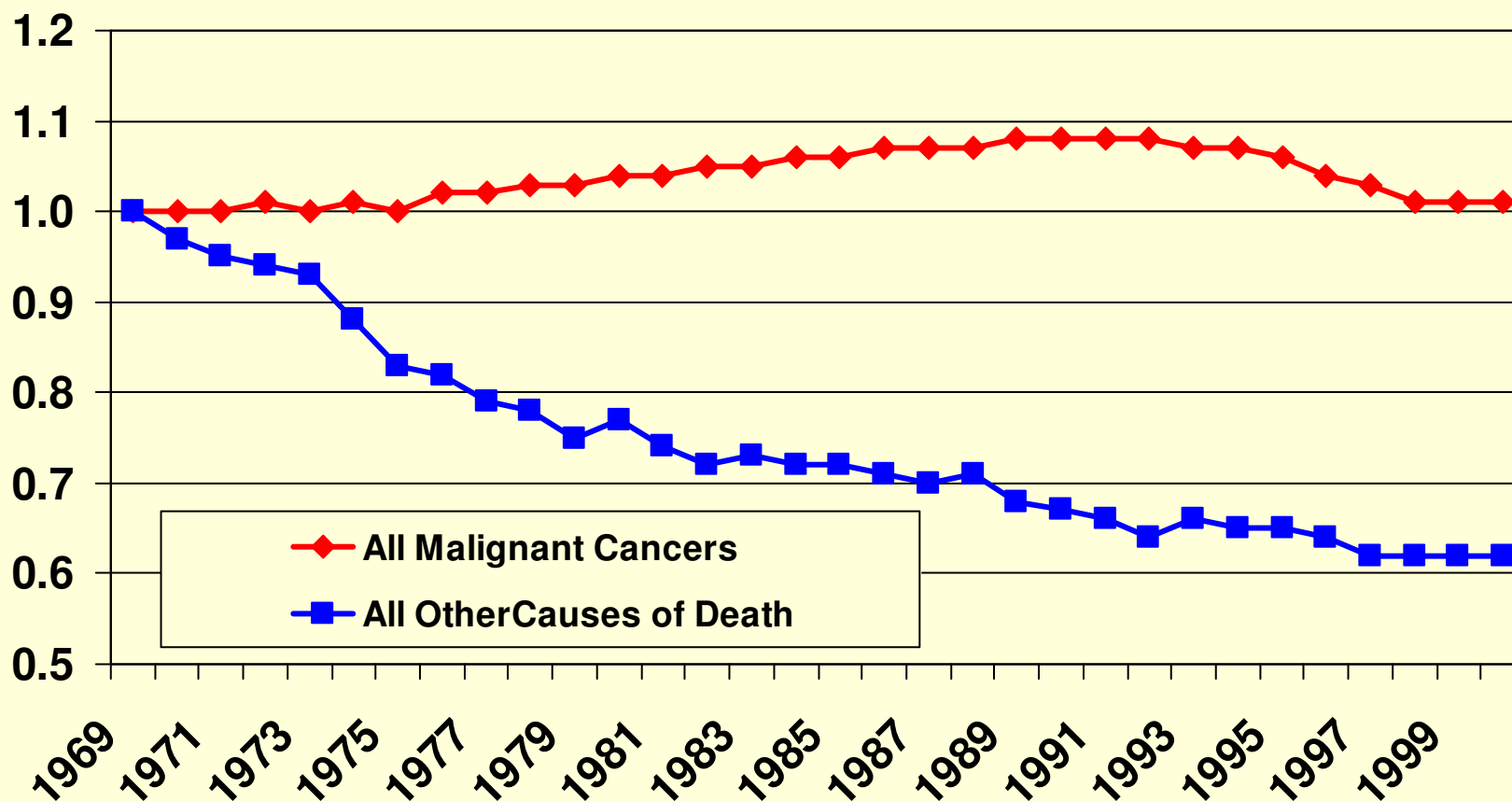
Bailar & Gornik (1997), “Cancer undefeated,” *New England Journal of Medicine* 336 (22), pp. 1569-74.

“Why have we made so little progress in the War on Cancer?”

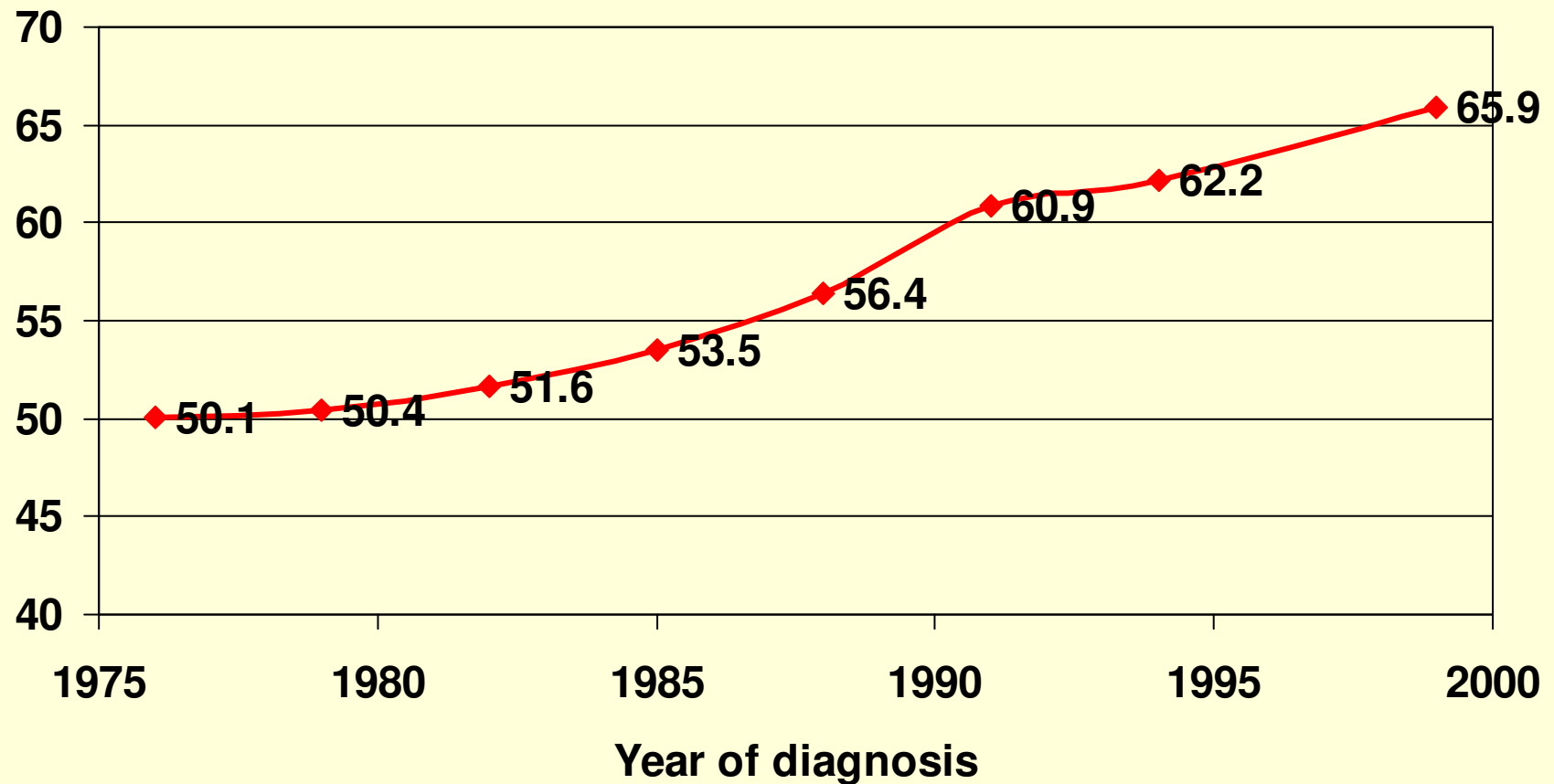
Clifton Leaf, “Why we’re losing the war on cancer, and how to win it,” *Fortune*, March 22, 2004

<http://blog.aperio.com/articles/Fortune_Cancer.pdf>

U.S. Mortality Age-Adjusted Rates, Total U.S., 1969-2000 (Index: 1969=1.00)



5-year relative survival rate, all cancer sites



Oncology drug approval basis

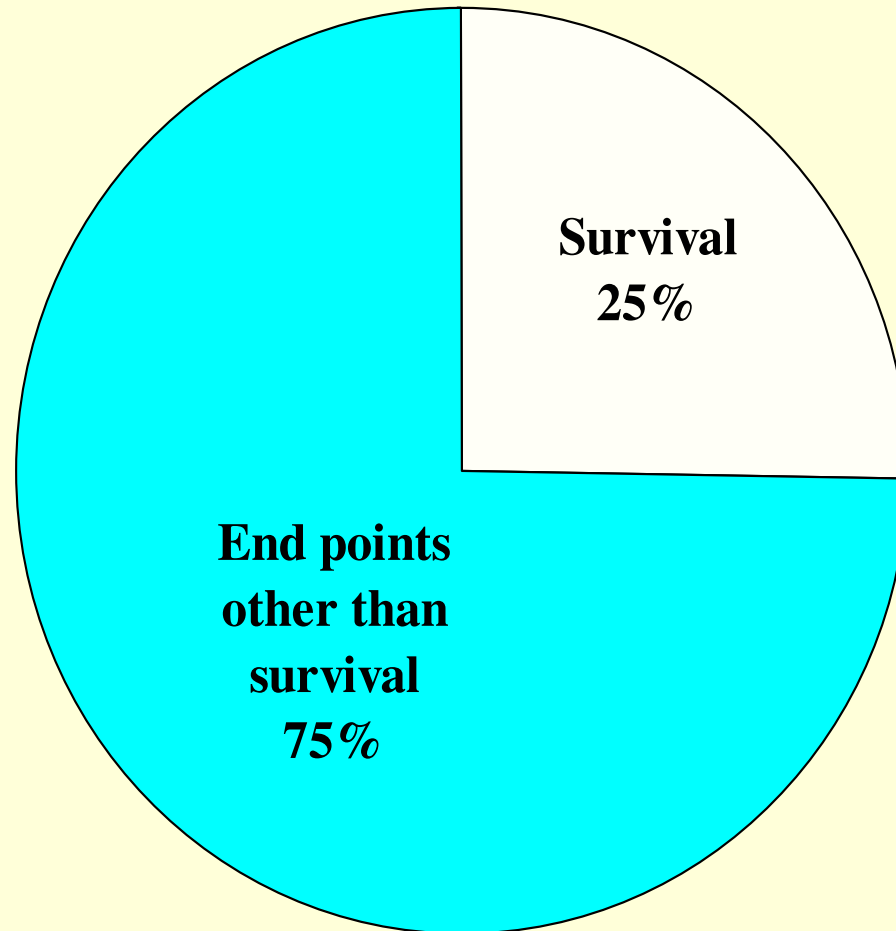
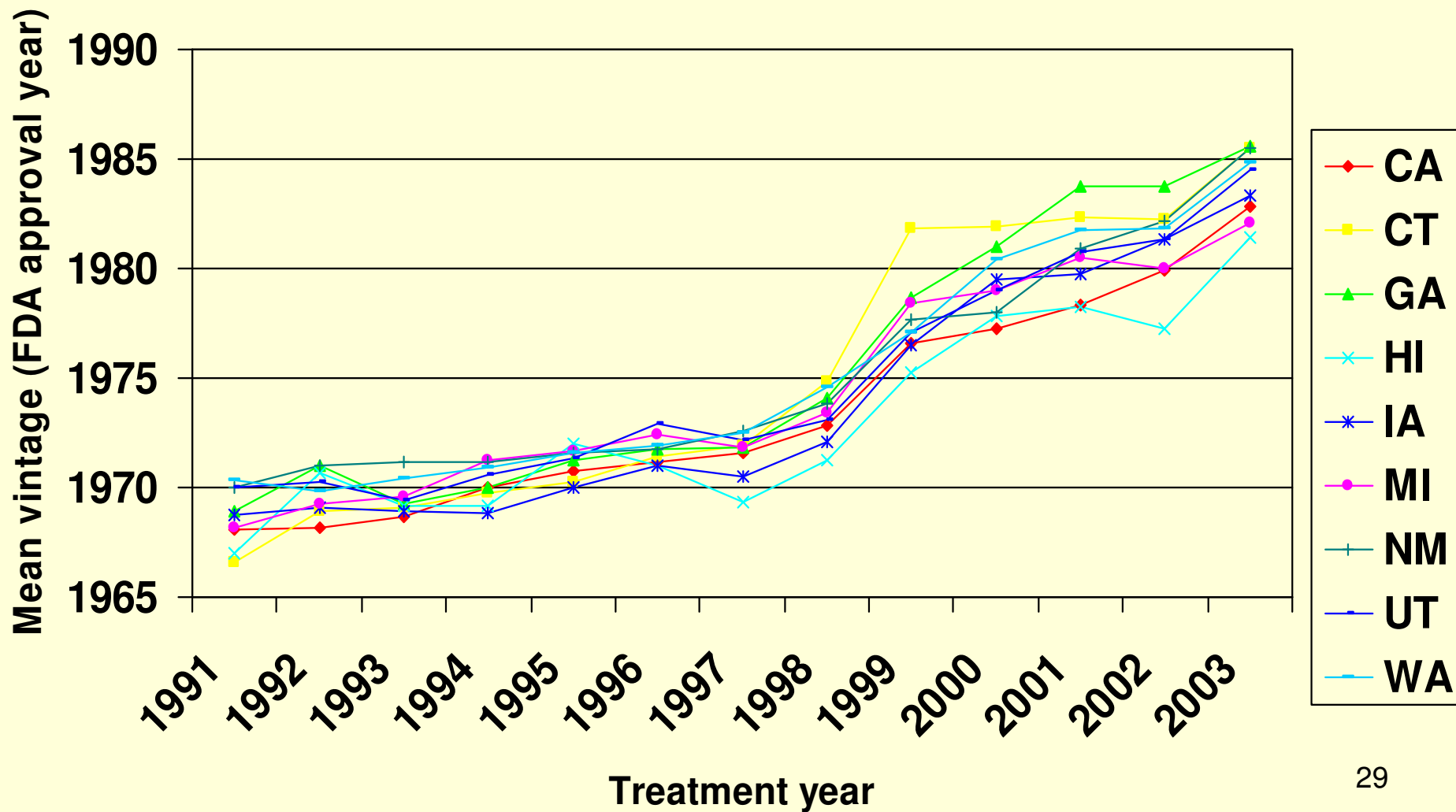
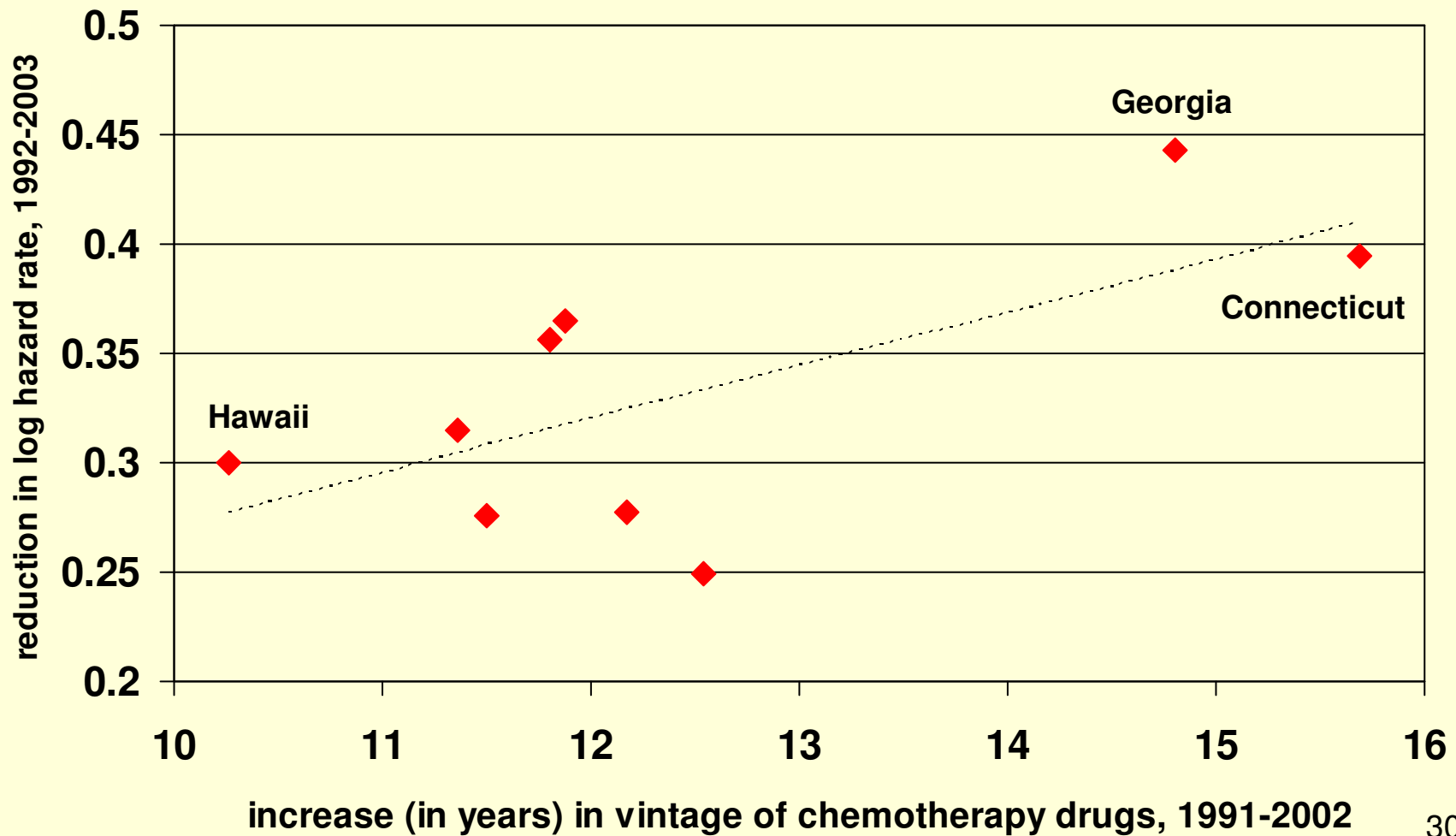


Figure 1
Mean vintage of chemotherapy treatments,
by state, 1991-2003



States that adopted new chemotherapy agents more rapidly had larger increases in cancer survival rates



Effect of 1991-2002 vintage increase on life expectancy of cancer patients

- I estimate that use of newer chemotherapy agents increased the life expectancy of U.S. cancer patients by 8-12 months during the period 1991-2002
- My upper-bound estimate of the average cost per life-year gained from using newer chemotherapy drugs is \$6246

Estimates of VSLY by leading economists greatly exceed values often used in HTA

Viscusi and Aldy: The value of a statistical life for prime-aged workers has a median value of about \$7 million in the United States

Viscusi, W. Kip and Joseph E. Aldy, "The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World," *The Journal of Risk and Uncertainty*, 27:1; 5–76, 2003.

Murphy and Topel: The value of a life year is \$373,000.

Murphy, Kevin M., and Robert H. Topel, "The value of health and longevity," *Journal of Political Economy*, 2006.

Summary

- In principle, the following is a reasonable decision rule for determining whether a technology is cost effective:

$$\frac{\Delta \text{COST}}{\Delta \text{QALY}} < \text{VSLY}$$

- But for HTA to yield valid decisions in practice, it is necessary to have reliable estimates of:

ΔCOST
 ΔQALY
 VSLY

(The devil is in the details!)

- In my opinion, incorrect estimates of some or all of these key inputs are often used:
 - ΔCOST is frequently overestimated
 - ΔQALY and VSLY are frequently underestimated
- Due to these estimation biases, health technologies that are truly cost-effective may often be rejected as cost-ineffective.