Surplus Appropriation from R&D and Health Care Technology Assessment Procedures

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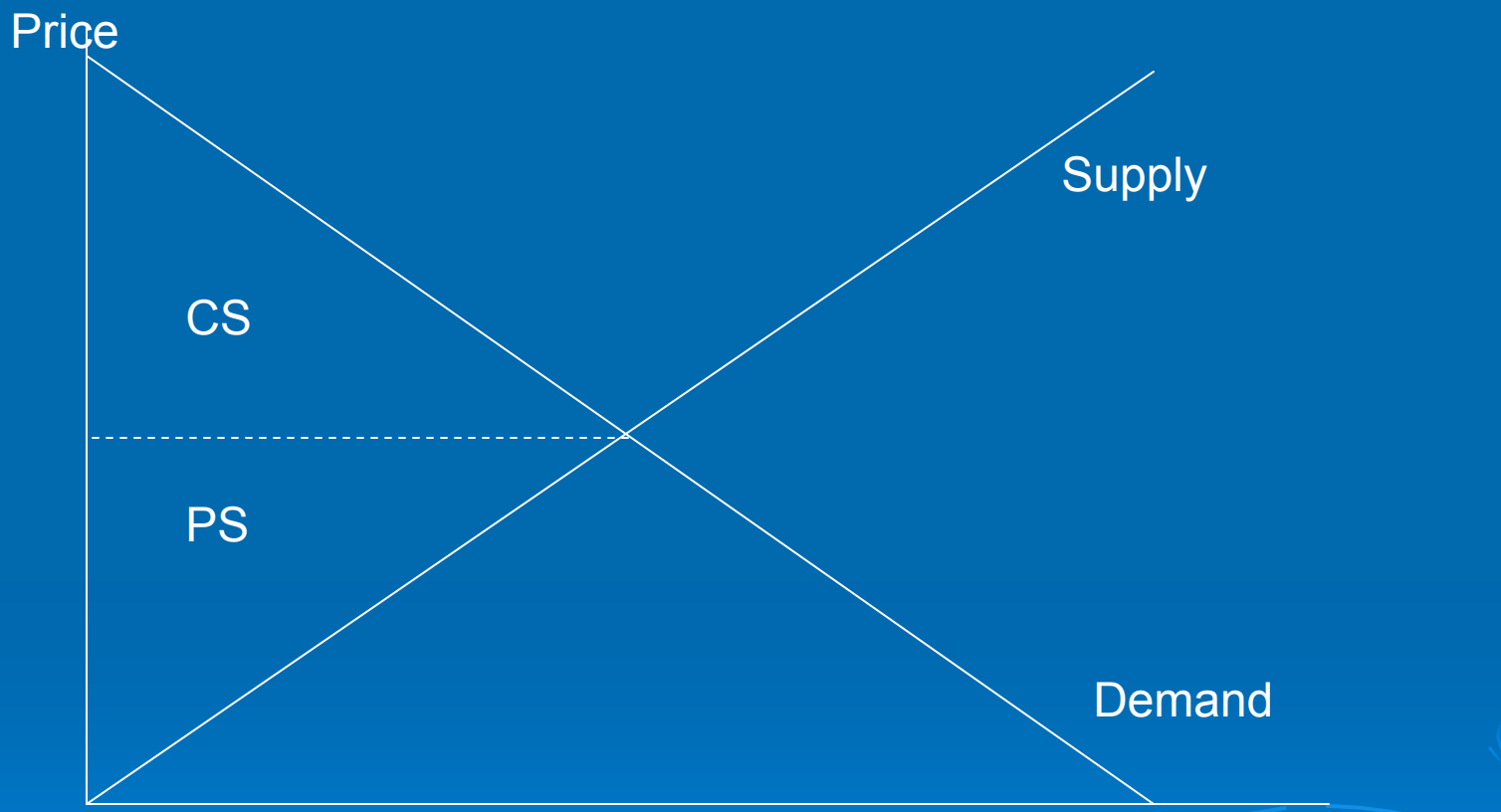
Motivation

- New technology is a driving force behind growth in healthcare spending
- How do we value and manage these new technologies?
- Desirability of CE Analysis in a Market or Non-Market (Government) Context?

Bottom Lines

- Need to account for dynamic incentives when assessing & adopting technology
- CEA induces static efficiency but not dynamic
  - Both dynamic efficiency and health will be maximized when CE *minimized*
- Dynamic R&D Incentives Are Modest
  - New HIV technologies: producer surplus 5% of social surplus
  - Harvard Registry technologies: median 13%
- Broader implications for using CEA to further lower R&D incentives

Surplus of New Technologies



Social Surplus SS = CS + PS

CE Analysis

- Quality Adjusted Price Measure
  - Ex: Cost per QUALY
- Aims to Maximize Consumer Surplus
- Consistent with Static Efficiency
- Efficiency gains when prices brought closer to costs

Dynamic Efficiency and CE Analysis

- CE technologies ~ High Consumer Surplus ~ Low Producer Surplus
- Maximizing expected social surplus results in CS = 0 and PS = SS i.e. CE is minimized!
- Higher CE → larger under-investment in R&D
- Price Discrimination → CE minimized, Dynamic Efficiency and Health is Maximized
- Why CEA harmful for public technology

Adoption: Price Control in Disguise

Alternative Models of R&D—Is Full Appropriation Always Optimal?

- Too much R&D due to competitive R&D investments, i.e. patent racing
- Publicly subsidized R&D lowers optimal levels of private R&D and appropriation
- Effects of insurance and moral hazard on optimal appropriation
- Consumer Based R&D and Pigouvian pricing

Estimating Surplus Appropriation for HIV/AIDS R&D

- Consumer Surplus
  - Incidence and Per-Capita Valuation by Year
- Producer Surplus
  - Sales less variable costs as estimated by long-run generic prices

Gross Consumer Surplus of HIV/AIDS Drugs

- The total value of life g (i.e. the gross consumer surplus) induced by new drug consumption is:

$$g = \sum_{t=1980}^{2000} \beta^{t-1980} n_t \cdot g_t$$

where g_t is the value of increased survival for an individual in cohort t (relative to the 1979 baseline) and n_t is the incidence of HIV.

Gross Consumer Surplus of HIV/AIDS Drugs

- Infra-marginal value of survival gains
  - (Becker, Philipson, and Soares, AER 2006)

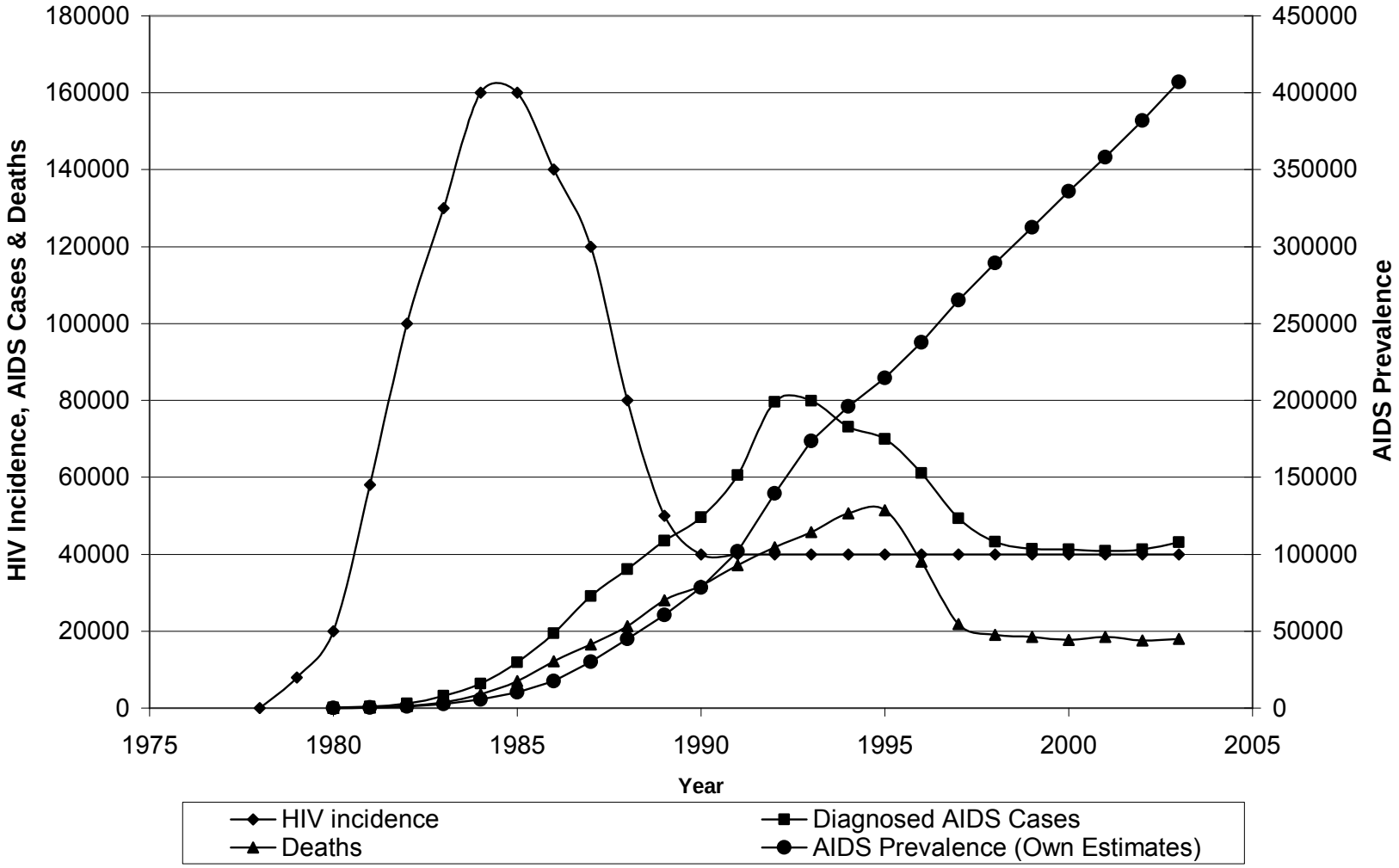
$$V[y_t + e_t, S_o(d)] = V[e_t, S_t(d)]$$

- Lifetime value of gain in survival:

$$g_t = \sum_{d=0}^{\infty} \beta^d \cdot S_o(d) \cdot e_t$$

Time-Series of HIV/AIDS

Figure 1: Estimates of HIV Incidence, AIDS Incidence & Prevalence, & Deaths from AIDS



Survival from HIV

Figure 3: Survival from HIV by Year of Infection

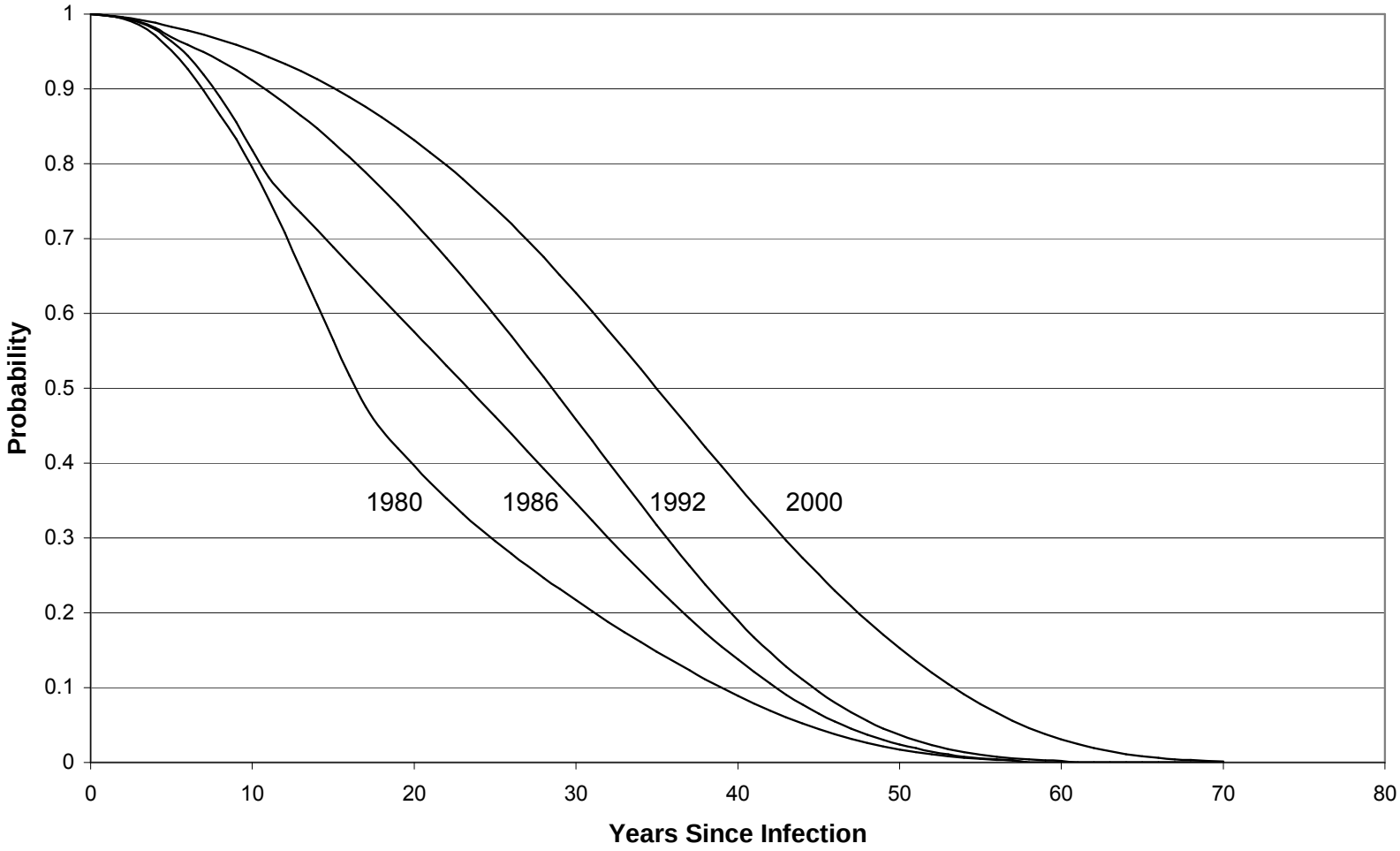


Table 1: Value of Gains in Survival for HIV Infected Individuals, Selected Years

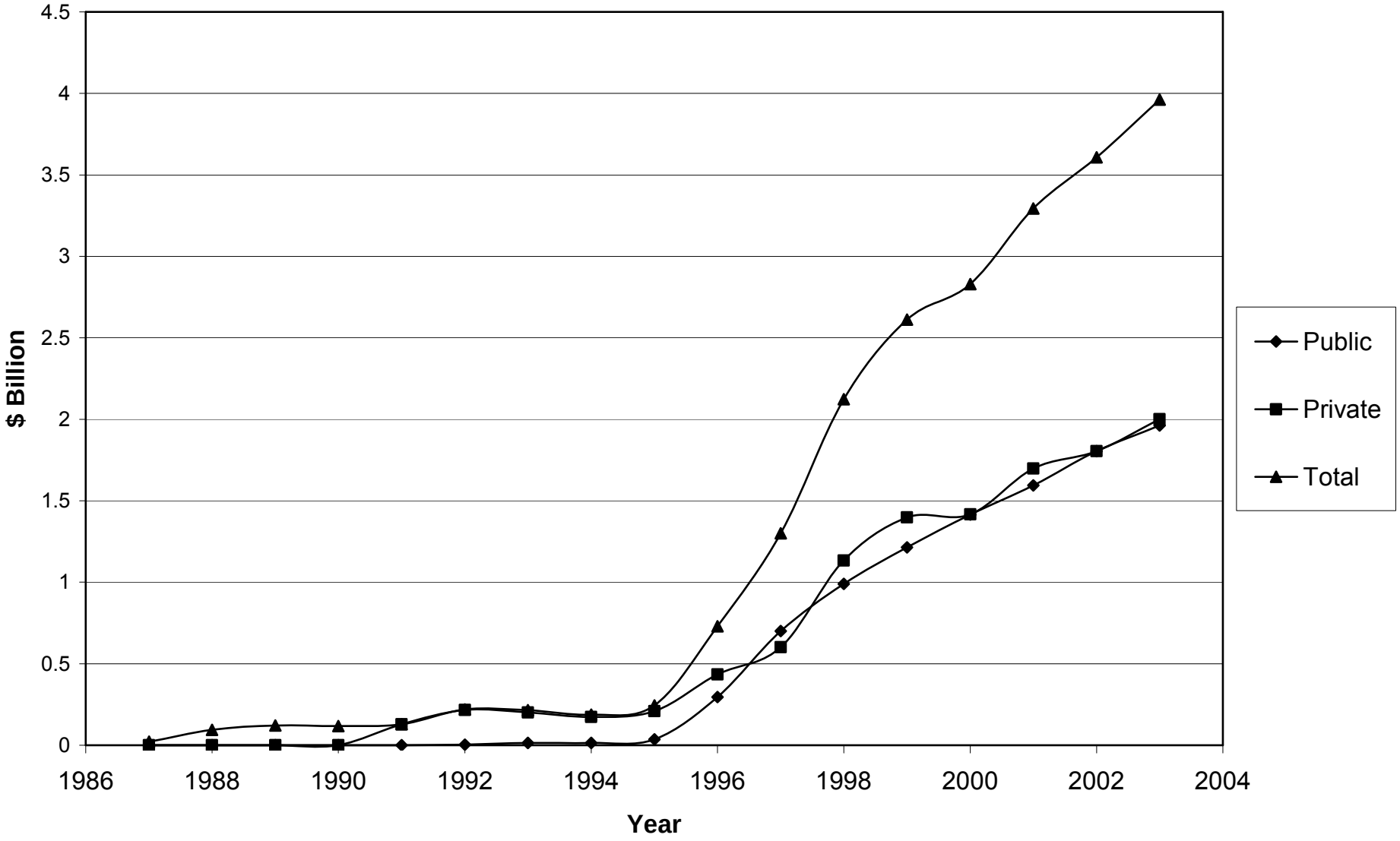
		Value of Survival Gains ($)	
Year of HIV Infection	HIV Incidence	Individual ($)	Aggregate ($ Billion)
1980	20,000	17,655	0.35
1984	160,000	116,156	18.59
1988	80,000	250,284	20.02
1992	40,000	383,328	15.33
1996	40,000	696,951	27.88
2000	40,000	740,515	29.62
Total Discounted Value (Year 2000 $ Billion)			398

All figures are discounted to 1980 and are in year 2000 dollars.

Producer Surplus from HIV/AIDS Drugs

- Lifetime producer surplus = Discounted sum of profits
- We estimate annual profits using annual sales data from IMS. Profits are assumed to equal 85% of sales
- Assuming future profits equal year 2000 profits, we estimate lifetime variable costs of $11.2 billion and lifetime profits of $62.9 billion

Figure 4: National Spending on HIV/AIDS Drugs



Producer vs Consumer Surplus

- We estimate social surplus to be nearly $1.38 trillion ($1.4 trillion gross benefit - $15 billion in variable costs)
- Consumer surplus is $1.33 trillion ($1.4 trillion - $74 billion in spending)
- Producer surplus is $63 billion, or 5% of social surplus

CE and Appropriation

- Average mark-up and CE identify *observed* appropriation generally:

$$\frac{PS}{SS} = \frac{m-1}{m \cdot CE - 1}$$

- CE ~13 and m(q) = 6.7 → Approp = 7%
- Does this make sense?
  - Annual HIV drug cost $9,751 per person → profit of $8,300. VOLY of 100K implies Obs App ~ 8%

Appropriation and CE Constant Returns Case

- *Potential* Appropriation under constant elasticity of demand:

$$\frac{PS}{SS} = \left(\frac{\varepsilon - 1}{\varepsilon} \right)^{\varepsilon}$$

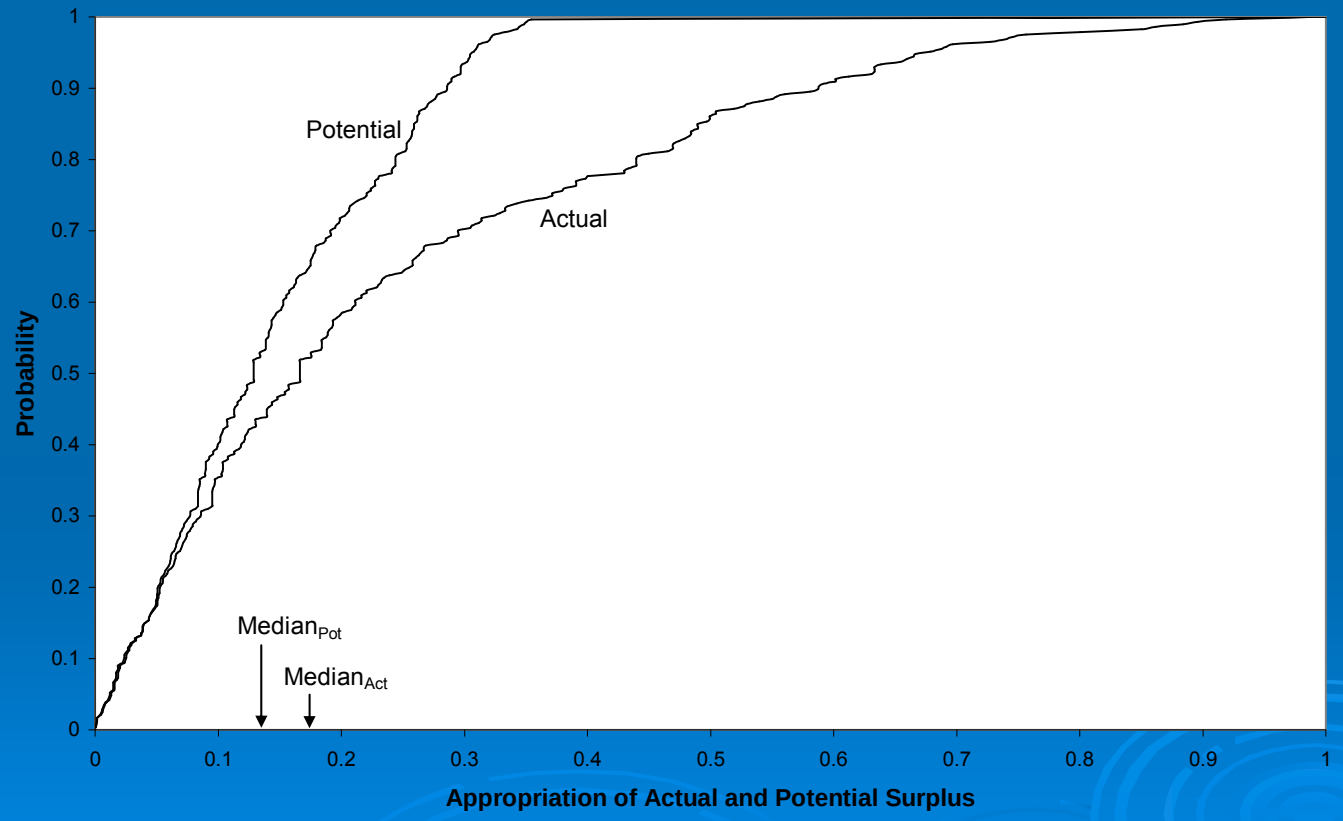
- The higher prices and the more output is restricted the *lower* is appropriation
- As elasticity falls, profits rise, but appropriation *falls* because consumer surplus rises faster

Surplus Appropriation Implied by Standard CE Studies

- Use estimates of gross benefits relative to spending from the literature to identify surplus appropriation for producers of those technologies
- Harvard Cost Effectiveness Analysis Registry
- For a given intervention, how much spending is required for an additional QALY (worth 50 – 100 K)

Surplus Appropriation Implied by "Cost-Effectiveness"

Figure 2: Cumulative Distribution of Actual and Potential Surplus Appropriation



Surplus Appropriation Implied by Standard CE Studies

- Median intervention costs $19,000 per QALY and has an appropriation of potential (actual) surplus of 13% (17%)
- HIV/AIDS, with a surplus appropriation of 5%, is in bottom 20th percentile

An Alternative Way of Inferring Low Degree of Appropriation

- Demand estimates may inform estimated producer shares
  - 85% fall in branded drugs vs. generic drugs implies a mark-up consistent with $\varepsilon=1.17$ →surplus appropriation of 10%
  - Low elasticity consistent with 1) high prices of HIV drugs (and other lifesaving technologies) and 2) low surplus appropriation

Conclusion

- CE analysis promotes static efficiency
- Technology assessment in a static vs dynamic setting differs greatly
  - Dynamic Efficiency and Health may be maximized when CE minimized
- Modest Appropriation of Innovative Returns
- The Dangers of CEA and Price Controls further limiting appropriation
- Future work should consider whether appropriation is too low, or CE too high, to induce correct R&D incentives
  - CEA as price ceilings or floors