Inflation and Discounting

Henry Glick

Epi 550

March 27, 2020

1

Which Lottery?

- Lottery A: $50,000 per year for 20 years
- Lottery B: $1,000,000 immediately
  - Probability of winning is identical
  - Equally priced
  - Tax free winnings
  - (Inflation adjusted)

2

Rationales for 1M Now

1. Consumption: "We want to spend more than 50k now"
   - Things now valued more than same things later
2. Investment: "We can invest 1M now and pay our selves more than 50k in future years
   - We are/capital is productive
- Each contributes separately to determination of theoretically correct discount rate
  - But typically cited rate probably ignores consumption

3

Comparison of Cost and Outcome in Multiple Periods

- Because costs and outcomes in different time periods are not directly comparable, comparisons require conversion to a common time period
- Conversion accounts for:
  - Changes in purchasing power of dollar over time:

    Inflation
  - Differential valuation of cost and outcome depending on when they occur:

    Discounting / Social rate of time preference
- Inflation NOT same as time preference

4

Inflation

- Inflation accounts for fact that purchasing power of a dollar changes over time
  - Stream of dollars without inflation adjustment
    - Nominal $
  - Stream after inflation adjustment
    - Real $
- Common measure of inflation
  - Consumer price index
    - Defined for market "basket" of goods and services
      - Can be problematic, given market basket has to change over time

5

Inflation: U.S. Consumer Price Index

Year	All Items	Medical Care	Medical Care Services
1995	152.5	219.8	223.5
2000	172.4	260.5	265.6
2005	194.5	322.9	336.3
2010	217.965	388.199	410.802
2015	238.638	446.271	475.546
2016	241.018	462.075	493.438
2017	244.955	474.360	505.813
2018	251.989	486.019	518.307
2019 (02)	252.776	491.227	527.683

- http://bls.gov/cpi/data.htm

[Multiscreen, all urban consumers\Not seasonally adjusted\US city average\Current base (1982-84)\[Cost category]\Monthly (June)]
MC=drugs+ supplies+MCS; MCS=professional+hospital services

6

Example: Expressing Hospital Costs in $2018

Year	Medical Care	Hospital Bill	Inflation-adjusted Bills	
2016	462.075	9595	10,200	(9595*491.227/462.075)
2017	474.360	12,303	12,740	(12,303*491.227/474.360)
2018	491.227	16,476	16,476	(16,476*491.227/491.227

	Nominal $	Real $2018
Totals	$38,374	$39,416

7

Makeup of Medical Care Component (2018)

Service	%
Medicinal drugs	19
Medical equipment and supplies	1
Professional services	37
Hospital	27
Nursing home/adult daycare	2
Home care	1
Health insurance	13

8

Sectoral Price Indices

Year	Hospital Services	Physician Services	Prescript Drug	Nursing Home	Homecare
1996	100	216.4	242.9	100.0	--
2000	115.9	244.7	285.4	117.0	--
2005	161.6	287.5	349.0	145.0	100
2008	197.186	311.342	378.284	165.343	107.882
2009	210.731	320.831	391.055	171.630	109.872
2010	227.227	331.330	407.824	177.003	111.280
2011	241.213	340.301	424.981	182.188	113.133
2012	253.563	347.306	440.149	188.805	114.470
2013	265.448	354.161	442.580	194.472	115.117
2014	278.754	359.097	458.343	200.080	116.704

9

Overall or Sectoral Price Indices

- In practice, inflation adjustments in literature most commonly made with medical care component of CPI
  - Used above in demonstration of mechanics of adjustment
- Some have argued that more or less money used for healthcare comes from / returns to other sectors of economy
  - Implication: consider use of overall CPI

10

Other Inflation Indices

- Chained / chain-weighted CPI
  - Adjusts market basket monthly rather than once every 2 years for usual CPI
    - Has political baggage related to attempts to use it to reduce federal COLA adjustments
- Potentially superior measures of inflation include:
  - Gross domestic product price index (or deflator)
    - Includes a greater percentage of economy than does CPI and unlike CPI is not based on a fixed basket of goods and services
  - Personal consumption Expenditures (PCE) Index
    - Unlike CPI, not limited to out-of-pocket expenditures

11

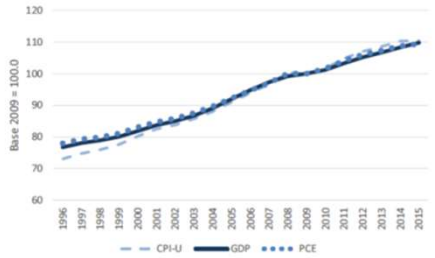
Inflation: GDP Deflator and PCE Index *

Year	GDP Deflator	PCE Index
1999	80.065	81.110
2000	81.110	83.131
2005	91.988	92.261
2008	99.246	100.065
2009	100.00	100.00
2010	101.221	101.653
2011	103.311	104.149
2012	105.166	106.062
2013	106.733	107.333
2014	108.273	108.758

* Source, BEA; different sources use different base years

12

Not A Lot of Difference



Note. CPI-U, Consumer Price Index—all urban consumers; GDP, gross domestic product; PCE, personal consumption expenditures. [Color figure can be viewed at wileyonlinelibrary.com]

Dunn A, et al. Adjusting health expenditure for Inflation, HSR, 2018

13

Dunn et al Conclusions

- GDP deflator or PCE preferable to CPI-U to adjust for general inflation
- PHC or PCE health-by function indices generally preferred to adjust total medical expenditures
- CPI medical preferred for adjustment of consumer out-of-pocket expenditures
- New disease-specific Medical Care Expenditure Index now available to adjust payments for disease treatment episodes
- There is no single gold standard for adjusting health expenditures for inflation

14

Per Capita National Health Expenditures

	National Healh Exp*	Medical Care CPI	"Tech-nology"
1990	2885	162.8	100.0
2000	4881	260.8	105.6
2005	6887	323.2	120.2
2009	8175	375.613	122.8
2010	8428	388.436	122.4
2011	8698	400.258	122.6
2012	8996	414.924	122.3
2013	9255	425.134	122.8

* Based on calculations in Catlin A, et al. National Health Spending In 2005: The Slowdown Continues. Health Affairs. 2007;26:142-53.

15

(International) Purchasing Power Parity (PPP)

- "Market basket" index used to translate costs in one country into comparable costs in another based on purchasing power in countries
- PPP preferred over exchange rates because PPP provides a comparative measure of buying power and not a reflection of supply of currency in international markets
- Common measures:
  - OECD PPP
  - "Big Mac" index

16

Purchasing Power Parity, 2012

Country	OECD	Big Mac
Canada	1.23	1.18
Czech Republic	13.7	18.6
Denmark	7.74	8.33
Euro Zone	0.787	.96
Hungary	128	192
Mexico	7.67	9.32
New Zealand	1.45	1.38
Poland	1.87	1.98
Switzerland	1.39	1.84
Turkey	1.04	1.45
US	1	1

http://stats.oecd.org/Index.aspx?DataSetCode=PPPGDP
http://bigmacindex.org/2012-big-mac-index.html

17

Time Preference

- Unlike inflation -- which accounts for changes in purchasing power over time -- discounting accounts for our preferences for costs incurred and outcomes obtained in different periods
  - Tend to prefer to consume immediate benefits to those occurring in the future (Marginal rate of time preference)
  - Investment today could produce more in the future (Marginal rate of return on private investment)
    - Market interest rate

18

Social Discount Factor

- Represents amount that future streams of cost and benefit must be discounted to account for fact that society values them less than if streams were available today

19

Discounting Formula

$$\Sigma_t \frac{B_t - C_t}{(1+r)^t}$$

where: B_t and C_t equal benefits and costs in time t

r equals discount rate

20

Discounting And Inflation

- What is relationship between inflation and discounting?
  - Real rate of discount (1+r), where r = real rate of time preference
  - Nominal rate of discount (1+r) (1+i), where i equals inflation rate

21

When are Different Rates Used?

- Real rate: Costs are already inflation-adjusted
  - i.e., real or constant $
- Nominal rate: Use when costs still incorporate inflation
  - If sectors have relatively different inflation rates, need to use sectoral rates of inflation to evaluate changes in costs over time
- Should we discount costs if inflation rate equals 0?

22

What Discount Rate?

- Current practice, U.S. (and most, but not all, other developed countries): 3% (1st and second U.S. Panel recommendations)
  - Approximate rate of return on long-term (from 1917 on) US treasury notes
    - Considered "riskless" and are tax free
- Appropriate rate for less developed countries?
- Adjust for risk separately in analysis

23

Implications of Discounting

- Treatment vs prevention
  - Why have those trying to justify childhood vaccination sometimes argue against discounting?
- Old vs young
  - Does it make sense for elder's associations to argue against discounting?

24

Discount Rate Can Matter...

	Therapy 1		Therapy 2	
Year	Cost *	QALY	Cost *	QALY
1	2000	.8	1000	.81
2	1000	.8	1000	.81
3	1000	.8	1000	.81
4	1000	.8	1000	.81
5	1000	.87	1000	.81

0% discount rate: Rx 1, 50,000/QALY
3% discount rate: Rx 1, 66,564/QALY
5% discount rate: Rx 1, 82,442/QALY

* All costs inflation-adjusted

25

...But It Doesn't Always

	Therapy 1		Therapy 2	
Year	Cost	QALY	Cost	QALY
1	2315	0.9550	1400	0.95
2	2107	0.869	1260	0.855
3	1917	0.7908	1134	0.7695
4	1745	0.7197	1021	0.6926
5	1587	0.6549	918	0.6233

0% discount rate: 5 yr: 39,737/QALY; 20 yr: 14,496
3% discount rate: 5 yr: 40,727/QALY; 20 yr: 16,080
5% discount rate: 5 yr: 41,394/QALY; 20 yr: 17,210

2-state Markov model; 10% conditional annual mortality; RR=.9; $RX = 1000/yr; $OMC=1000/yr; $Death=5000; all costs inflation-adjusted

26

Discounting in First and Succeeding Years

- Convention is to NOT discount if costs and outcomes are measured for at most a year
- If costs and outcomes are measured for more than a year, must discount
  - For consistency, do not discount cost and effects in first year (time 0):
    - $B_0 / (1 + r)^0$
  - Start discounting in second year:
    - $B_1 / (1 + r)^1$, $B_2 / (1 + r)^2$, etc.

27

"When" to Discount and Inflation-Adjust

- Need to discount a function of duration of follow-up per participant, not duration of study
- Need to adjust for inflation depends on whether costs are measured in "constant" dollars (e.g.by use of data from 2013 fee schedules) or in dollars from different years (e.g., by use of billing data from different years)

28

When Example #1

- You follow people for 4 years; at end of follow-up you obtain price weights from Federal government for year 2017
  - Discount?
  - Inflation adjust?

29

When Example #2

- You enroll people during a 6 month period and follow each for 6 months; either you collect bills or obtain price weights from government for year 2014 to estimate costs
  - Discount?
  - Inflation adjust?

30

When Example #3

- You enroll people during a 3-year period, but follow each for 1 year only; during each year you collect bills for each hospitalization to estimate costs
  - Discount?
  - Inflation adjust?

31

When Example #4

- You follow people for 4 years; you collect bills for each hospitalization to estimate costs
  - Discount?
  - Inflation adjust?

32

Discounting Life-saving and Other Nonmonetary Effects

- Debate – generally among noneconomists -- exists in literature about whether or not years of life or QALYs need to be discounted, and if so, if need to be discounted at same rate as costs

33

"Years of Life Obtained at End of Life"

- Not true of "QA" of QALYs; is it true for expected years of life?
- Actuarially, can gain years at different points in life
- Can we have preferences between following 2 treatments?

Years of life	Treatment 1 (Prob)	Treatment 2 (Prob)
0	0.50	0.25
5	0.00	0.25
10	0.00	0.25
15	0.50	0.25
Exp Value	7.50	7.50

34

"End of Life" (cont.)

- Cumulative probabilities

Years of life	Treatment 1	Treatment 2
0	1.00	1.00
5	0.50	0.75
10	0.50	0.50
15	0.50	0.25

- Differences between treatments are due to probability of living 5 vs. 15 years
- May be a number of sources of preference (including risk or variance), but one may be time preference
- Empirical rather than theoretical question?

35

Evaluation of Programs 1 And 2 *

Variable	Year 1	Year 2
Program 1		
Costs	1000	0
QALYs	100	0
Program 2		
Costs	0	1000
QALYs	0	100

- Program benefits might be due to one-year shifts in survival curve or to providing assistive devices for one year to different cohorts of disabled individuals

36

Evaluation of Programs 1 And 2 (cont.)

Variable	Year 1	Year 2
Program 1		
Costs	1000	0
QALYs	100	0
Program 2		
Costs	0	1000
QALYs	0	100

- Should program 2 have a smaller (better) cost-effectiveness ratio than program 1?

37

Summary of Programs 1 and 2

Variable	Program 1	Program 2 *
Discounted Costs (3%)	1000.00	970.87
Undiscounted QALYs	100.00	100.00
Discounted QALYs (3%)	100.00	97.087
CER (Undisc Ben)	10.00	9.7087
CER (Disc Ben)	10.00	10.00

- IMPLICATION: Failure to discount both costs and outcomes (at an equal rate), given a set of programs that are identical in all features except for their timing, leads later programs to have more favorable ratios than earlier ones

38

Rationales for Discounting Health

- Consistency (Weinstein and Stason)
- Discounting paradox (Keeler and Cretin)
- Horizontal equity

(All three seem to be variations on previous example)

39

Consistency (1)

- When costs and benefits are both expressed in monetary terms, there is little debate about whether 2 should be discounted
- Why should it matter if we wait until after we construct cost-effectiveness ratio to translate effects into money terms (e.g., by comparing CER to W or by calculating NMB)

40

Consistency (2)

- [In economic assessment, years of life] "...are being valued relative to dollars and, since a dollar in the future is discounted relative to a present dollar, so must a year of life in the future be discounted relative to a present dollar." (assumed steady state relationship between dollars and health benefits)
- Williams: "because it is possible, at the margin, to transform health into wealth, and vice versa, at any point in time, and since "wealth" is (ideally) allocated through time with reference to the rate of social time preference, then it would be inconsistent to apply a different rate of discount to 'health' from that being applied to "wealth."

41

Discounting Paradox: Keeler and Cretin

- Statistically identical cohorts (that differ only in their position in time) vie for dollars from budget that must be allocated (once and for all) at current moment
- Paradox: If discount rate for costs is higher than that for effects, cost effectiveness ratio for any program will be improved by delaying its implementation (see prior example)
  - i.e., those with later positions in time can argue that health expenditures should be targeted disproportionately at them, because cost effectiveness ratios for these expenditures will be lower

42

Horizontal Equity

- If discount rate for costs equals discount rate for effects, potential program beneficiaries who are identical in every respect except for their positions in time relative to moment decision maker must act will receive equal treatment

43