Valuation of Life

- Read: *The Life You Save May Be Your Own* [Schelling]
- Implicitly calculated all all times!

  E Traffic accident policing
- We care if we know the person:

  E A "6-year-old cute girl" needs money for brain operation

  v. Donation for medical research foundation

  E A child trapped in a deep well

  v. Potential victim in a future disaster

  E Sending a man to certain death v. low prob of returning
- Statistical life (ex-ante, finite) v. Certain life (ex-post, infinite):

  E Everyone takes risk in daily life for money/convenience

  E Death lottery: Russian roulette, box drawing (1 killed out of 1000)

  ▷ Can only estimate statistical life

  ? What if govt knows who will die, but the public do not?
- Social benefits of life-saving: Jones-Lee (1976)

  1. Labor productivity
  2. Subjective desire to live, pains of relatives
  3. Delayed expenditures: medical/funeral
  4. Property damages in accidents

1. Human Capital Approach

- Valued as "discounted lifetime labor income" forgone due to premature death:

$$L = \sum_{t=\tau}^{T} \frac{p_t y_t}{[1+r]^{t-\tau}}$$

where:

$p_t \equiv$ survival probability

$y_t \equiv$ time-t labor earning

- "Net output" method:

$$L = \sum_{t=\tau}^{T} \frac{p_t[y_t - c_t]}{[1+r]^{t-\tau}}$$

where:

$c_t \equiv$ time-t consumption

- Problems:
  - Lack of theoretical foundation
  - Victim's desire to live is ignored
  - Prolonged life after retirement has no value

- Suggested as a lower bound for life value [Conley 1976]

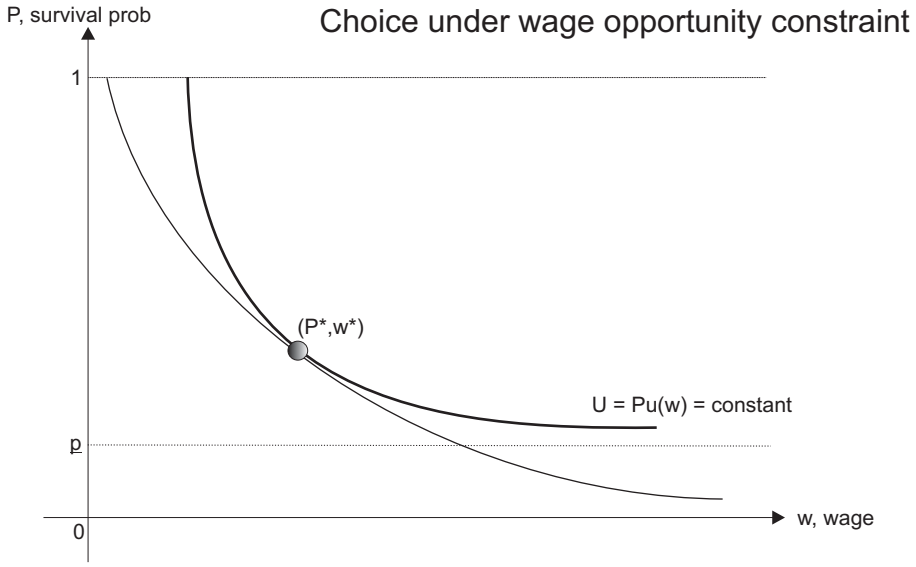
2. WTP/WTA

- People's subjective desire to live recognized
- Based on welfare theory: risk avoidance behaviors
- Job choice: risky v. safe

  E 領港人 v. 白領職員

- Expected utility:

$$U \;=\; p \cdot u(w)$$



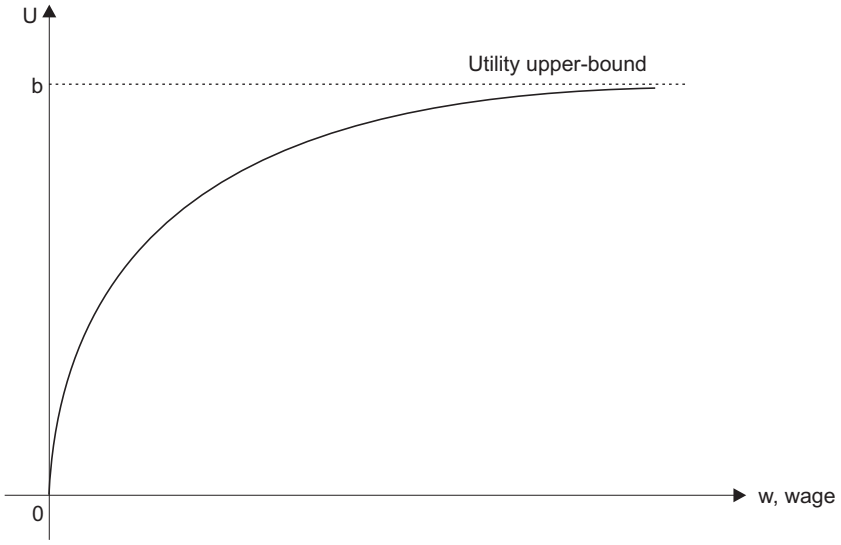
▷ Survival is essential!

- If utility UB exists:

$$u(w) \leq b, \quad \forall\, w$$

  then risk LB also exists:

$$p = \frac{p^* u(w^*)}{u(w)} \geq \frac{p^* u(w^*)}{b}$$



- Problems:
  - People may not perceive risk accurately
  - Imperfect occupational mobility
  - Wage differential not reflecting risks
  - Tradeoff between wealth/risk not constant

    ▷ Cannot extrapolate !

3. Cook 1978

- Conley [1976] suggests using human capital as a LB for life WTP
- Cook [1978] shows this may not be true.[1]

3.1. The Model

- Consumer utility: with lifetime consumption C

$$U(C), \;\; U' > 0, \;\; U'' < 0$$

- Human capital: lifetime no-risk income

$$y$$

- Wage opportunity constraint:

$$w(p), \;\; w'(p) < 0$$

  ▷ Lower survival probability p for extra income w

- Insurance market:
  - Exogenous survival prob: p
  - Consumer pays premium w first
  - Dead consumer gets nothing
  - Surviving consumer gets benefits

$$\frac{w}{p}$$

[1] Cook, P.J., "The Value of Human Life in the Demand for Safety: Comment," *AER*, 68(4):710–11.

– Actuarially fair: insurance company earns zero expected profit

$$p \cdot \frac{w}{p} \;=\; w$$

- Risk-bearing consumer:
  - Pays premium: w
  - Higher survival consumption:

$$C \;=\; y \;+\; \frac{w}{p}$$

3.2. Consumer WTP for Life

- Consumer EU-max:

$$\max_p \ \text{EU} \ = \ pU(C) \ + \ [1-p]U_0$$
$$= \ pU(y + \frac{w}{p}) \ + \ [1-p]U_0$$

where:

$U_0 \equiv$ death utility

- Interior foc:

$$[U(C) - U_0] \ + \ U'(C)\left[\frac{dw}{dp} - \frac{w}{p}\right] \ = \ 0$$

- Consumer marginal WTP for life:

$$W \ \equiv \ -dw/dp$$

$\triangleright$

$$W \ = \ -\frac{w}{p} \ + \ \frac{U - U_0}{U'} \ = \ [y - C] \ + \ \frac{U - U_0}{U'} \ = \ y \ + \ \left[\frac{U - U_0}{U'} - C\right]$$

- Let $U_0 = 0$:

$$W \ = \ y + \left[\frac{U}{U'} - C\right]$$

- Comparision: WTP (W) v. human capital (y)

$$W \ \gtreqless \ y \quad \rightleftharpoons \quad \frac{U}{U'} - C \ \gtreqless \ 0 \quad \rightleftharpoons \quad U \ \gtreqless \ CU'$$

3.3. Case 1: $U(0) = U_0$

- Any consumption is better than death

  ▷ Strong desire to live

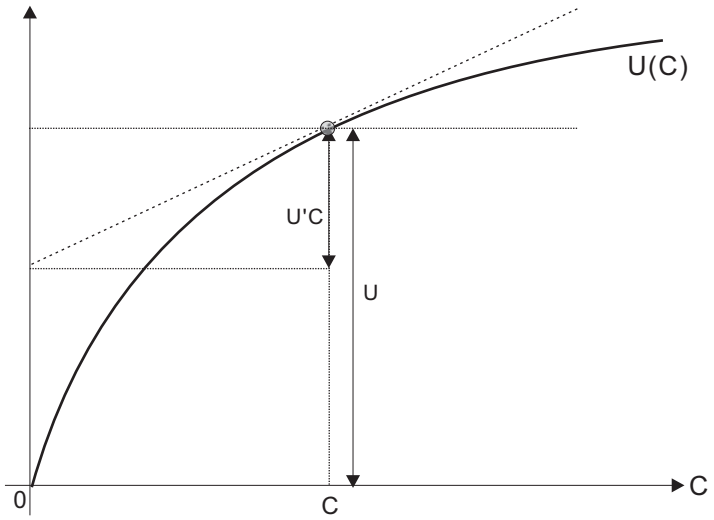
- By concavity of U, we know:

$$U \ > \ U'C$$

  ▷

$$\frac{U}{U'} \ > \ C$$

- Consumer WTP > human capital y



3.4. Case 2: $U(0) < U_0$

- Low consumption ($C < \underline{C}$) is as bad as death
- Consumer feels worse than death when $C < \underline{C}$
- $\forall\, C \in [\underline{C}, \bar{C}]$:

$$U \;<\; U'C$$

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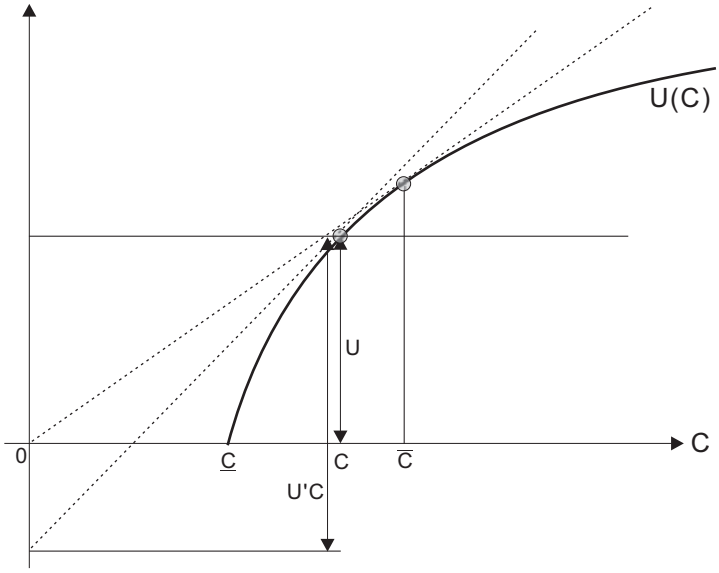
$$\frac{U}{U'} \;<\; C$$

- Consumer WTP $<$ human capital y



3.5. Policy Implication

- Monkeys in Paradise:
  - Population: m (monkeys)
  - Fixed total resources: W (bananas)
  - Risk survivors: n ($< m$)
- Survival rate:

$$p \;=\; \frac{n}{m}$$

  ▷ Expected consumption:

$$C \;=\; \frac{W}{n}$$

- Is "life-saving" a good thing?
  - Expected utility:

$$\text{EU} \;=\; \frac{n}{m} \;\cdot\; U(\frac{W}{n})$$

  - Value of life-saving device:

$$\frac{d\text{EU}}{dn} \;=\; \frac{U}{m} \;-\; \frac{n}{m}\, U'\frac{W}{n^2} \;=\; \frac{1}{m}\; [U - U'C]$$

    ▷ Worthwhile (at initial $C = W/n$) only when:

$$U \;-\; U'C \;>\; 0$$

- For poor society:

  ▷ $C < \bar{C}$ initially, survival is not first priority ($W/n \downarrow$)

  ▷ Should raise W first

- For wealthy society: life-saving is desirable