

Centre for Health Economics
Seminar Series
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Searching for a Square Circle: The Social Willingness to Pay for a QALY

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(First of the “Square Circle” Trilogy)

Square Circle Trilogy

1. Fellowship of the logical ring

- The shadow of the past: Welfare Theory
- Methods for evaluating the social value of a life (year/QALY)
- Statistical life years vs Elves
- Evidence from the cost side
- What are we to do?

Square Circle Trilogy

2. Where on middle earth are we?

Assumptions mathematics and mysticism in the undoing of economic theory

- Theme: Hypothesis: Theory in 20th Century failed
- Great questions of 19th century dropped
- Dissenters (Keynes Schumpeter Simon) sidelined
- Robbins/Samuelson put us in orbit
- Arrow transported us to “La La Land”
- Methodology which achieved this

Square Circle Trilogy

3. Return of the King: The Common sense Methodology of Karl Popper
 - Why did we go wrong?
 - Problem solving as a logical and psychological starting point
 - Criticism as error elimination

Disclaimers

- Target is
 - Theory, not Applied Economics
 - Orthodox (esp Welfare) Theory
 - Not experimental economics, economics and psychology, econometrics etc
 - Hypotheses; not proofs
 - Objectivity: absolutely no personal opinions

Censors Classification

R

Warning: The following overheads may cause offence. Economists over 30 should be accompanied by their students

Welfare Theory: Shadow of the Past

(Lord of the Tautological Rings)

9 Dark Riders

$$(1) \frac{MU_X}{MU_Y} = \frac{P_X}{P_Y}$$

X, Y = Commodities

Revealed Preference Criterion of MU

→ $\frac{P_X}{P_Y}$ **defined** as equal to $\frac{MU_X}{MU_Y}$

$$(2) \frac{MC_X}{MC_Y} = \frac{P_X}{P_Y}$$

Profit maximisation **defined** by

$$P_X (=MR_X), = MC$$

$$(3) \frac{MU_X}{MU_Y} = \frac{MC_X}{MC_Y} \quad \text{Therefore equal by definitions above}$$

Proximate Conclusion

Efficiency achieved by assumption of utility (revealed preference) and profit maximisation
all else irrelevant ... assume it is.

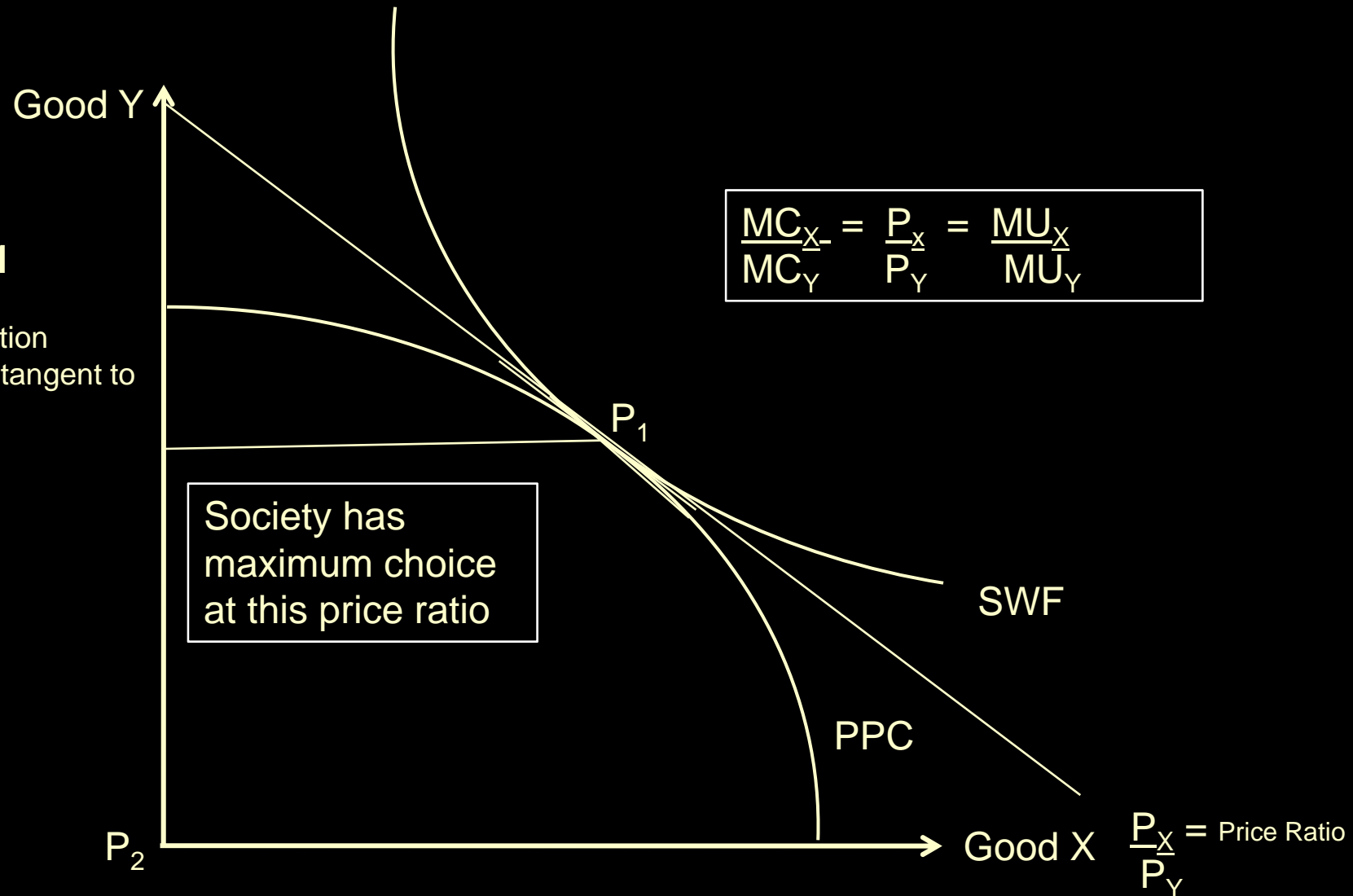
Policy Conclusion from Welfare Theory

Competition Desirable... extrapolate	(everywhere?)
Private Ownership desirable	(everywhere?)
No Monopoly	(ever?)
Min/No Gov Regulation except Property Rights	(ever?)
Minimum Tax	✓ ✓
Maximum Profits	✓ ✓
Self Interest	✓ ✓

Production Possibility Curve and Social Welfare Function

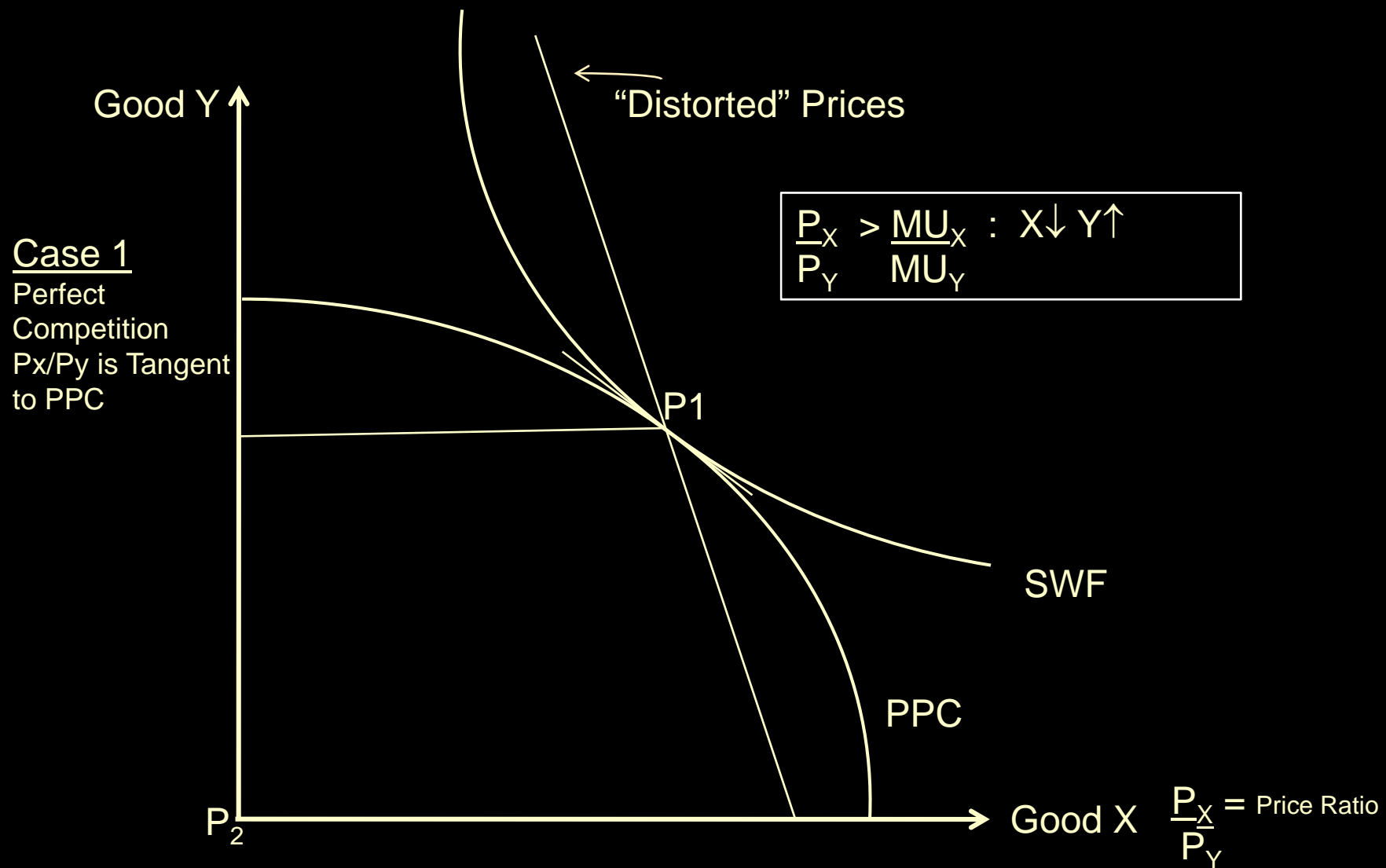
Case 1

Perfect
Competition
 P_X/P_Y is tangent to
PPC



Result: every possible point available at current prices

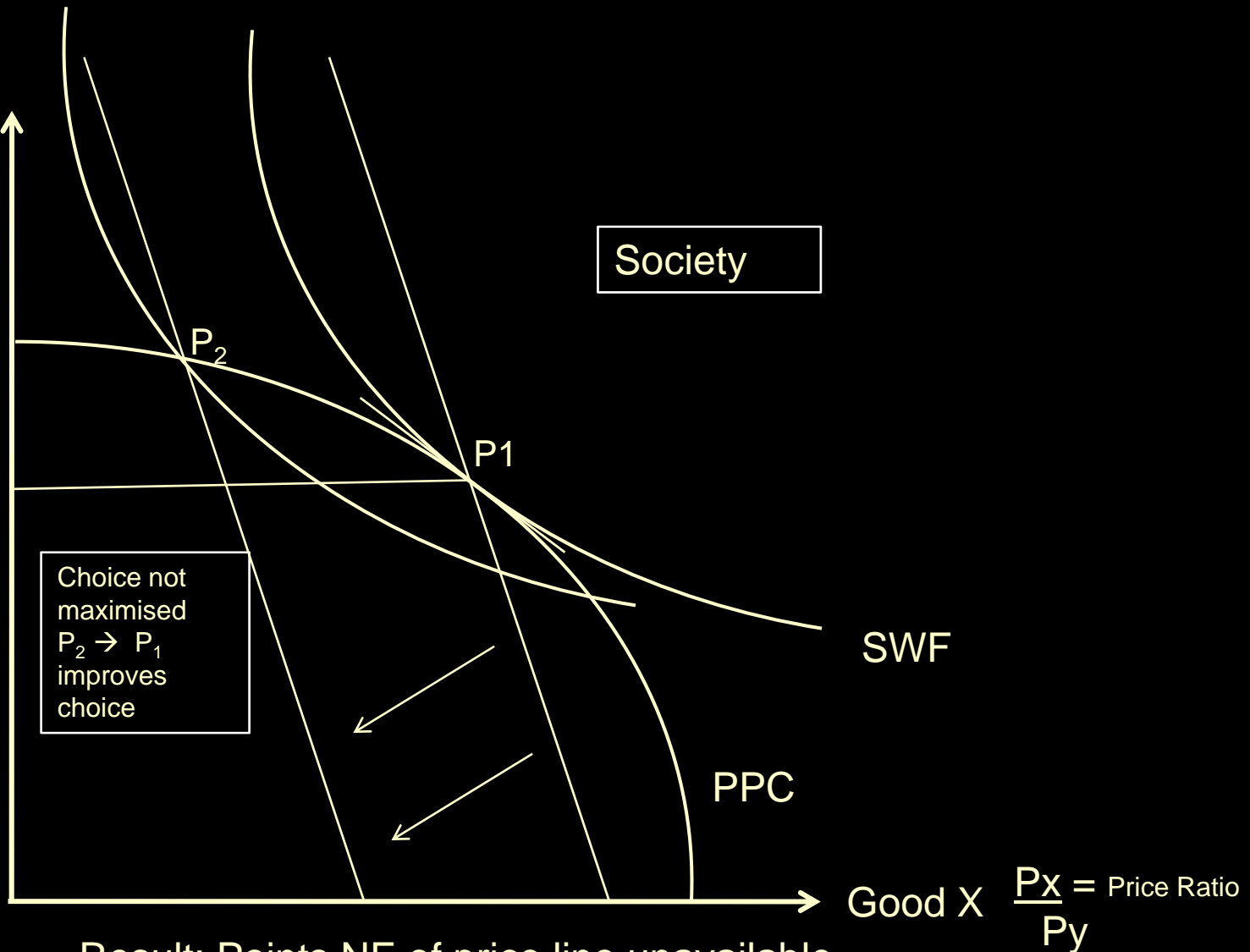
Production Possibility Curve and Social Welfare Function



Production Possibility Curve and Social Welfare Function

Case 1

Perfect Competition
 P_x/P_y is Tangent to PPC



Result: Points NE of price line unavailable

Conclusion 1

- If Assume 1 SWF = $f [U_1 U_2]$
Assume 2 U Maximised by choice
(Rev Pref)

And then (from above) PC maximises choice

To maximise choice (SWF), Maximise choice (PC)

Conclusion 1a

Assume (6) people 'rational' ie consistently selfish

Assume (7) no coercion, indecision,
eg social pressure

Conclude: maximising profit without distortions (eg government) – PC – gives max choice and each individual exercises choice (or doesn't) and thus increases revealed utility (or doesn't) ie Pareto efficiency

First fundamental law of WT

Conclusion 2 (Reverse)

- With any combination of initial resources
If we want people to have max opportunity to choose or not choose (Pareto efficiency) then we should maximise choice available (PC)

Second Fundamental law

Summary

- If personal choice is the only social goal, then a powerless responsive supply side which maximises choice is best
- Caveats
 - No economics of scale
 - Externalities
 - Anything else
- Result
 - Intellectual edifice with massive repercussions for theory, thought, policy and current world

Dollar Value of a Life Year

'Value' = WTP

Value of a Life Year: Anomalies

1. People don't select the lowest cost/life year
2. The search for \$ value/LY has overlooked an obvious hypotheses: 'there isn't one'
(despite universal belief by non economists)
3. Economists keep a straight face when they talk about the value of a statistical life (year)
eg Euro Will Collaboration

Methods for Estimating Value of Life (Year)

1. Observe policy or legal decisions
2. Stated Preference
 - Direct: Willingness to Pay
 - Indirect: Willingness to Pay Tax (JA Olsen)
3. Value statistical life year
 - (Viscusi 2008, Jones-Lee etc)
 - SLY methodology

Policy Decisions

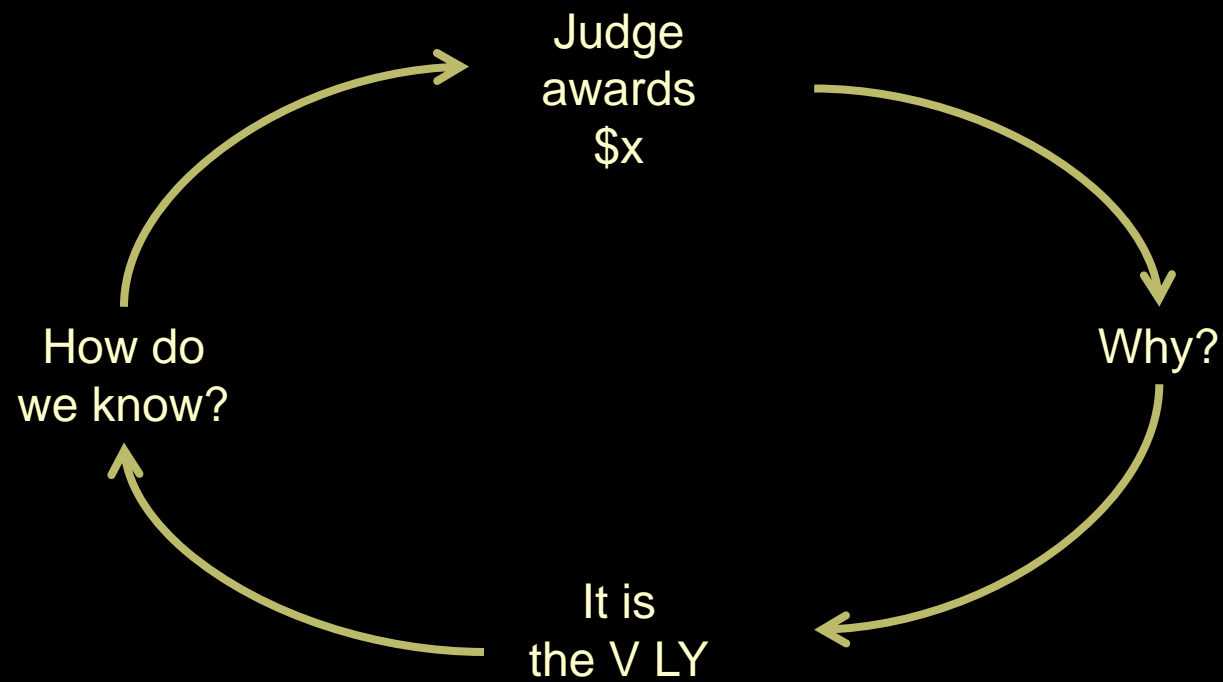
Judge/Jury Compensation

Cost of rails on Sydney Harbour Bridge
(Cost)/(LY gained)

Safety devices for appliances, pools etc/ LY

Revealed Preference and The Logical Ring Cycle

Tune: Die Vulkarie



Power of the Ring

- Judge Q: What is the right amount
A: Wait to see what I do
- Solving our own problems
Problem: Not sure what I want
Solution: Want to see what I do
- Problem for CBA of Public Projects
if $VLY \leftarrow$ Public Projects

Conclusion

- Positive analysis of result of public activities ✓✓✓
- Normative concept for prescription in CBA
↙ accidents of history

Stated preference for full LY

- 1 'How much should we pay for 1 LY'
 - Study: Richardson certa 1998
 - Subject: Staff CHE
 - Result: Incomprehension

*(What is spent now to give us an idea of what **should** be spent?)*

Stated preference

2. JA Olsen: 'What is your WTP = \uparrow Tax For service X'

- Best (conceptual) approach to date
- Problems
 - How much tax do others pay
 - How many lives will be saved
 - if few, tax \uparrow small, WTP/LY large
 - if large, tax \uparrow large, WTP/LY small

Summary

People don't know

Revealed Preference and Risk

- Method: Obtain WTP for reduced risk of death, p
eg cost of safety devices
- Or : Compensation for increased risk of death, p ,
eg wage

- $$\text{Wage} = a + b (\text{year's training}) + c \text{ Other} + d \cdot (p)$$
$$\rightarrow d = 10,000 \text{ (say)}$$

- Assume NM Axioms i.e. Linear extrapolation
Value of life = $d/10,000$
- Example:
1 in 10,000 risk of death = \$ 4,000
100% risk of death = \$ 40 million

Value of statistical lives: Problems

1. Common sense
2. Perspective
3. Which probabilities
4. EU Theory and Linear Transformation

Problem 1: Commonsense

- Q1: would you accept \$40,000 for 1:10,000 risk of death? Yes
- Q2: would you accept \$40 m for certainty of death No
- Solution
 - Invent a square circle, ie non existent with a snappy label
 - Enter: STATISTICAL LIFE YEAR:
and SLY methods

Problem 2

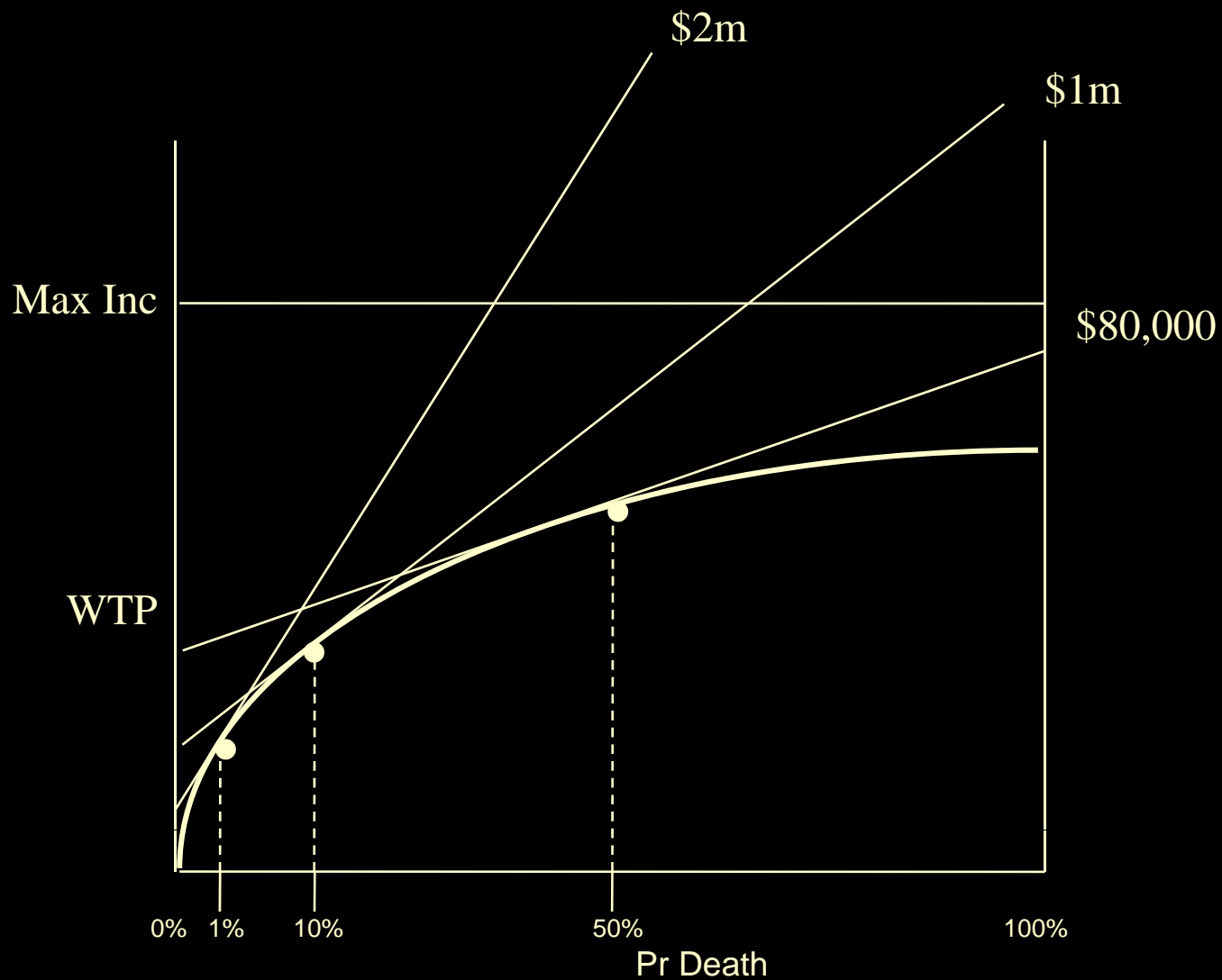
- Personal vs social perspective in a NHS
- SLY \leftarrow personal values
- SLY then used (slyly) for social purposes
eg NHS
taxpayer WTP for someone else
 \nwarrow personal WTP for own risk

Key: social generosity

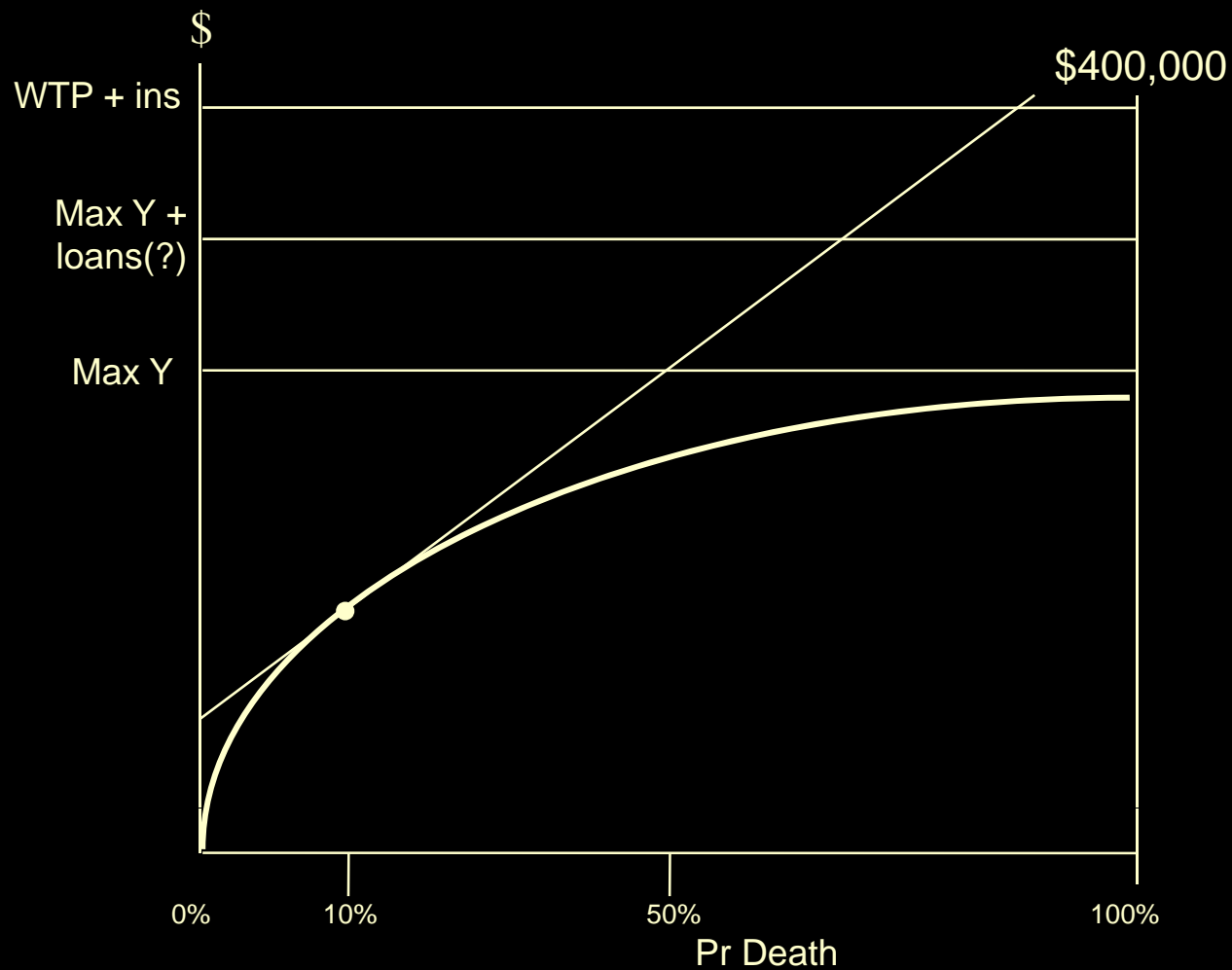
Problem 3

- Which probabilities to Use?
 - Willingness to Pay
 - Compensation

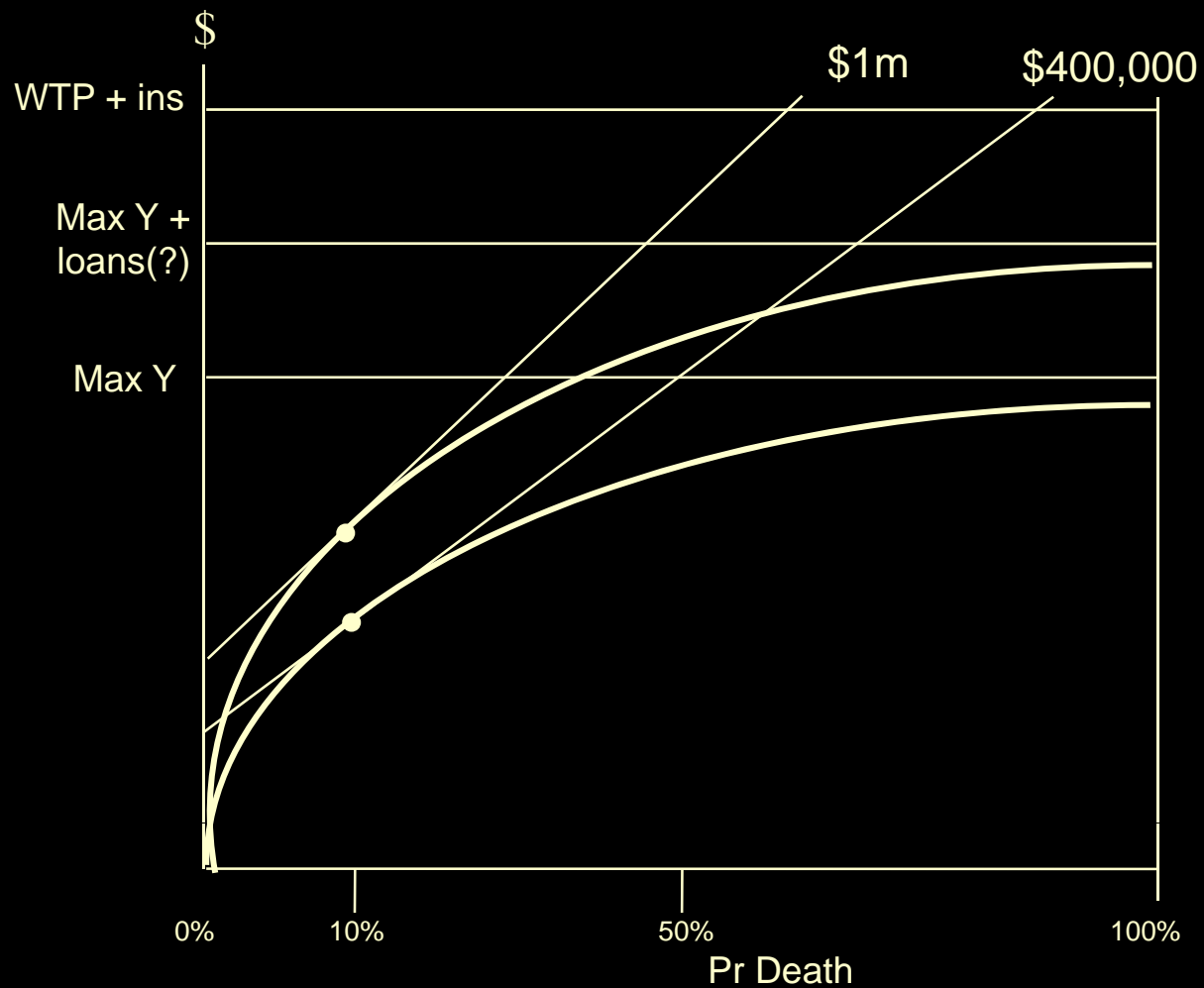
Extrapolating VSL from WTP



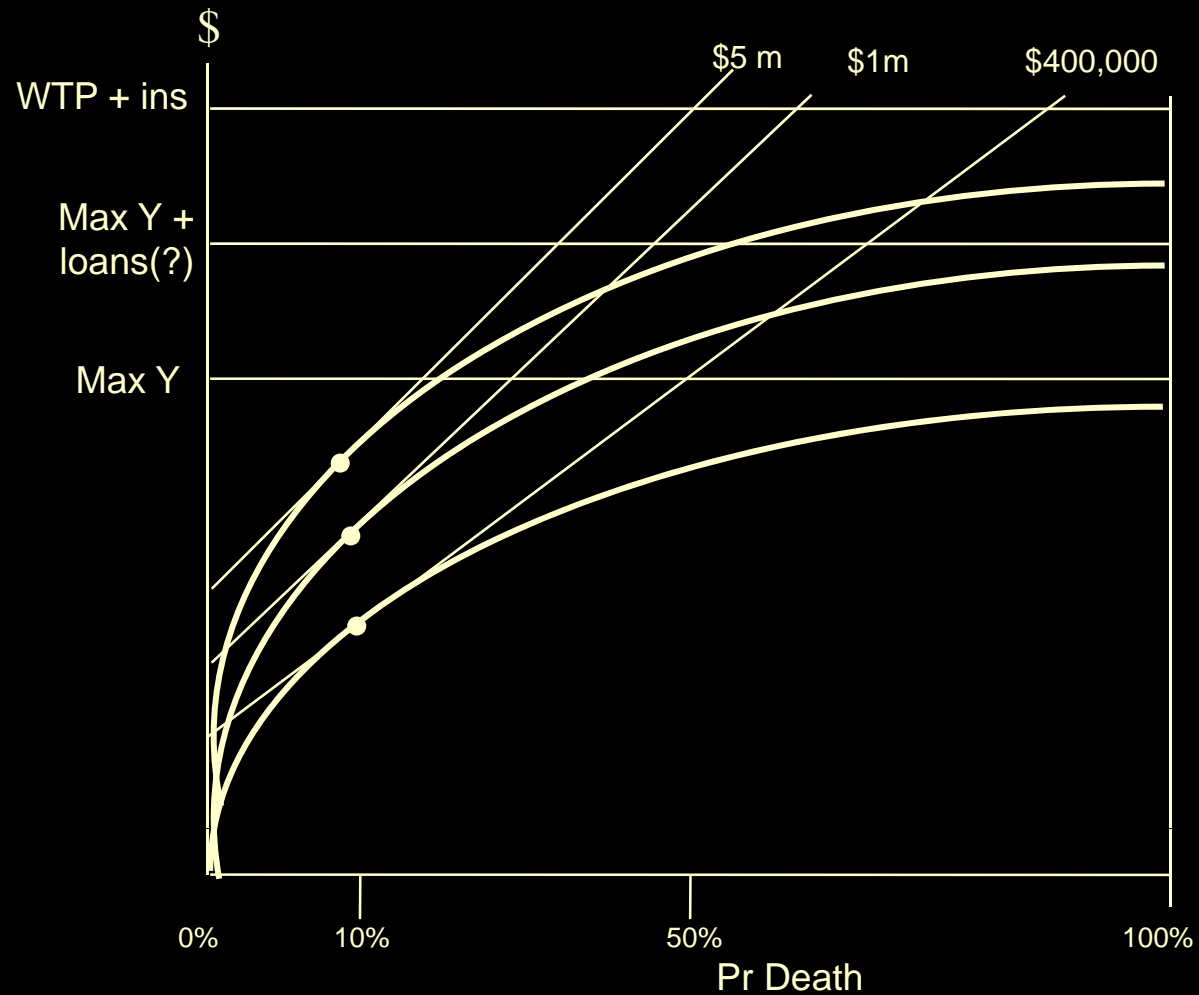
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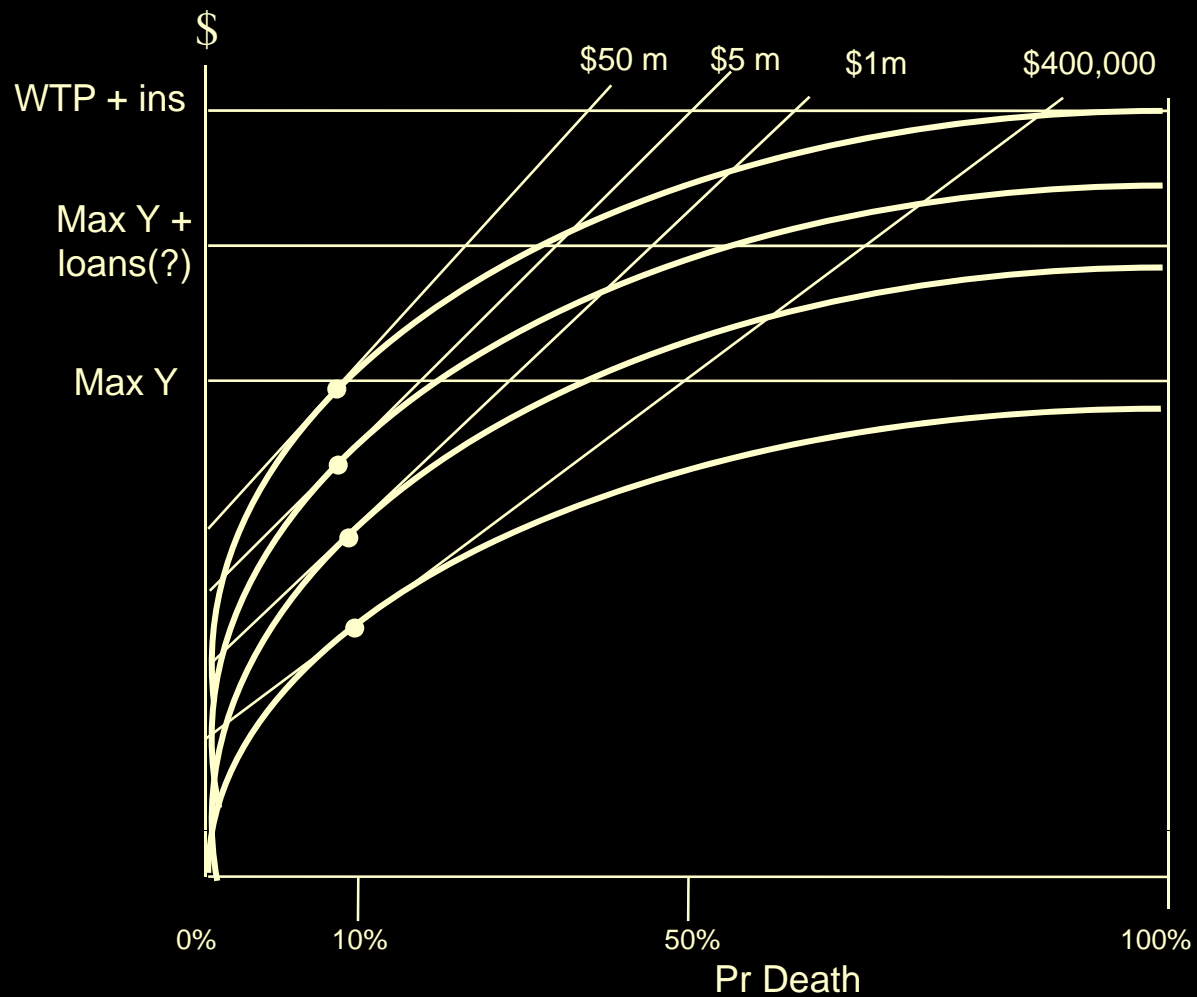
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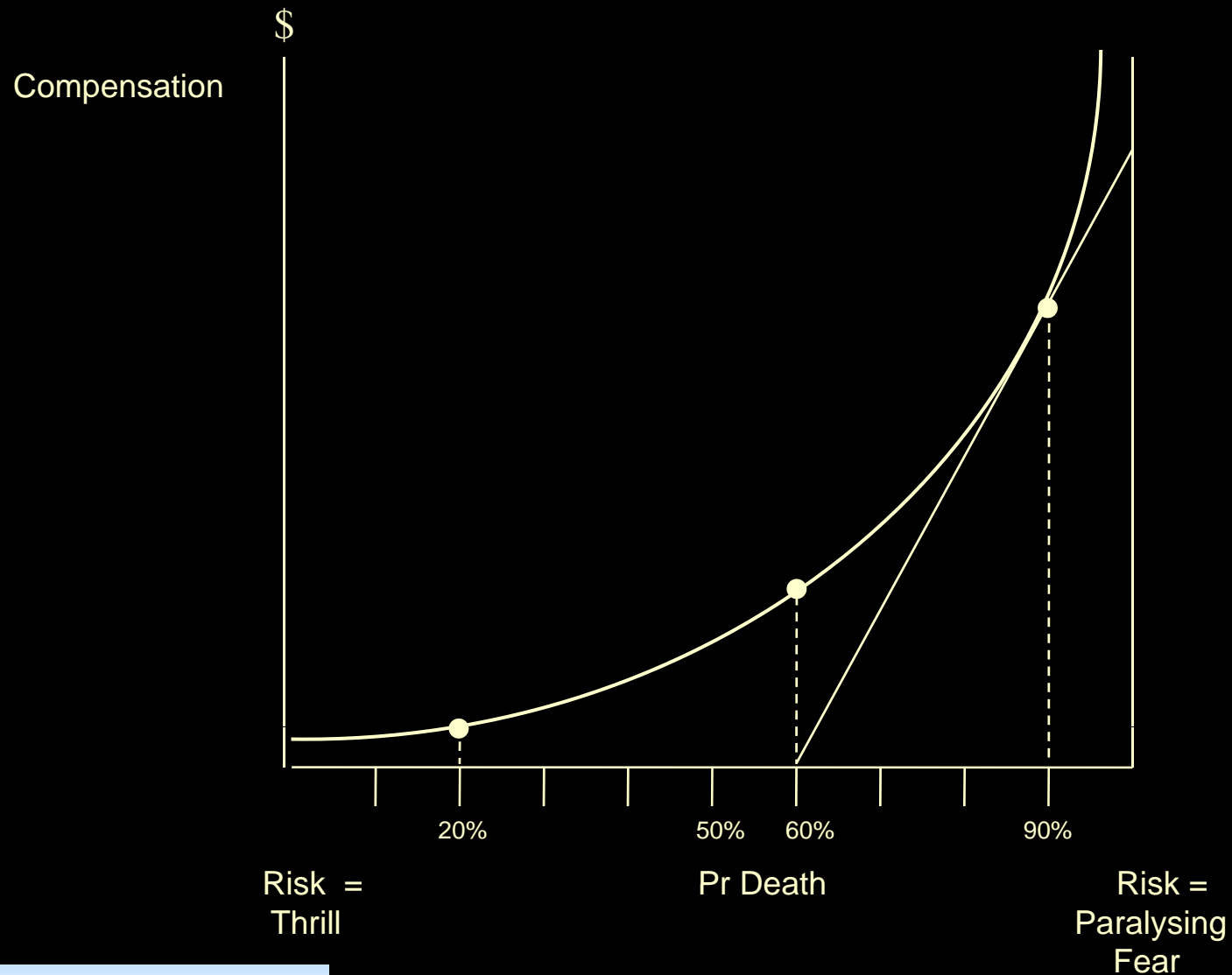
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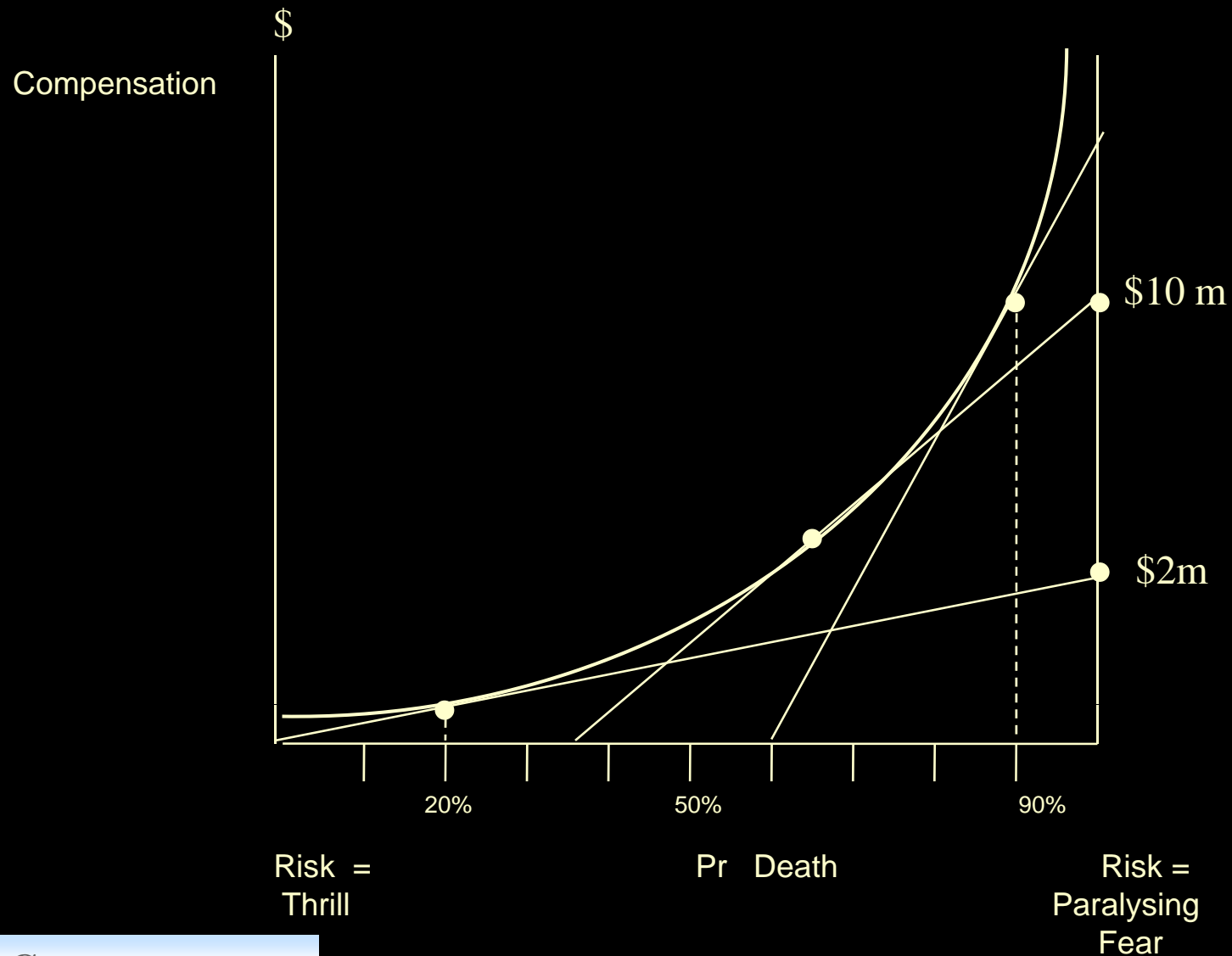
Extrapolating VSL from WTP



Extrapolating from compensation



Extrapolating from compensation



Problem 4 Linear Extrapolation

- Axioms of von Neumann-Morgenstern
 - Empirically flawed
 - Theoretically wrong

Critique: Allais Paradox (1953)

	Probability of			Result
	\$0	\$4 million	\$10 million	
A		1.0		
B	0.01	0.89	0.01	A > B
C	0.89	0.11	-	
D	0.9	-	0.1	C > D

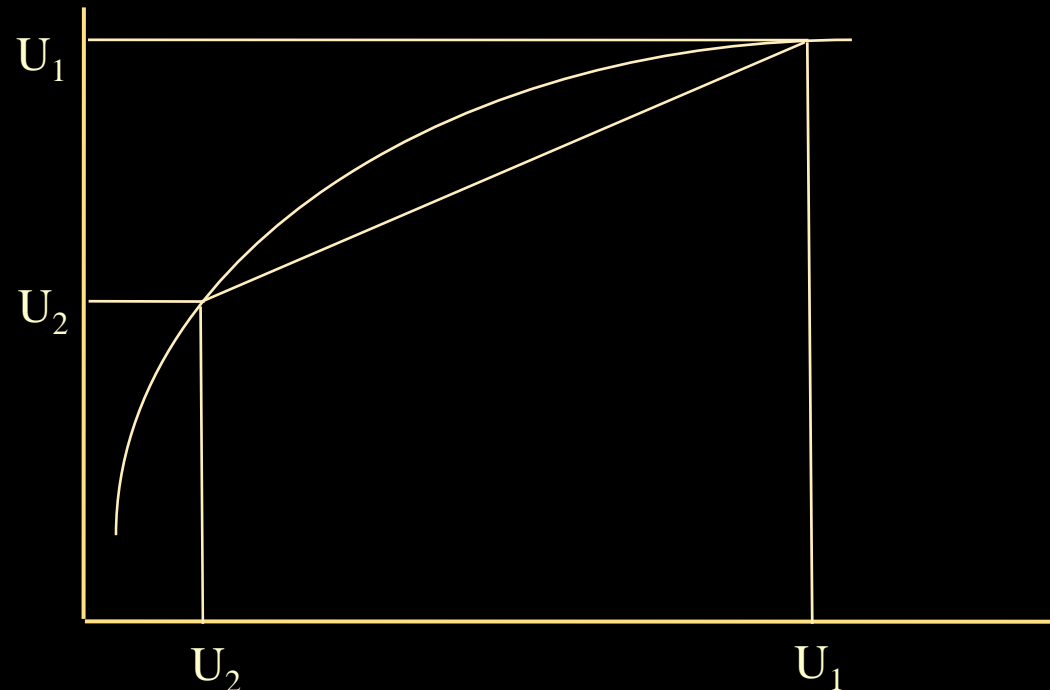
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	\$0	\$4 million	\$10 million
A		1.0	
B	0.01	0.89	0.0
C	0.89	0.11	-
D	0.9	-	0.1
Linear Transformation			
C		$1.0 - 0.89$	-
D		$0.89 - 0.89$	0.1

Critique: Allais Paradox (1953)

	Probability of			Result
	\$0	\$4 million	\$10 million	
A		1.0		
B	0.01	0.89	0.1	$A > B$
C	0.89	0.11	-	$C < D$
D	0.9	-	0.1	
Linear Transformation of A vs B				
A		$1.0 - 0.89$	-	$A > B$
B		$0.89 - 0.89$	0.1	
Equals				
C^T	0.89	.11	-	$A > B$
D^T	0.9	-	.01	ie $C^T > D^T$
				But $C < D$

Theory: EU and Marschak's definition of Risk



$$E(U) = p_1 U_1 + p_2 U_2 : \text{'Defines risk'}$$

Error: 'E(U)' = expected (average) of U1, U2
≠ expected utility of gamble

Risk per se

Process of gamble →

Risk per se

'Disutility of risk per se'

'Process utility'

'irrational utility'

Utility of gambling

Love of gambling

History of 'risk per se'

Plato

Adam Smith

Pascal

Ramsay

Von Neumann Morgenstern

1948-52

Post 1952

Description

'Wonder

'Surprise, wonder'

Boredom

Love of chance, excitement

Mere act of chance

Dropped from literature

Disregard of 'g' labelled 'Classical View'

Von Neumann, Morgenstern

I want to make it absolutely clear that I believe –as von Neumann did – that there may be a pleasure of gambling, of taking chances, a love of assuming risk, etc. But what we did say and what I do feel I have to repeat even today after so many efforts have been made by so many learned men, is that the matter is still very elusive. I know of no axiomatic system worth its name that specifically incorporates a specific pleasure or utility of gambling together with a general theory of utility... I am not saying that it is impossible to achieve it in a scientifically rigorous manner. I am only saying (as we did in 1944) that this is a very deep matter' .

Rationalising 'g'

- (a) 'g' is 'absorbed' in process of gamble
- (b) measurement 'under risk' is necessary

Rationalising 'g'

- (a) 'g' is 'absorbed' in process of gamble
- (b) measurement 'under risk' is necessary

Proposition (a) is false

$$\text{eg } .25 \times \$100 = \$30 \quad \dots (1)$$

Transform

$$\times 2 \rightarrow .5 \times \$100 = \$60 \quad \dots (2)$$

$$\times 2 \rightarrow 1.0 \times \$100 = \$120 \quad \dots (3)$$

Step: (3) eliminates 'risk' \rightarrow nonsense

ie cannot transfer 'g' (Morgenstern)

The Mystical Power of Labels

- c) Measurement 'under **risk**' is necessary for utility; otherwise have '**value**'

In the world of 'under risk'

g (instant death \leftarrow SG)

= g (disappointment aspro fails)

Connection = mystical
 \neq empirical

Problem 5 Embodied linear transformation (cont)

Logic is 'disembodied' and a-temporal

1 person x [risk (1/100)] x 100

≠ 100 people x risk (1/100)

≠ 1 person x 100 choices

Result of multi person insurance/compensation

(a) Frequency distribution of gained/lost LY expost

(b) Frequency of distribution of gained/lost fear ex ante

Ontological status and social value of fairies and statistical life years

Fairies

- Small magical people, undetectable to non believers

SLY

- Population weighted average of the reciprocal of the probability of death times the full insurance premium adjusted by income status with residual ambiguity wrt unemployed and social security recipients
- Undetectable to non-believers

Clarity of concept/characteristics

- Head, 2 arms, legs etc
- Female
- Low BMI
- High metabolic rate
- Glow in dark
- Like dancing
- Flimsy clothes (Rudd disapproves)
- Probably don't exist
 - (no known evidence to support this)

Clarity of concept/characteristics

- Head, 2 arms, legs etc
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 - Flimsy clothes (Rudd disapproves)
 - Probably don't exist
 - (no known evidence to support this)
- Never properly described
 - 2 independent frequency distributions (a) future LY gained
(b) subjective wellbeing from fear reduction/other emotions
 - Interval and ratio property unclear of what
 - Measured in \$
 - Cant' be bought/sold
 - Definitely don't exist
 - (no evidence anyone understands them)

Reason for belief

- Regular sightings over hundreds of years
 - Vast literature
 - Believed in by 20% of world's population
- Minor literature
 - Believed by mathematically trained economists who believe in the mystical powers of the NM axioms
 - World of “under risk”
 - Narnia etc

Benefits

- Enormous pleasure to
100% of children
80% of parents

Costs

- Nil

Benefits

- Simplify policy
- Give economists
authenticity
- Randomly re-
distribute life and
death

Net social value

Normative judgement

Evidence from the Cost Side

- Anomaly: People reject criterion:
min cost/QALY
- Significance: Equivalent to rejecting
existence of VLY
- Hypotheses: Due to fairness
(John McKie Seminar)
- Testing: Severity Project (last seminar)

Cost/QALY and VLY

- Objective: Max (Ben – Cost)
if Ben = Constant = 1 QALY
Max (Constant – Cost) ... (1)

→ Min. Cost/QALY

= Normal Rule

- Rejection of rule implies
 1. Reject maximisation

OR

2. Eq (1) mis-specified: should be

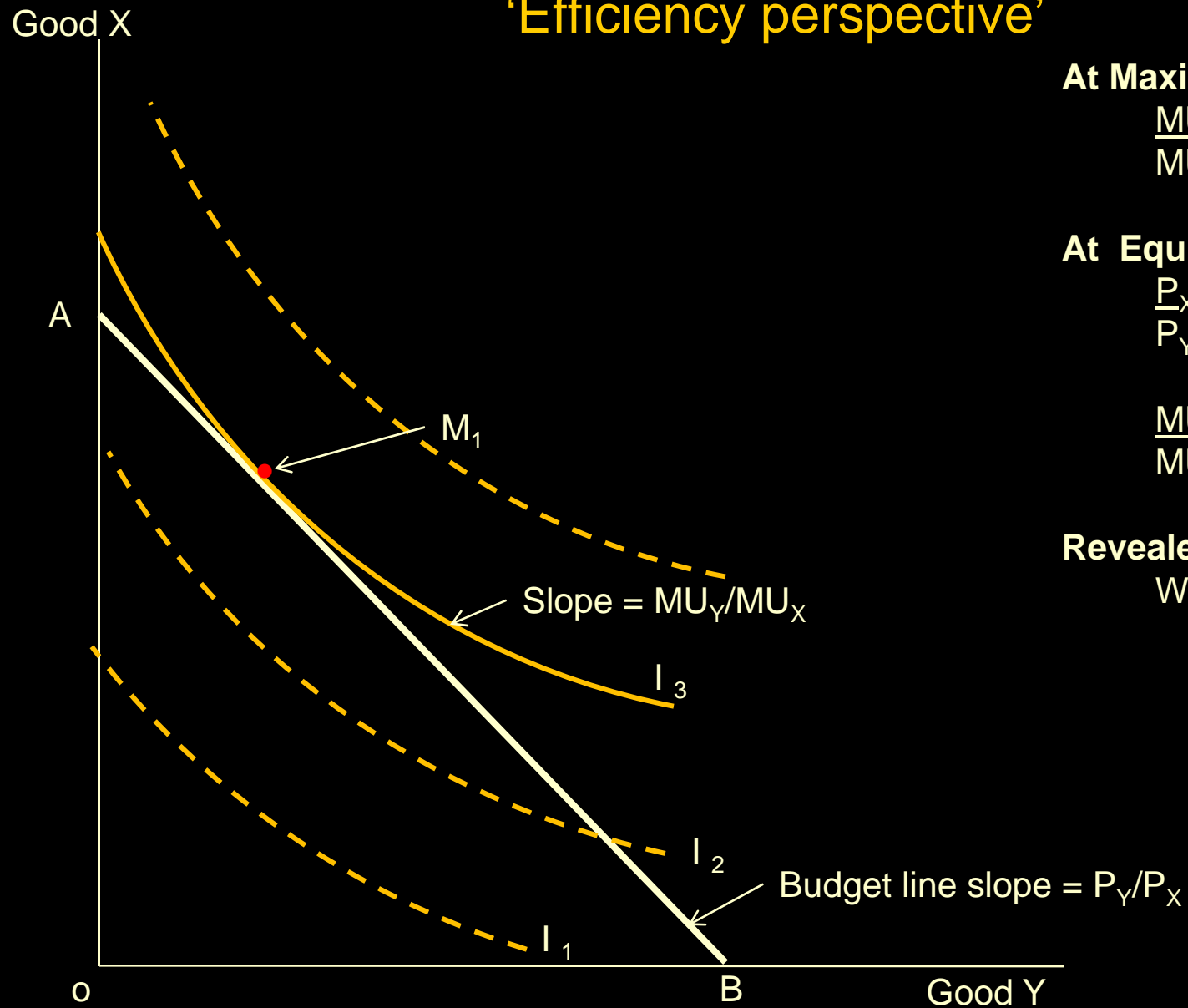
Max (QALY + 'other' – Cost) ... (2)

OR

→ Min Cost/(QALY + 'other')

→ Min (Cost – 'other')/QALY

Figure 1 Orthodox demand theory 'Efficiency perspective'



At Maxima M

$$\frac{MU_Y}{MU_X} = \frac{P_Y}{P_X}$$

At Equilibrium

$$\frac{P_X}{P_Y} = \frac{MC_Y}{MC_X}$$

$$\frac{MU_Y}{MU_X} = \frac{MC_Y}{MC_X}$$

Revealed preference

$$WTP = MC$$

Figure 2 Costs, benefits in CEA (Efficiency)

$MC_Y < MC_X \rightarrow$ corner solution

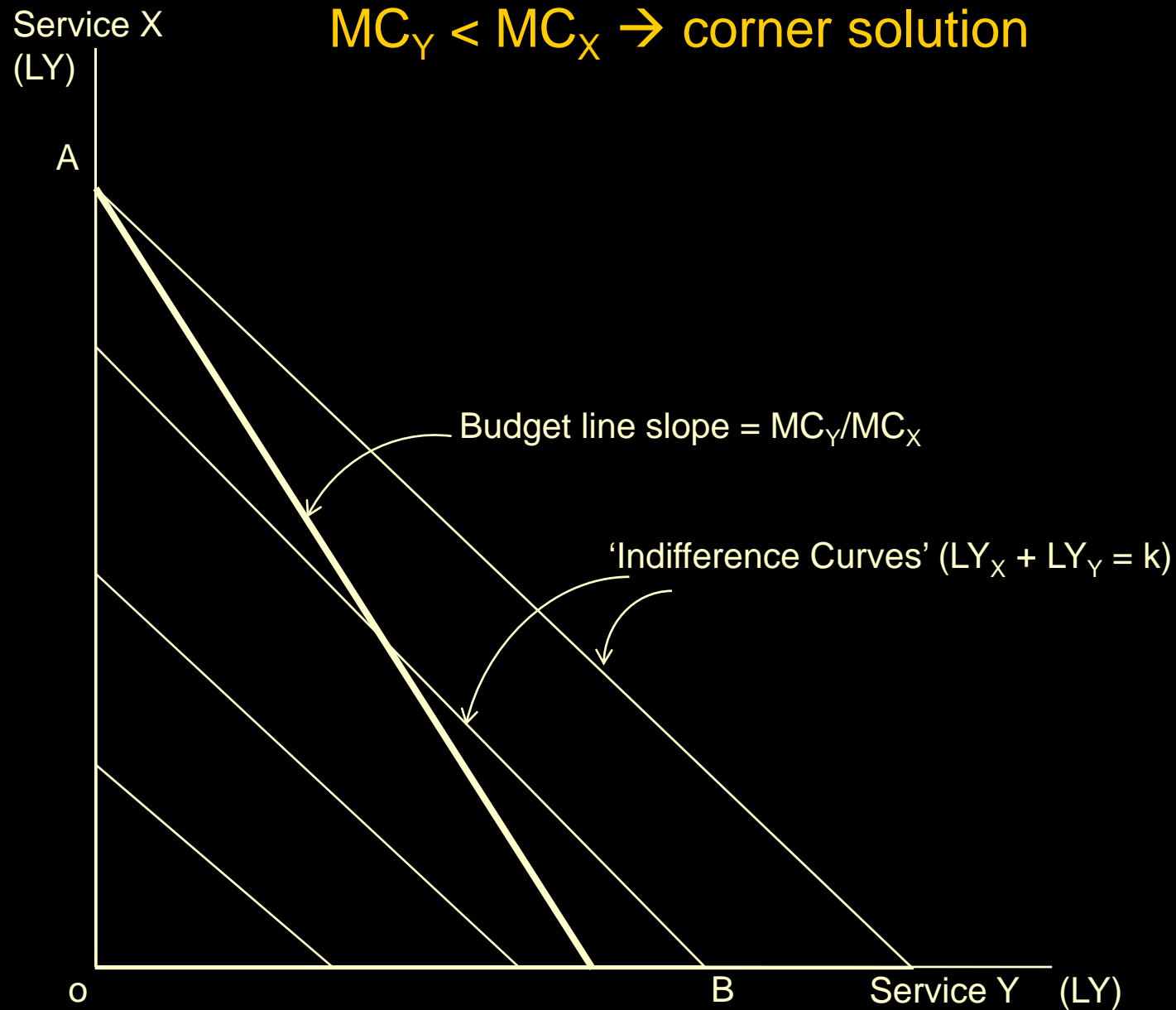


Figure 3 Indifference 'curve' perfect egalitarianism Fairness perspective

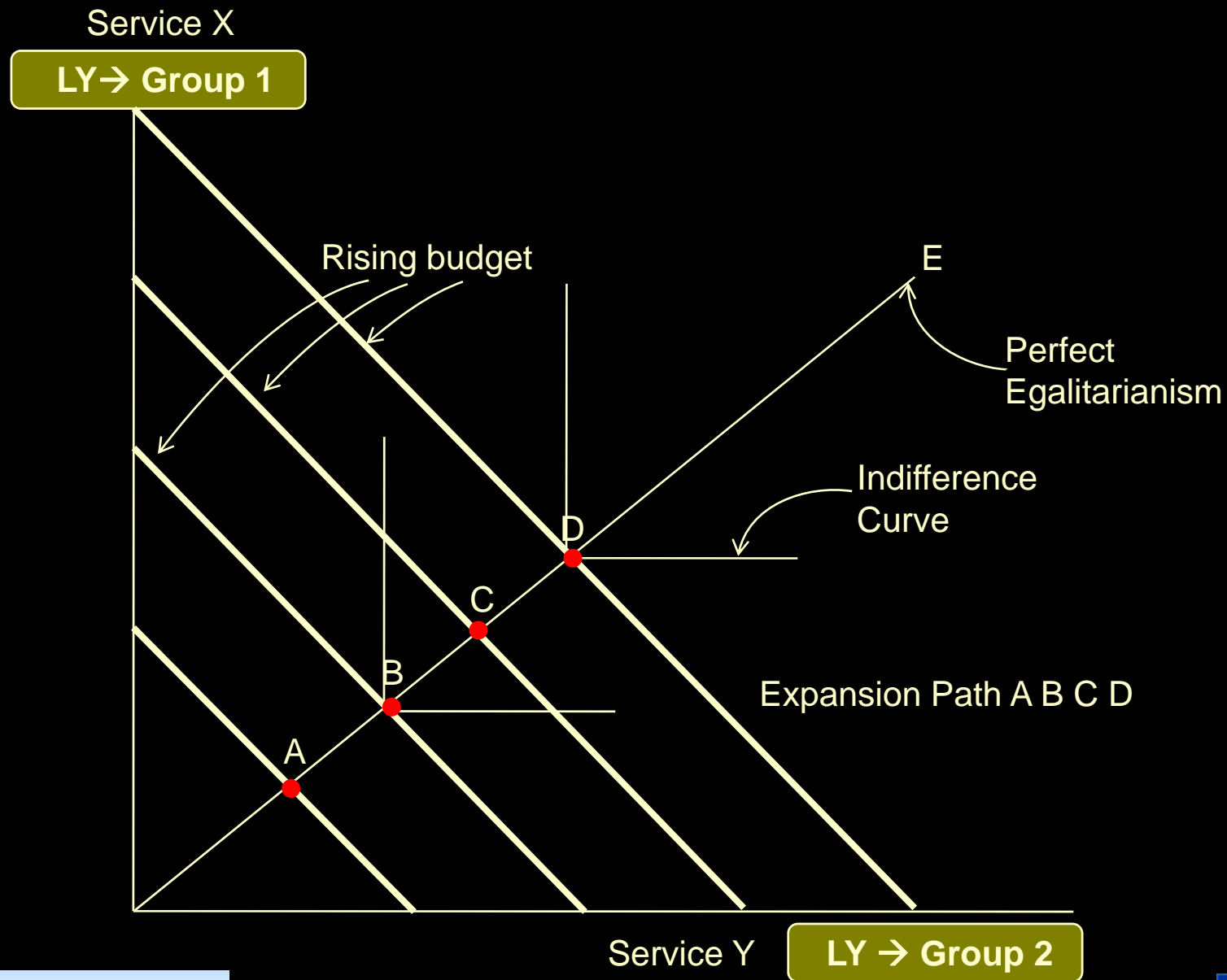


Figure 4

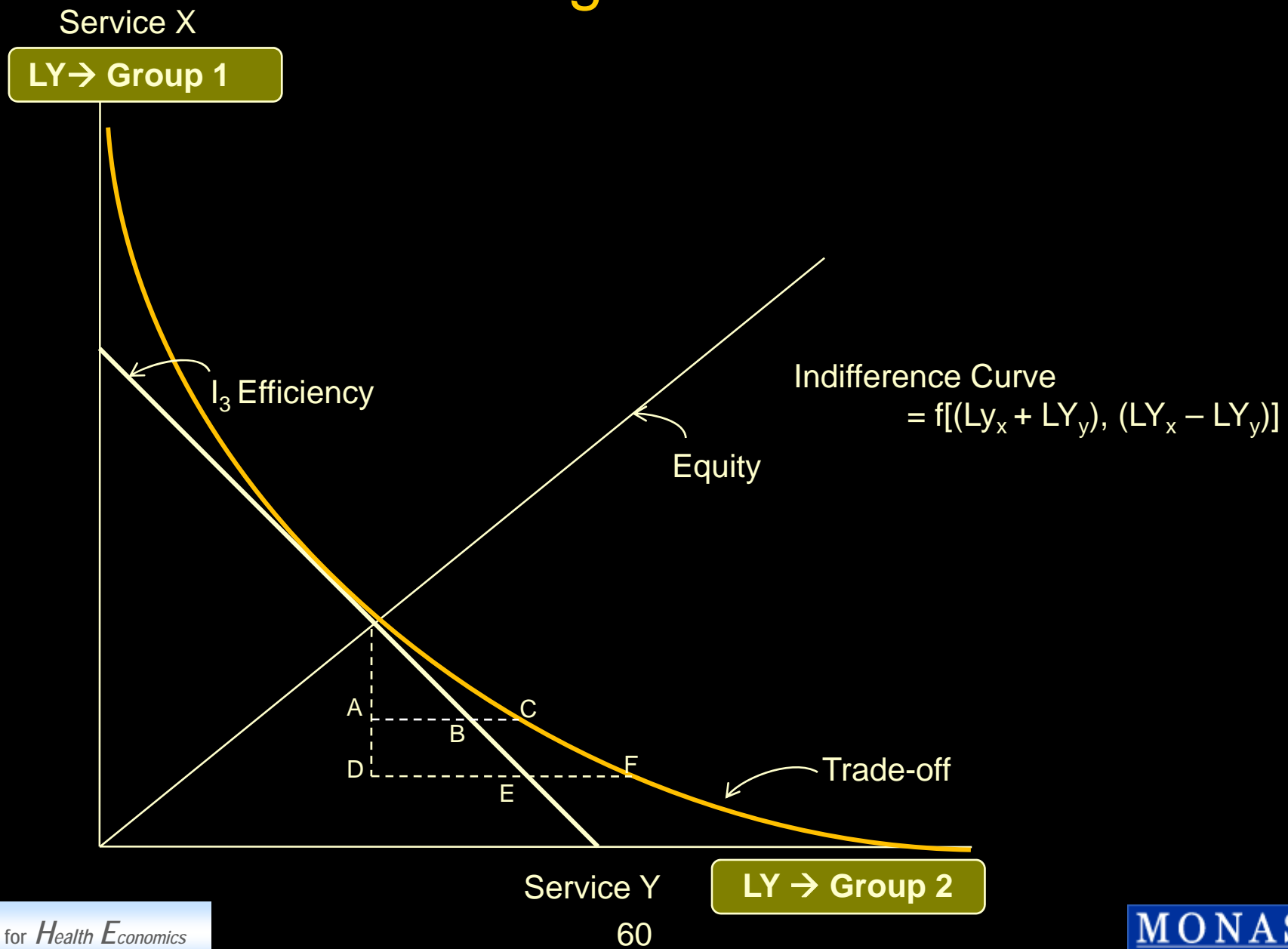


Figure 5 SW = f(Fairness Efficiency)

$$MC_Y > MC_X$$

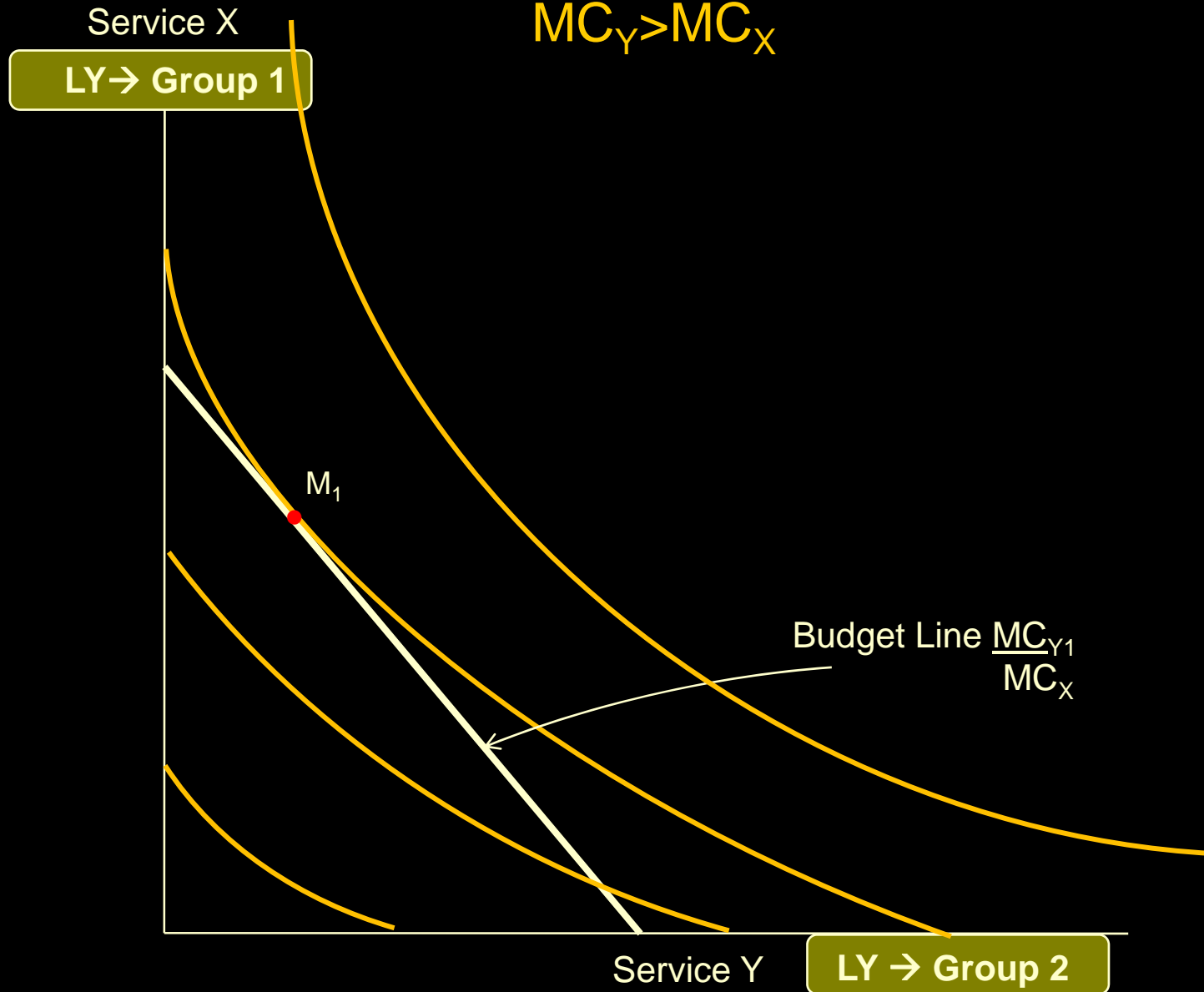
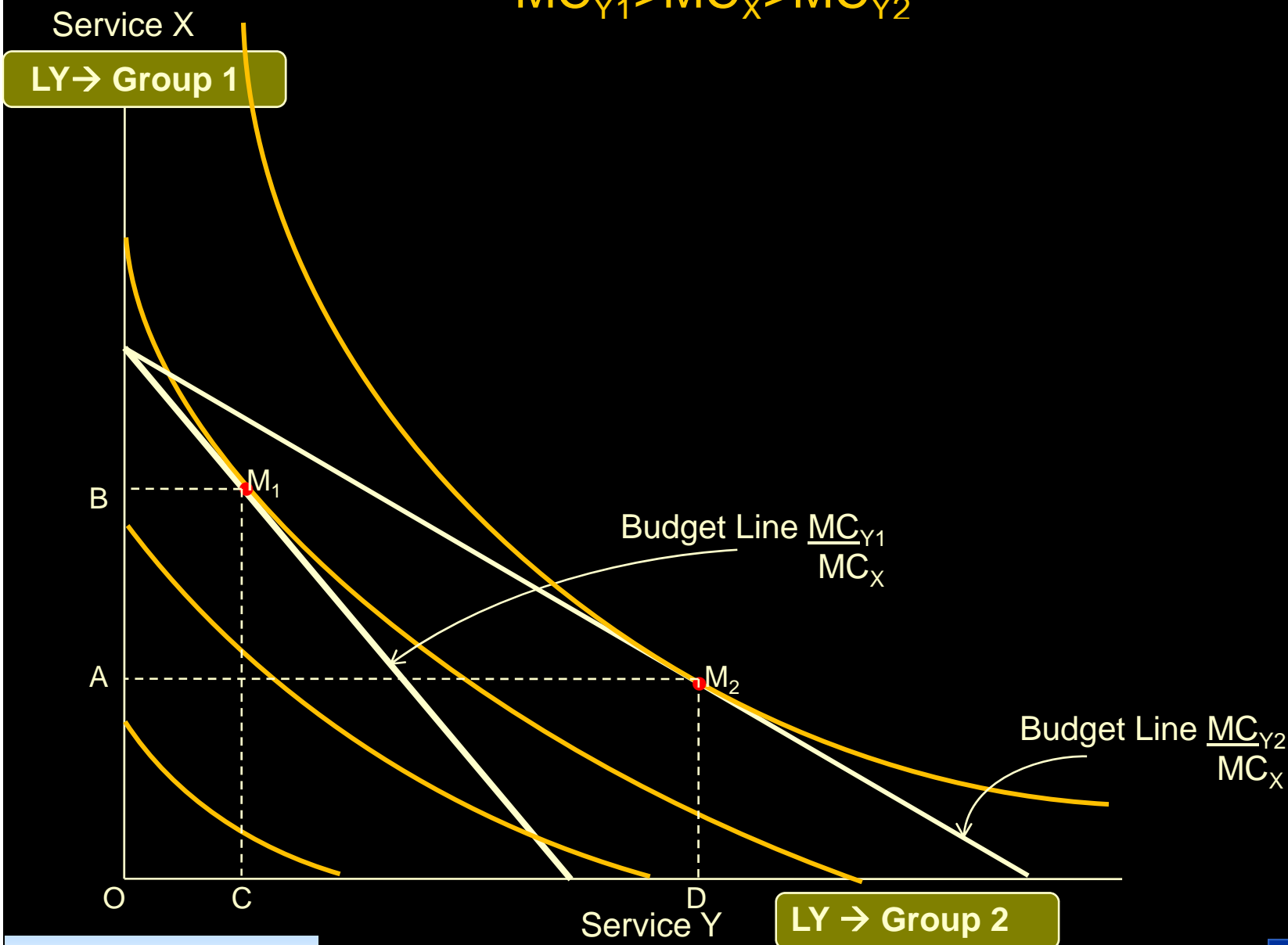


Figure 6 SW = f(Fairness Efficiency) Fixed budget

$$MC_{Y1} > MC_X > MC_{Y2}$$

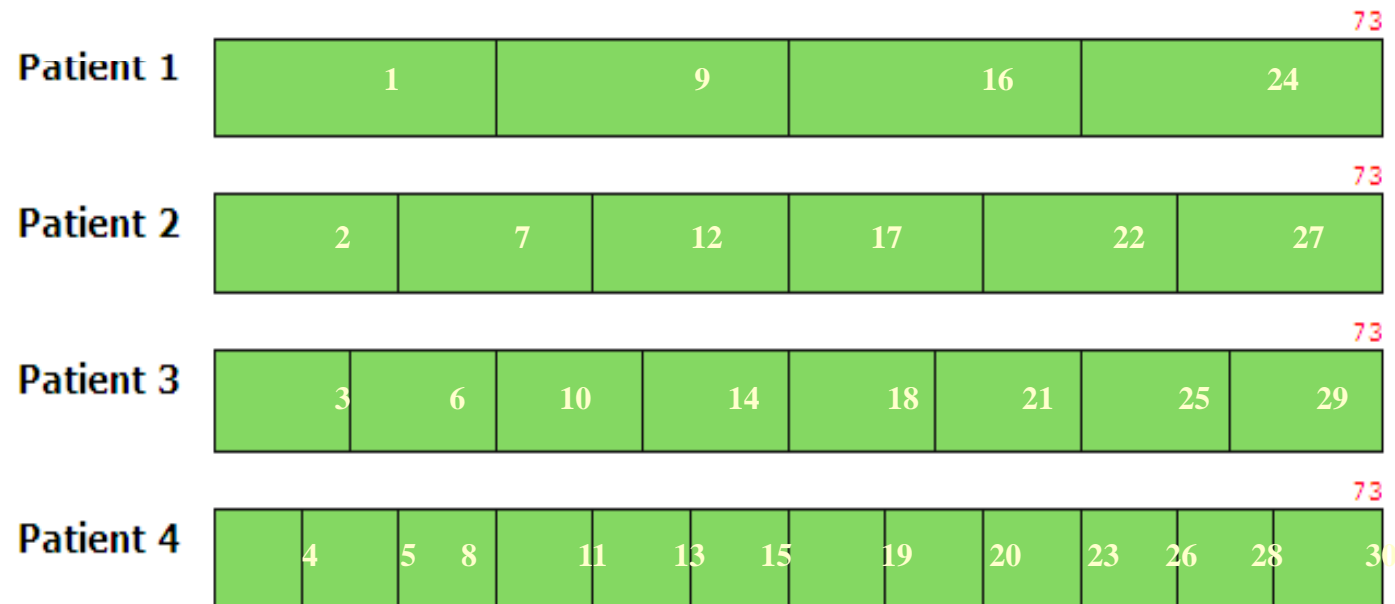


Orthodox Economic Ranking

Patient 1	1	2	3	4	73								
Patient 2	5	6	7	8	9	10	73						
Patient 3	11	12	13	14	15	16	17	18	73				
Patient 4	19	20	21	22	23	24	25	26	27	28	29	30	73

[\[Exit and Clear Survey\]](#)

Extreme Egalitarianism



[\[Exit and Clear Survey\]](#)

next >>

Indices: Spearman correlation and ad hoc index

		Spearman correlation		$\Sigma (O_1 - O_2)^2 / \text{max ind}$	
		Response Order vs Order			
	n	Efficiency	Egalitarian	Efficiency	Egalitarian
Graduate	68	0.48	0.28	0.12	0.15
Total	118	0.40	0.24	0.15	0.17

Indices: Spearman correlation and ad hoc index

		Spearman correlation		$\Sigma (O_1 - O_2)^2 / \text{max ind}$	
		Response Order vs Order			
	n	Efficiency	Egalitarian	Efficiency	Egalitarian
Economist	9	0.40	0.23	0.26	0.26
Graduate	68	0.48	0.28	0.12	0.15
Other	39	0.34	0.22	0.19	0.21
Total	118	0.40	0.24	0.15	0.17

Deriving a cost algorithm to replace cost

- Cost/LY = [gained LY/1,000]⁻¹
= [size of 'Block']⁻¹
- 'Budget' = [\$10,000] [number of iterations]
- LY/person = services [clicks]*[LY/service]
- "Severity" = Life expectancy

Deriving the threshold

$$\ln \rho / (1-p) = a - b_1 P - b_2 LE + b_3 Y$$

$$\text{if } \rho = 1/2$$

$$0 = a - b_1 P - b_2 LE + b_3 Y$$

If Y, LE fixed

$$\begin{aligned} \text{cost}/LY = P &= (1/b_1)(a + b_2 LE + b_3 Y) \\ &= \text{fixed threshold/person} \end{aligned}$$

Deriving the threshold

$$\ln \rho / (1-p) = a - b_1 P - b_2 LE + b_3 Y$$

$$\text{if } \rho = \frac{1}{2}$$

$$0 = a - b_1 P - b_2 LE + b_3 Y$$

If Y, LE fixed

$$\begin{aligned} \text{cost/LY} = P &= (1/b_1)(a + b_2 LE + b_3 Y) \\ &= \text{fixed threshold/person} \end{aligned}$$

But

$$LE = f[Q] = f[\text{cost/LY}] \text{ ie endogenous}$$

$$[\text{Cost/LY}]/\text{person} = 1/b_1 [a - b_2(f(\text{cost/LY})) + b_3 Y] \dots \text{Equation 1}$$

Conclusion from severity algorithm

Cost/service

- Inextricably linked to a group of people
- Inextricable from fairness of relative treatment

Appropriate algorithm

- $\text{Min (Cost - k)/QALY}$

Conclude: Do not minimise cost/QALY

There is no 'single' dollar value for a life year

Conclusion

- Welfare Theory: Logical Tautology
- EUT: Theoretically flawed ignores time (fairly fundamental)
- Statistical Life Year: Square circle with a catchy label
- Value of a QALY: Non-existent: ignores fairness (also fairly fundamental)
- Conclusion: Economic theory has some very large order anomalies... TBC

What are we to do?

- Short run
 - Continue applied economic research
 - Be critical of methods
 - Come to 'Square Circle' 2 and 3

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What are we to do?

- Short run
 - Continue applied economic research
 - Be critical of methods
 - Come to 'Square Circle' 2 and 3
- Long run
 - Investigate social objectives
- Very long run
 - Reincarnate as an engineer