LECTURE 4

VOUCHER VS. CASH
INCOME AND SUBSTITUTION EFFECTS
CONSUMER WELFARE

Conceptual Q: A consumer buys 2 goods, x and y. When x becomes more expensive, the consumer buys more y.

Wrong. Tut 2 Q3. Look at demand function for y, when x becomes more expensive, you buy less y. It really depends what utility function u have. This is possible, but not always true.

Where are we?

- Consumer choice
- Individual demand
- Application/Extension of the basic consumer choice model
  - Revealed preference
  - Voucher vs. cash
  - Income and substitution effects
- Consumer welfare
  - How to measure the benefit/loss to consumers when there is a price change?

Part 1

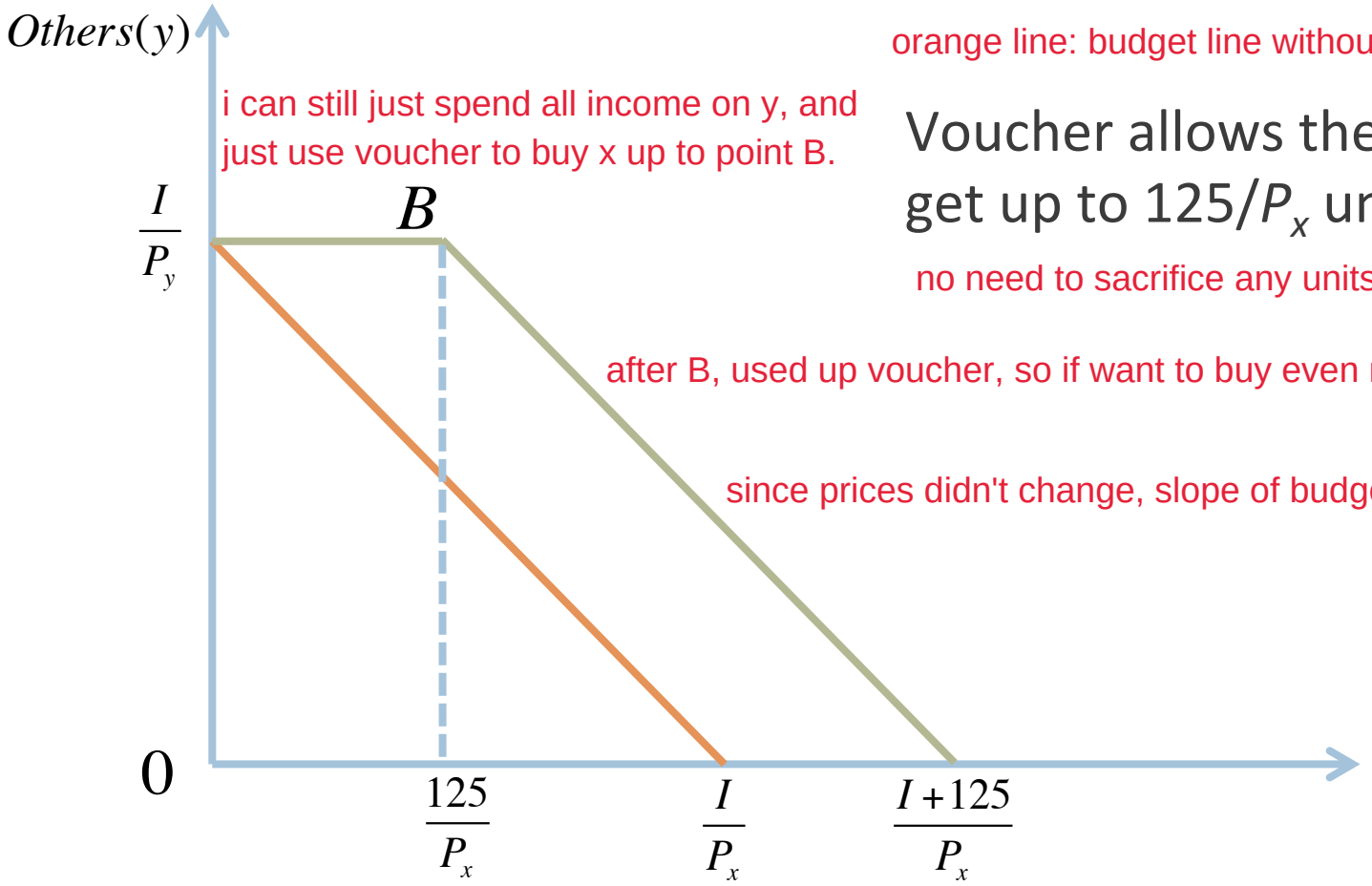
Application: Voucher vs. Cash

Back-To-School Vouchers

- NTUC offers back-to-school education vouchers to low-income families
  - $125 voucher per school child to be spent on school-related goods
- Similar program
  - US food stamps voucher for food for low-income family
- What is the effect of the voucher on
  - Consumer's choice
  - Consumer's utility

Budget Line with Voucher

how budget line changes



orange line: budget line without voucher

i can still just spend all income on y, and just use voucher to buy x up to point B.

Voucher allows the consumer to get up to $125/P_x$ units of x for free

no need to sacrifice any units of y to get these x.

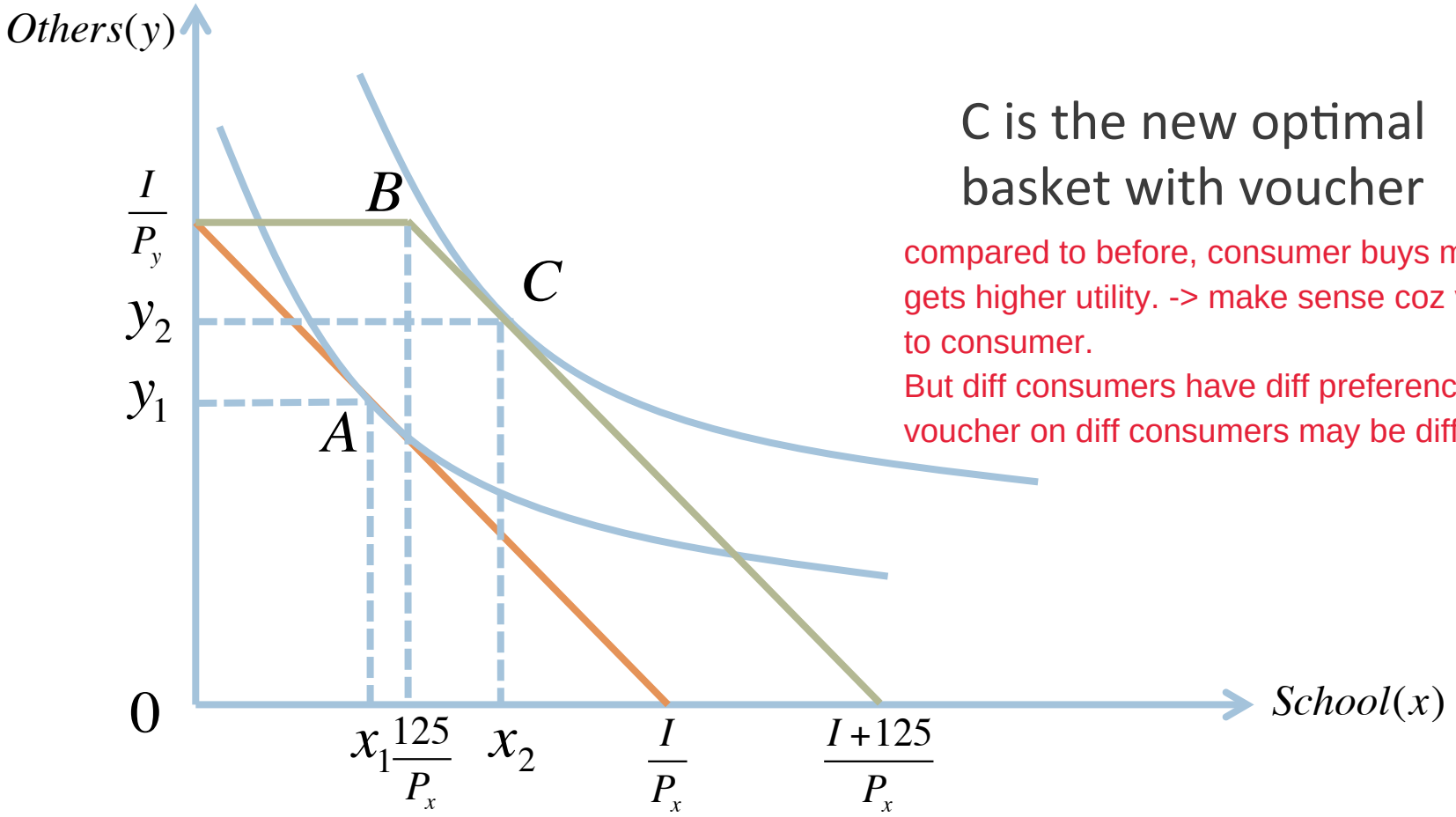
after B, used up voucher, so if want to buy even more x, have to give up some y.

since prices didn't change, slope of budget line still the same

horizontal intercept: spend all income + all voucher on good x

Impact of Voucher on Consumer 1

how optimal basket for the consumer may change



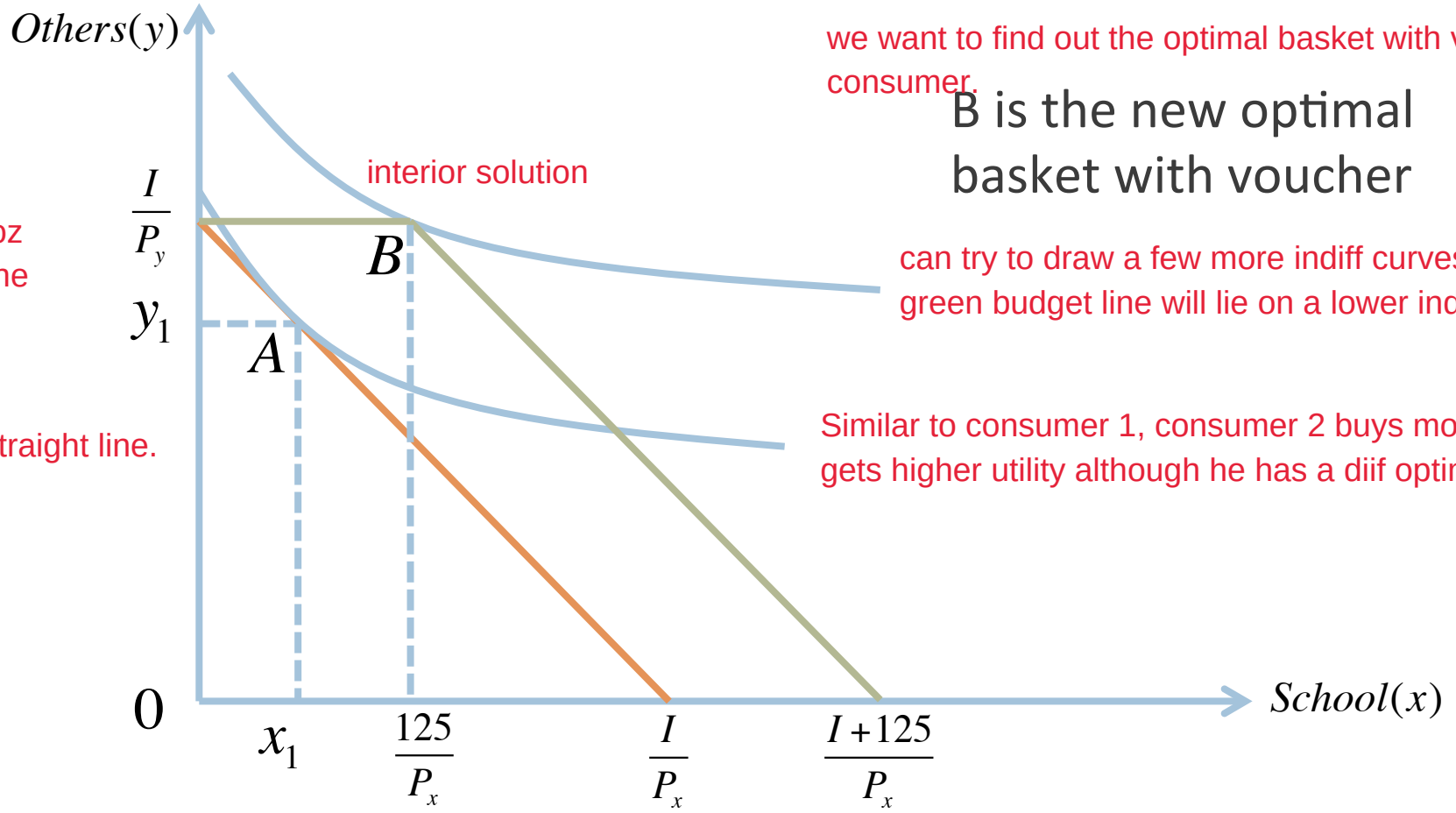
C is the new optimal basket with voucher

compared to before, consumer buys more x and more y, and gets higher utility. -> make sense coz voucher is a good thing to consumer.

But diff consumers have diff preference, so the impact of voucher on diff consumers may be diff.

Impact of Voucher on Consumer 2

for simplicity, assume consumer 2 has the same budget line as consumer 1, same income, face same prices. The only diff is consumer 2 has diff preference, reflected by shape of indiff curve.



we want to find out the optimal basket with voucher for this consumer.

B is the new optimal basket with voucher

interior solution

B is not a tangency point coz budget line is not a linear line

can try to draw a few more indiff curves, all other points on the green budget line will lie on a lower indiff curve compared to B.

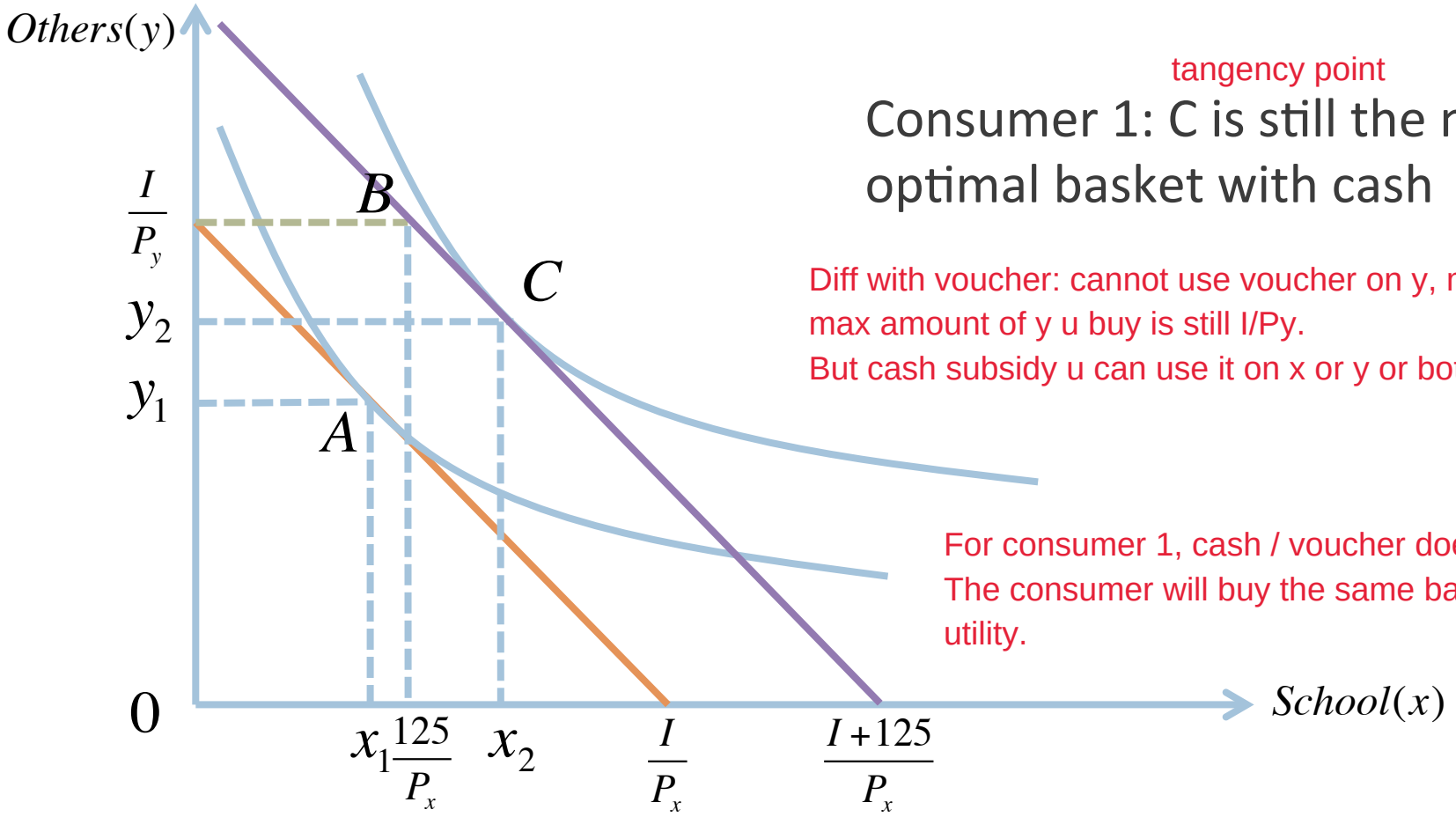
Budget line is not always a straight line. e.g. when u have voucher

Similar to consumer 1, consumer 2 buys more of both goods and gets higher utility although he has a diif optimal basket.

instead of giving voucher that can only be spent on x, how abt giving them cash directly no restriction?

How about a cash subsidy of $125?

= increase income by $125



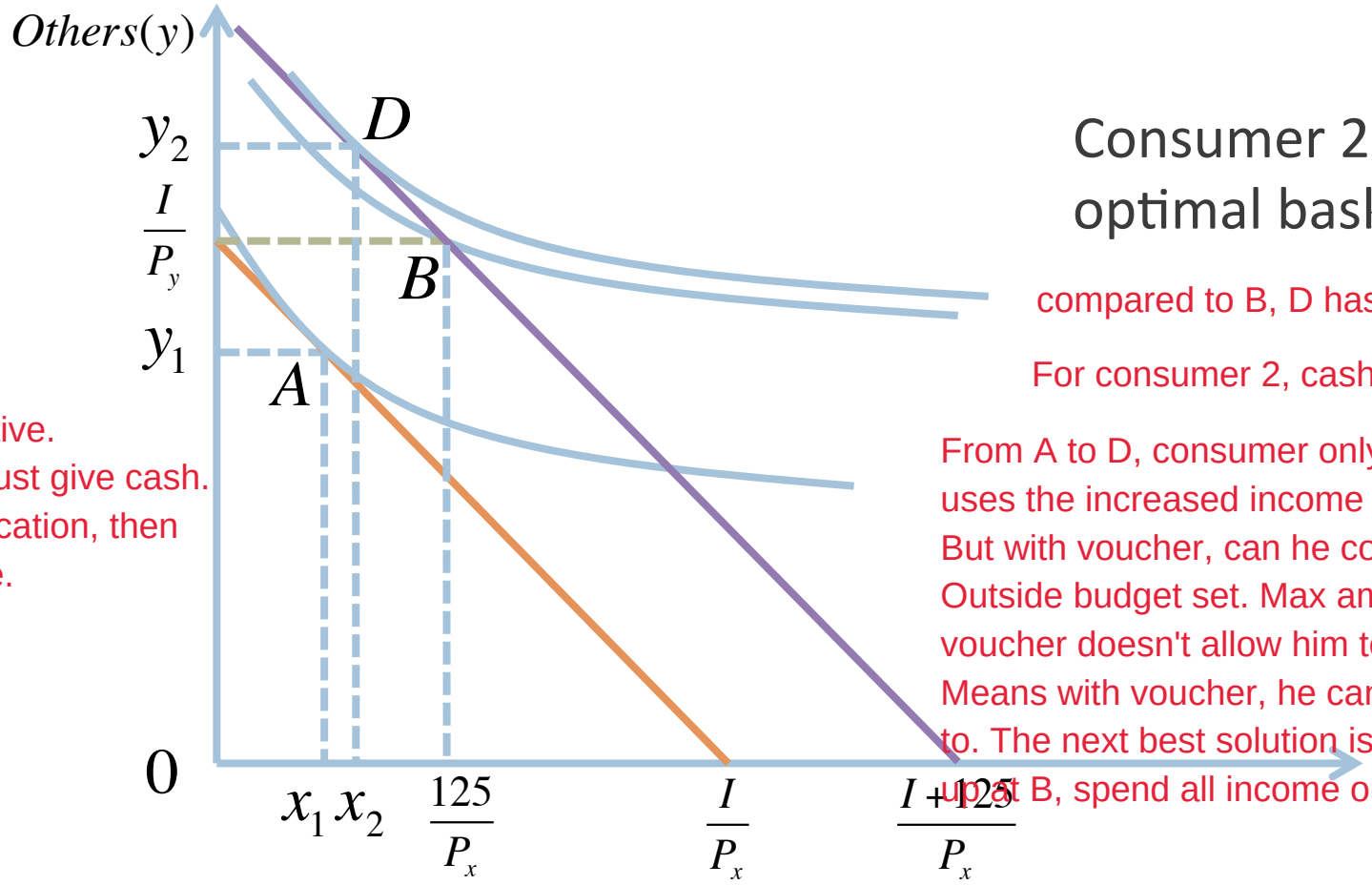
tangency point

Consumer 1: C is still the new optimal basket with cash

Diff with voucher: cannot use voucher on y, means with voucher the max amount of y u buy is still I/Py.
But cash subsidy u can use it on x or y or both.

For consumer 1, cash / voucher doesn't make a difference. The consumer will buy the same basket and get same utility.

Cash Gives Consumer 2 Higher Utility!



Consumer 2: D is the new optimal basket with cash

compared to B, D has higher utility

For consumer 2, cash / voucher makes a difference.

From A to D, consumer only buys a little bit more of x, he mostly uses the increased income to buy y.
But with voucher, can he consume at D? No not affordable. Outside budget set. Max amount of y u can buy is I/Py. Coz voucher doesn't allow him to buy more y, only can buy more x. Means with voucher, he cannot consume at D although he wants to. The next best solution is to try buy as much as possible y, end up at B, spend all income on y, just use voucher to buy x.

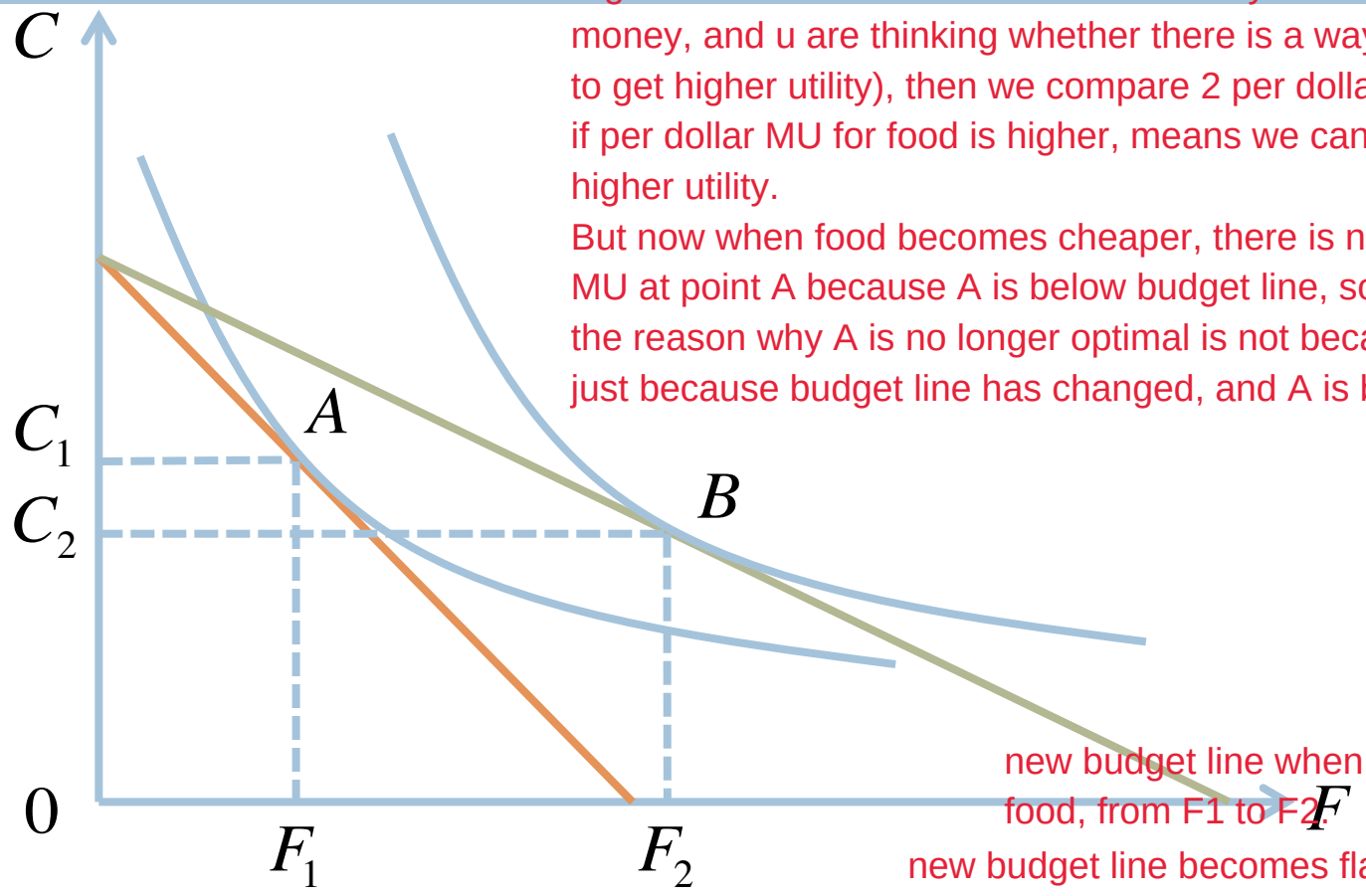
Depends on government motive.
If just want ppl to be happy, just give cash.
But if want to encourage education, then use voucher is more effective.

Note: If you give consumer a cash subsidy vs a voucher on a specific good, for the same amount. The cash subsidy is never going to be worse than voucher. (general conclusion) Whatever u want to do with voucher, u can also do it with cash, no restriction.

Part 2

Income and Substitution Effects

What happens to the consumption of food when food becomes cheaper?



Why buy more food when it's cheaper?
coz per dollar MU for food higher? Not valid argument. When do we use this argument? We use it when we are already on budget line (alr spending all money, and u are thinking whether there is a way for u to reallocate your money to get higher utility), then we compare 2 per dollar MU. At a point on budget line, if per dollar MU for food is higher, means we can buy more food and gets a higher utility.
But now when food becomes cheaper, there is no point talking abt the per dollar MU at point A because A is below budget line, so for sure A won't be optimal. So the reason why A is no longer optimal is not because per $ MU has changed. It's just because budget line has changed, and A is below budget line.

new budget line when food becomes cheaper, buy more food, from F1 to F2.
new budget line becomes flatter coz price ratio changed (slope of budget line determined by the relative price of 2 goods)

Why does the consumer buy more food?

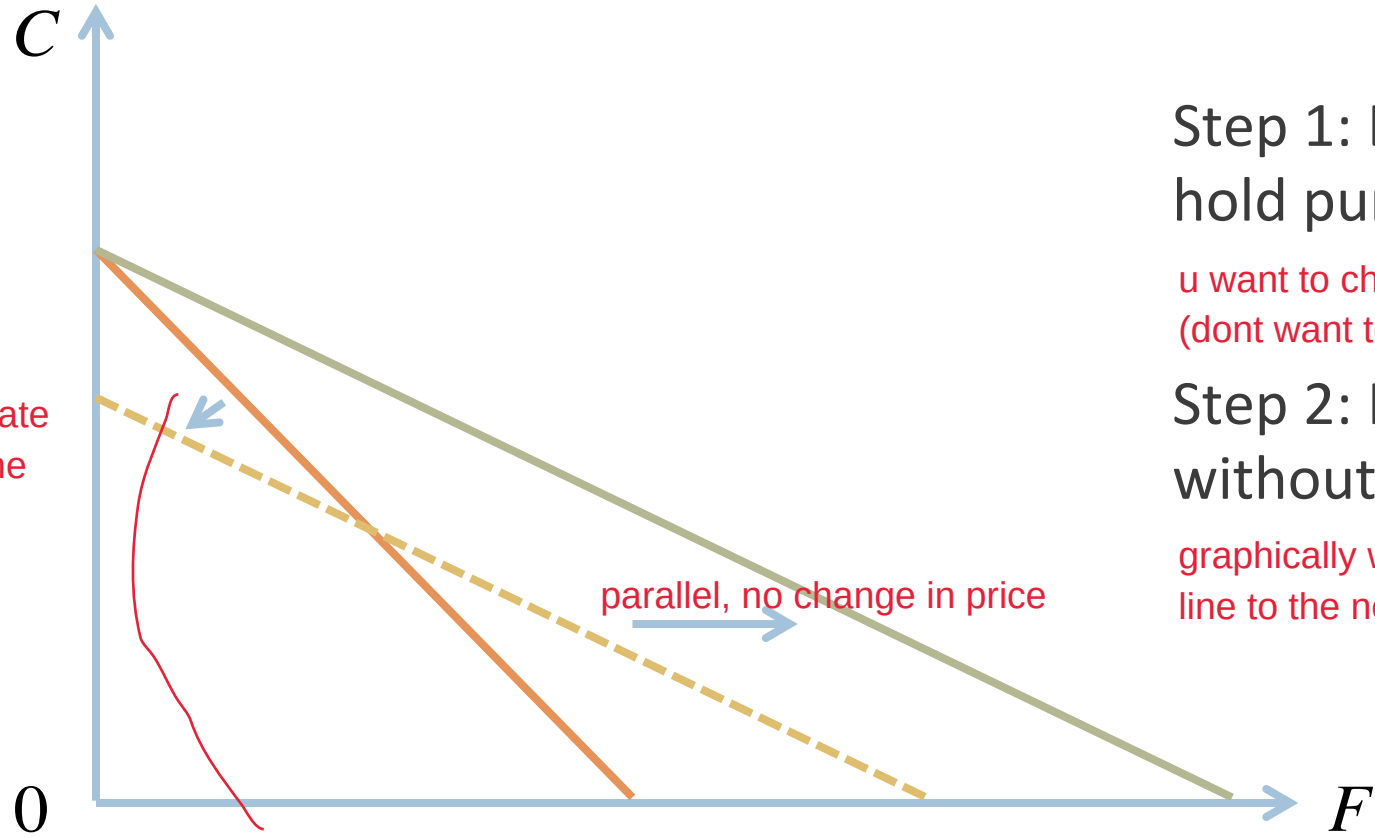
- Change in relative price — food cheaper
  - Food becomes cheaper relative to clothing
    - Budget line becomes flatter
  - Consumer buys more food and less clothing
- Change in price also leads to a change in purchasing power — change in purchasing power DUE TO change in price
  - Consumer is effectively richer — income doesnt change, food cheaper, enable u to buy more food than before.
    - New budget line is "higher" -> budget set bigger than before
  - Consumer buys more food

so part of reason why buy more food is not coz food cheaper, is coz higher purchasing power.

From F1 to F2, both these 2 changes are happening. We dont know how much of the change is due to the change in price alone, and how much of the change is due to change in purchasing power.

We want to decompose price change into 2 parts.

Decomposing the Change in Budget Line



Step 1: Lower the price of food but hold purchasing power constant

u want to change the slope of budget line but dont want it to be higher (dont want to expand the budget set of the consumer)

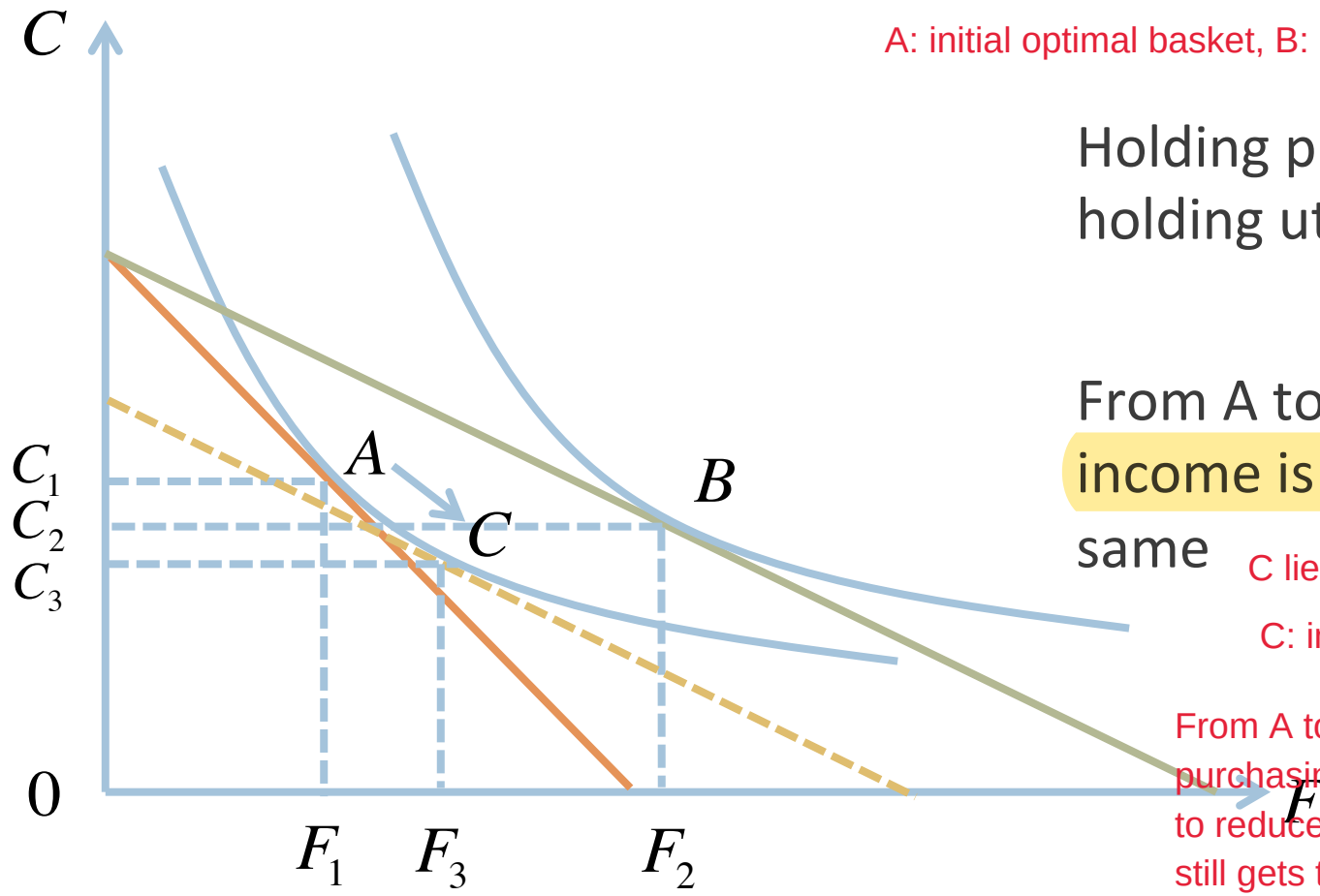
Step 2: Increase purchasing power without changing the price of food

graphically we want to move the budget line from intermediate budget line to the new budget line. How to get it? increase income

How to get this dotted budget line from the initial one? besides lowering food price, also reduce consumer income -> makes sense coz u want to keep purchasing power constant. If u don't reduce income, purchasing power is higher.

From *A* to *C*

In this module, we assume purchasing power=utility, in the sense that if we want to hold consumer's purchasing power constant, we gonna hold consumer's utility constant. Intuitively, suppose consumer has higher purchasing power, means consumer can buy more things and get higher utility. So how u make sure consumer doesn't have higher purchasing power? U require the consumer to have the same utility as before. e.g. i tell u im going to make food cheaper for u, but meanwhile i still want u to have the same utility than before, still feel the same as before.



A: initial optimal basket, B: new optimal basket

Holding purchasing power constant = holding utility constant

From A to C, price of food is lower, income is lower, but utility remains the same

C lies on the same indiff curve as A.

C: intermediate basket

From A to C, we make food cheaper, and want to hold consumer's purchasing power constant. To do this, reduce income, how much to reduce? Reduce consumer income to the point where consumer still gets the same utility as before.

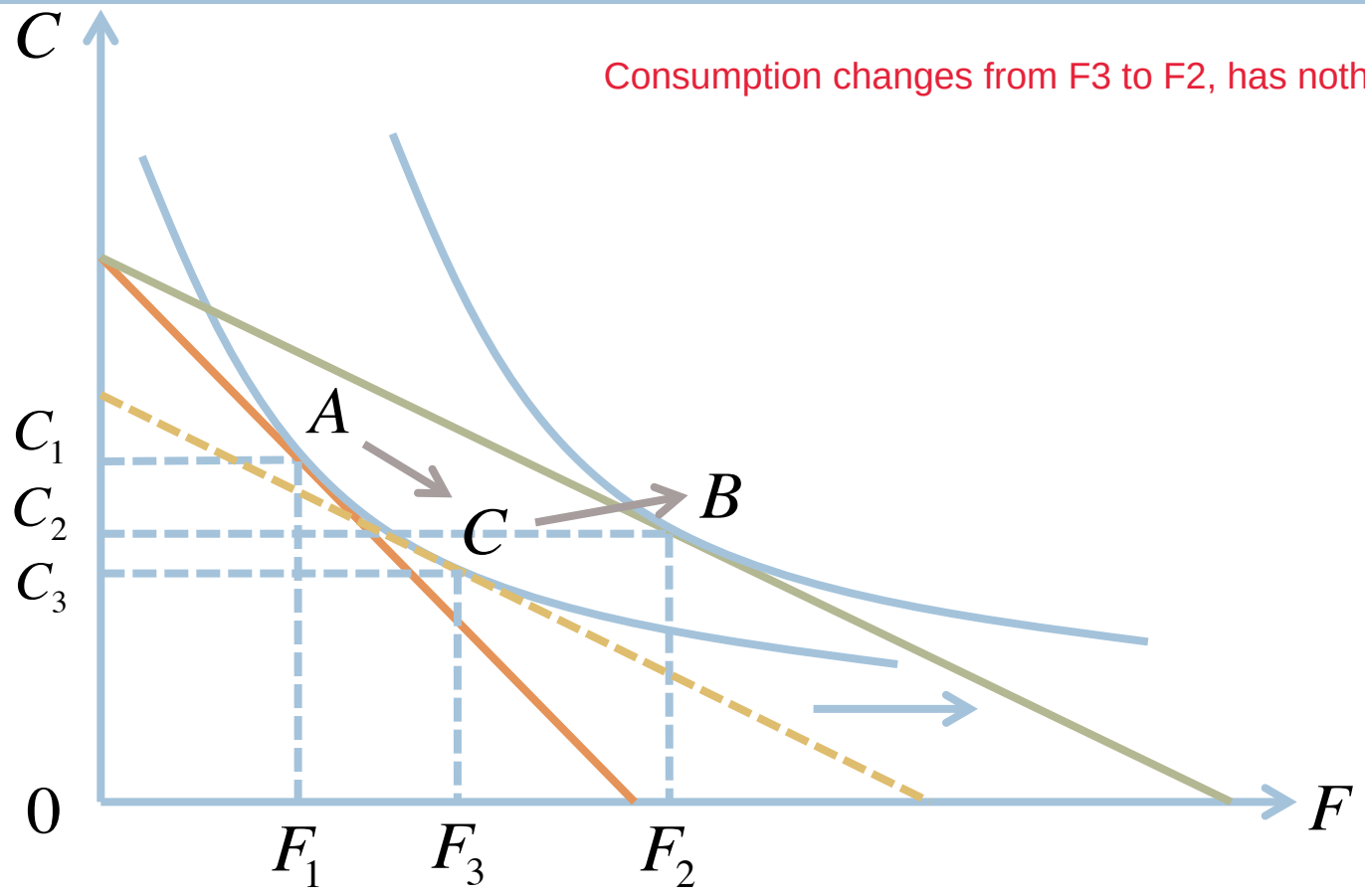
F1 to F3 has nothing to do with change in purchasing power, it's purely due to change in price of food.

Substitution Effect

- Definition 4.1 *Substitution effect* is the change in consumption of one good associated with a change in its price, holding the level of utility and other prices constant
- Substitution effect for food is F_3-F_1
  - Let the price of food drop, and take away some income from the consumer so that the consumer is exactly as well off as before
  - The consumption of food increases from F_1 to F_3

From *C* to *B*

now we don't want to change price, just want to increase consumer purchasing power.
We giev back the income we took away from consumer earlier.

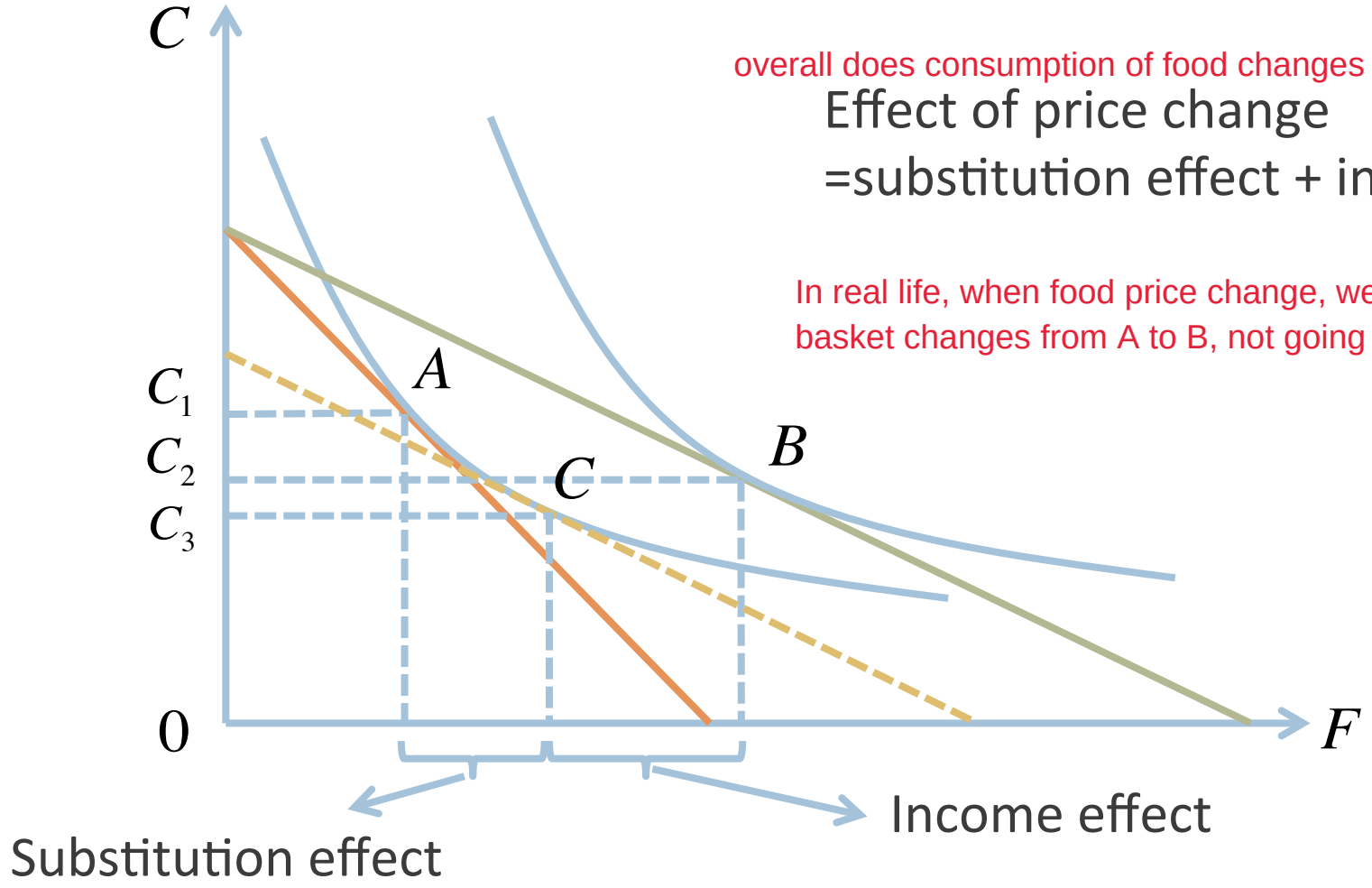


Consumption changes from F3 to F2, has nothing to do with change in price.

Income Effect

- Definition 4.2 *Income effect* is the change in consumption of a good associated with a change in purchasing power, holding all prices constant
- Income effect for food is F_2-F_3
  - Keep the prices fixed, and give back the consumer the income we took away
  - The consumption of food increases from F_3 to F_2

Decomposing the Effect of Price Change



overall does consumption of food changes when there is a change in price.

Effect of price change
=substitution effect + income effect

In real life, when food price change, we are just going to see optimal basket changes from A to B, not going to observe C (theoretical).

Example: Computing Substitution and Income Effects

- Suppose the consumer has utility function

$$U(F,C) = FC$$

- Suppose price of food is 2, price of clothing is 2, income is 10
- Optimal basket is *F*=2.5, *C*=2.5, consumer's utility is 6.25
- Suppose price of food decreases to 1
- Then new optimal basket is *F*=5, *C*=2.5
- Total change in food is 5-2.5=2.5

we want to know how much of this is subst effect / income effect

Example: Computing Substitution and Income Effects Cont'

- The intermediate basket (basket C) must satisfy

utility of C same as A.

$$FC = 6.25$$

MRS $$\frac{C}{F} = \frac{1}{2}$$ tangency condition

tangency point bet intermediate budget line and indiff curve, the intermediate budget line reflects new price for food, 1, not old price 2.

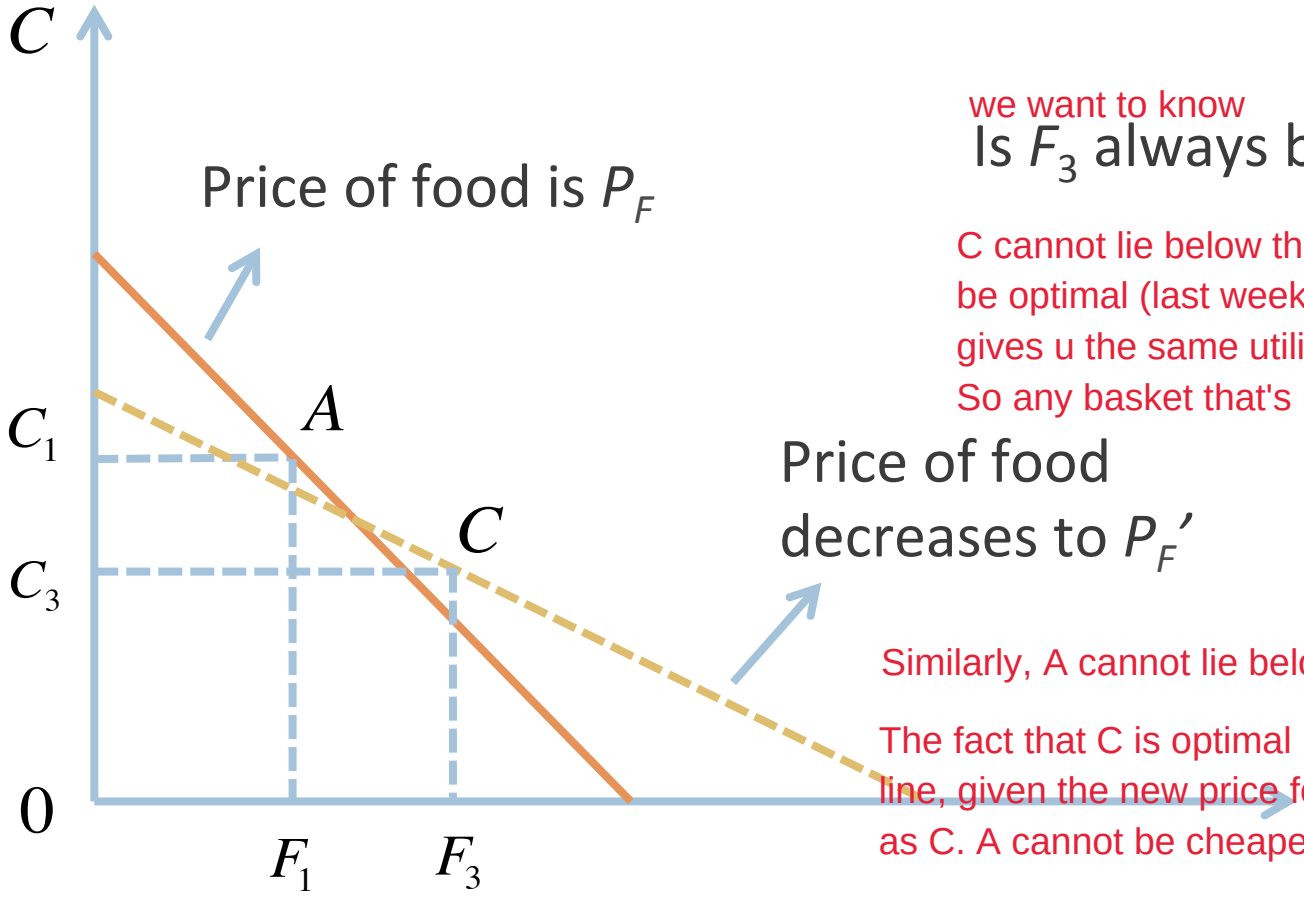
- The intermediate basket is F=3.54, C=1.77
- Substitution effect is 3.54 - 2.5 = 1.04 -> consumption of food increase by 1.04 due to change in food price alone.
- Income effect is 5 - 3.54 = 1.46 -> purely due to consumer richer, higher purchasing power because food is cheaper.

can we say when food cheaper, these 2 effects always positive?

Direction of Substitution Effect in Graph

A: initial basket
C: intermediate basket

Consumer is indiff bet A and C coz same utility.



we want to know
Is F_3 always bigger than F_1?

C cannot lie below the initial budget line. Or else C should be optimal (last week revealed preference), cheaper and gives u the same utility.
So any basket that's indiff to A cannot be cheaper than A.

Similarly, A cannot lie below the intermediate budget line.

The fact that C is optimal means given the intermediate budget line, given the new price for food, A must cost at least as high as C. A cannot be cheaper than C.

Direction of Substitution Effect

- If price of food decreases, substitution effect is always non-negative
- Suppose from A (F_1, C_1) to C (F_3, C_3), the price of F dropped from P_F to P_F'
- We know the consumer is indifferent between A and C, A is optimal given the initial budget line, C is optimal given the intermediate budget line
- By revealed preference, we have

Cost of C given the initial price Pf, must be more than or equal to consumer initial income which is cost of basket A coz A lies on the initial budget line.

$$P_F F_3 + P_C C_3 \geq P_F F_1 + P_C C_1$$

Pf'F1 + PcC1 >= Pf'F3 + PcC3

General argument. We are not assuming anything on consumer preference, we don't need to know consumer utility function.

Direction of Substitution Effect Cont'

- Rearranging,

$$P_F(F_3 - F_1) + P_C(C_3 - C_1) \geq 0$$
$$P_F'(F_1 - F_3) + P_C(C_1 - C_3) \geq 0$$

- Adding up the two equations,

$$(P_F - P_F')(F_3 - F_1) \geq 0$$

- Thus

$$F_3 \geq F_1$$

Question: when is the substitution effect 0?

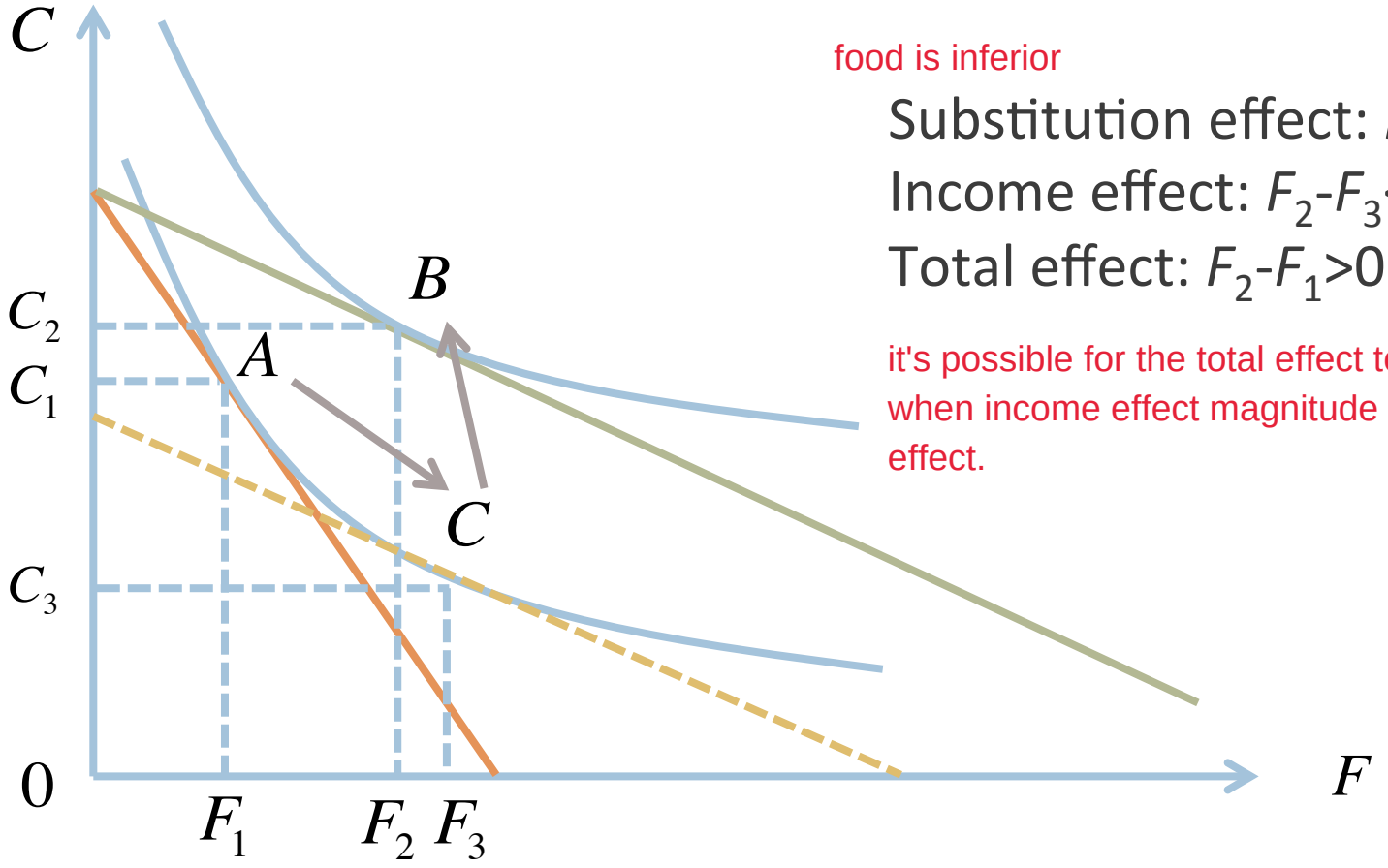
Direction of Income Effect

- If food is normal
  - If price of food decreases, purchasing power increases, consumer buys more food +ve income effect
  - If price of food increases, purchasing power decreases, consumer buys less food
  - Income effect same direction as substitution effect

subst effect in the case of price drop is non-negative

- What if food is inferior?
  - Income effect opposes substitution effect

Income Effect for an Inferior Good



food is inferior

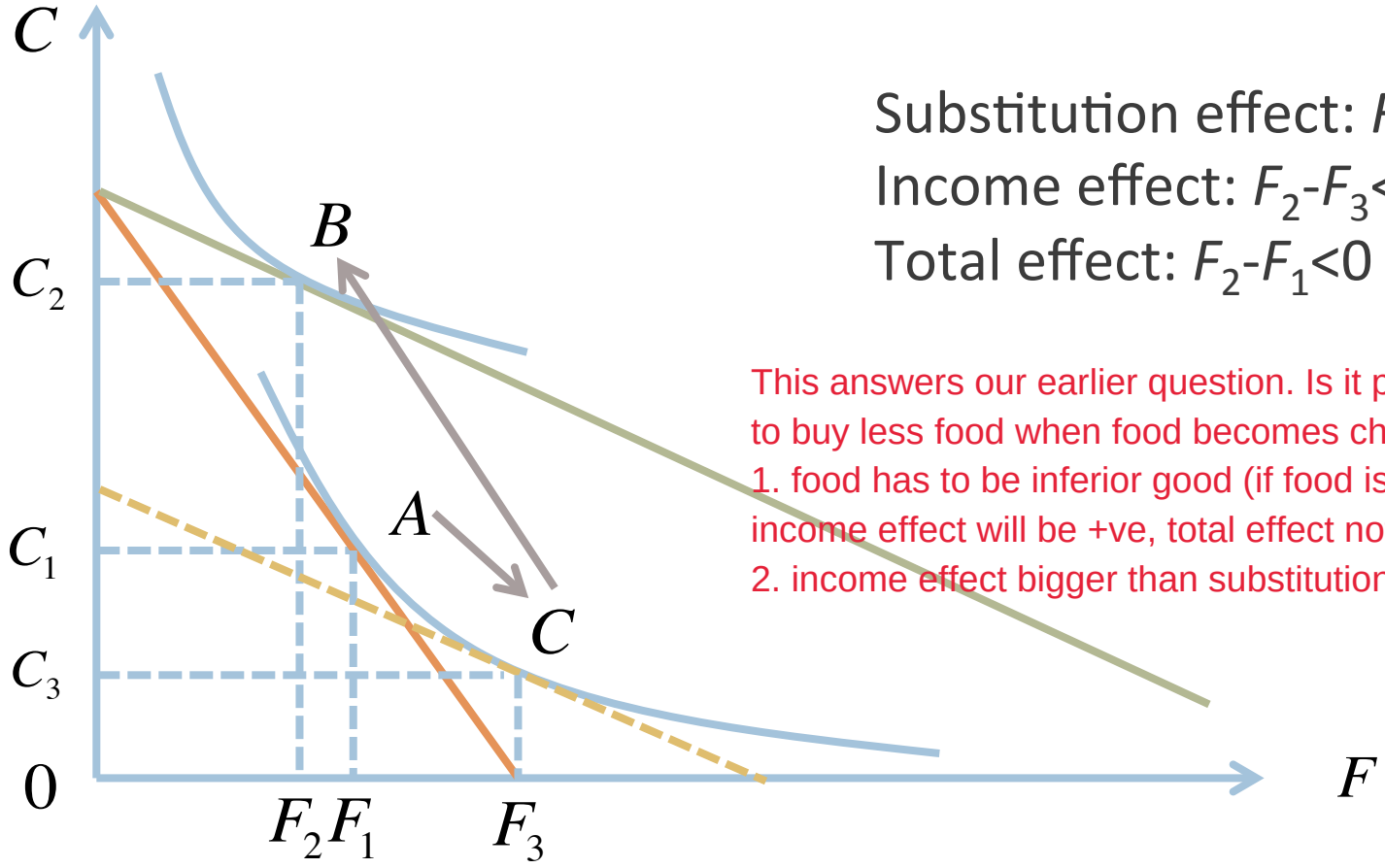
Substitution effect: F_3-F_1>0 A to C

Income effect: F_2-F_3<0 C to B

Total effect: F_2-F_1>0

it's possible for the total effect to be -ve, too. This happens when income effect magnitude is bigger than substitution effect.

What if income effect dominates substitution effect?



Substitution effect: F_3-F_1>0
Income effect: F_2-F_3<0
Total effect: F_2-F_1<0 negative effect

This answers our earlier question. Is it possible for rational consumer to buy less food when food becomes cheaper? Yes. Need 2 things:
1. food has to be inferior good (if food is normal, the both subst and income effect will be +ve, total effect not -ve)
2. income effect bigger than substitution effect

Giffen Good

- Definition 4.3 A good is a *Giffen good* if
  - As price decreases, quantity demanded for the good drops
  - As price increases, quantity demanded for the good goes up
  - Holding other factors fixed
- Law of demand revisited
  - Is demand curve always downward sloping?
  - Not for Giffen good!
  - Demand curve is upward sloping for Giffen good

Example: Rice as Giffen Good

- Jensen and Miller conducted field experiments on poor urban households in China
  - Hunan province: provides subsidy on rice
  - Gansu province: provides subsidy on wheat
- What do they find?
  - 1% decrease in the price of rice causes 0.22% decrease in rice consumption

means rice for poor households is Giffen good.

1. rice inferior 2.income effect > subst effect

Source: Jensen and Miller, "*Giffen Behavior and Subsistence Consumption*", 2008

Giffen Goods vs. Inferior Goods

- Giffen goods
  - Positive correlation between price and quantity demanded
- Inferior goods
  - Negative correlation between income and quantity demanded
- Are all Giffen goods inferior goods?

Yes, Giffen good has to be inferior in the first place, otherwise the 2 effects are not going to have opposite signs.

- Are all inferior goods Giffen goods?

No, to be Giffen goods, also need income effect > subst effect.

Part 3

Consumer Welfare

How to measure the change in utility when price changes?

- When the price of a good decreases
  - Consumer is usually better off (higher utility)
- When the price of a good increases
  - Consumer is usually worse off (lower utility)
- How to quantify the benefit or loss due to a change in price? in terms of money
  - Consumer surplus
  - Compensating variation
  - Equivalent variation

Why is measuring consumer welfare important?

- Consider the merger between Grab and Uber
- CCCS concluded the merger was anti-competitive reduce competition
- There may be some benefits
  - E.g., merger may reduce the cost of production
- There may be some costs
  - E.g., the new firm may be able to set higher prices
  - Need to estimate the potential damage to consumers due to higher prices

in terms of money

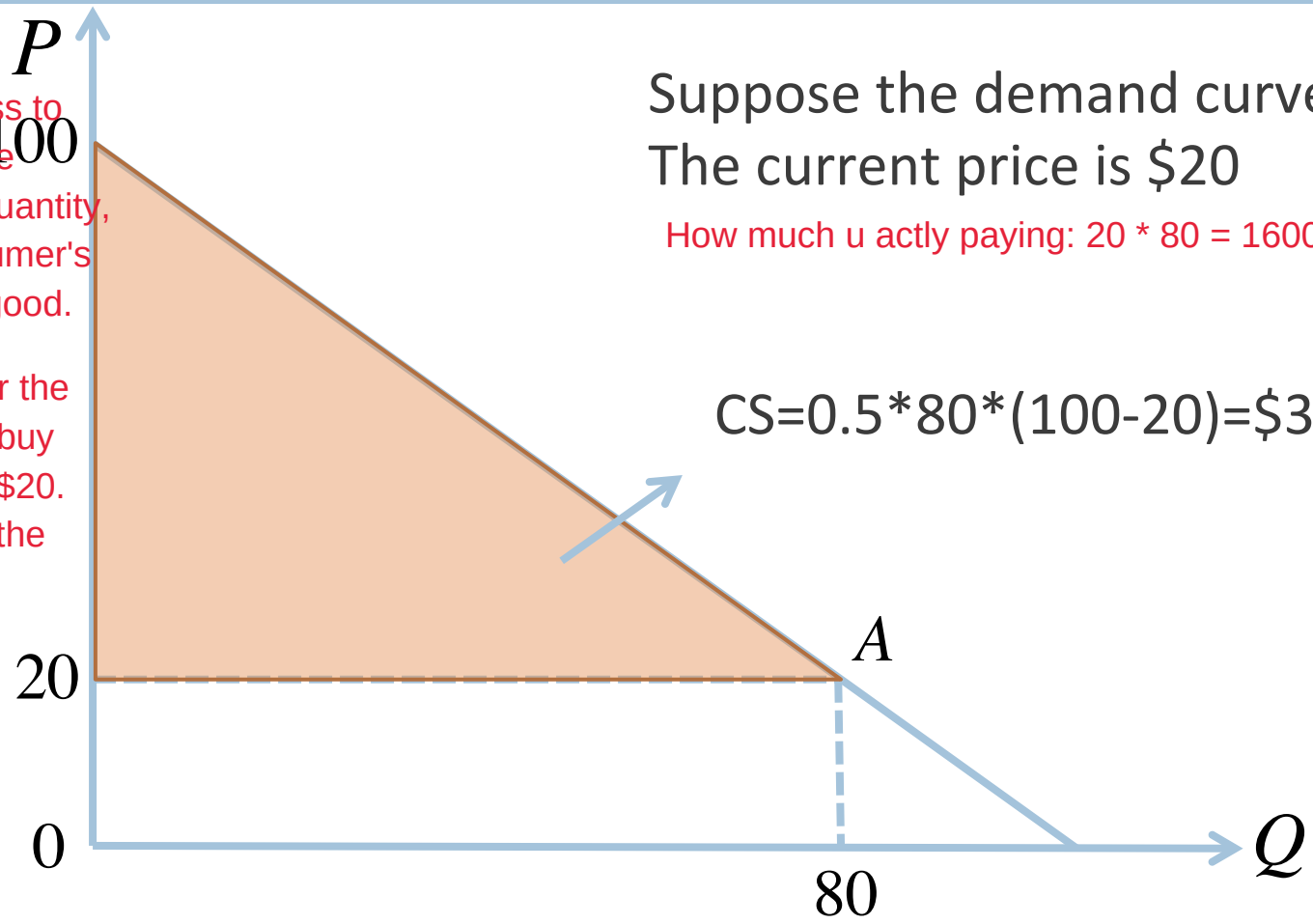
Consumer Surplus

- Definition 4.4 *Consumer surplus* (CS) for an individual consumer is the difference between the consumer's willingness to pay for a good and the cost of purchasing the good
  - E.g., the consumer is willing to pay 1 million to buy a house
  - The consumer actually paid 0.8 million
  - CS is 0.2 million
- CS is the area below the demand curve and above the price

Consumer Surplus in Graph

In lecture 2, price represents willingness to pay for that unit of good. Demand curve gives relationship between price and quantity, so demand curve represents the consumer's willingness to pay for each unit of the good.

e.g. consumer is willing to pay $100 for the very first unit of the good. I'm going to buy the 80th unit of food when the price is $20. If price is above $20, not going to buy the 80th unit.

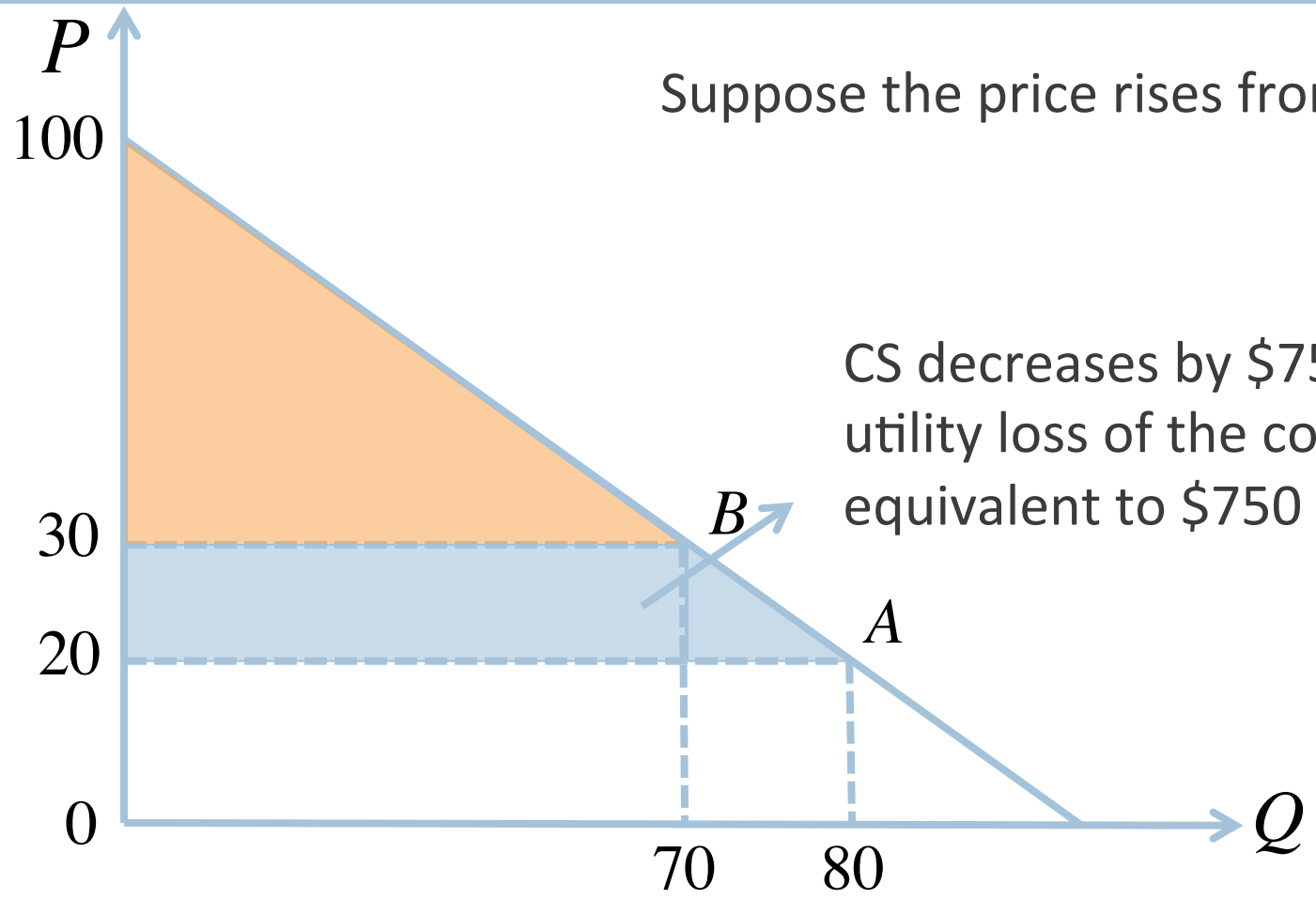


Suppose the demand curve is Q=100-P
The current price is $20

How much u actly paying: 20 * 80 = 1600

CS=0.5*80*(100-20)=$3,200

Change in Consumer Surplus



Suppose the price rises from $20 to $30

CS decreases by $750:
utility loss of the consumer is equivalent to $750

Compensating Variation: An Example

- Suppose the consumer buys food and clothing and has an income of $100
  - At the initial optimal basket, his utility is 20
- Suppose food becomes cheaper
- After the price drop, to still get a utility of 20, the consumer only needs to spend $90
- The compensating variation is $100-$90=$10
  - After the price drop, the consumer can spend $10 less and still get the same utility as before, thus the benefit of the price drop is equivalent to $10

Because of lower price for food, it allows me to save $10 and still get the same utility than before.

Compensating Variation: Definition

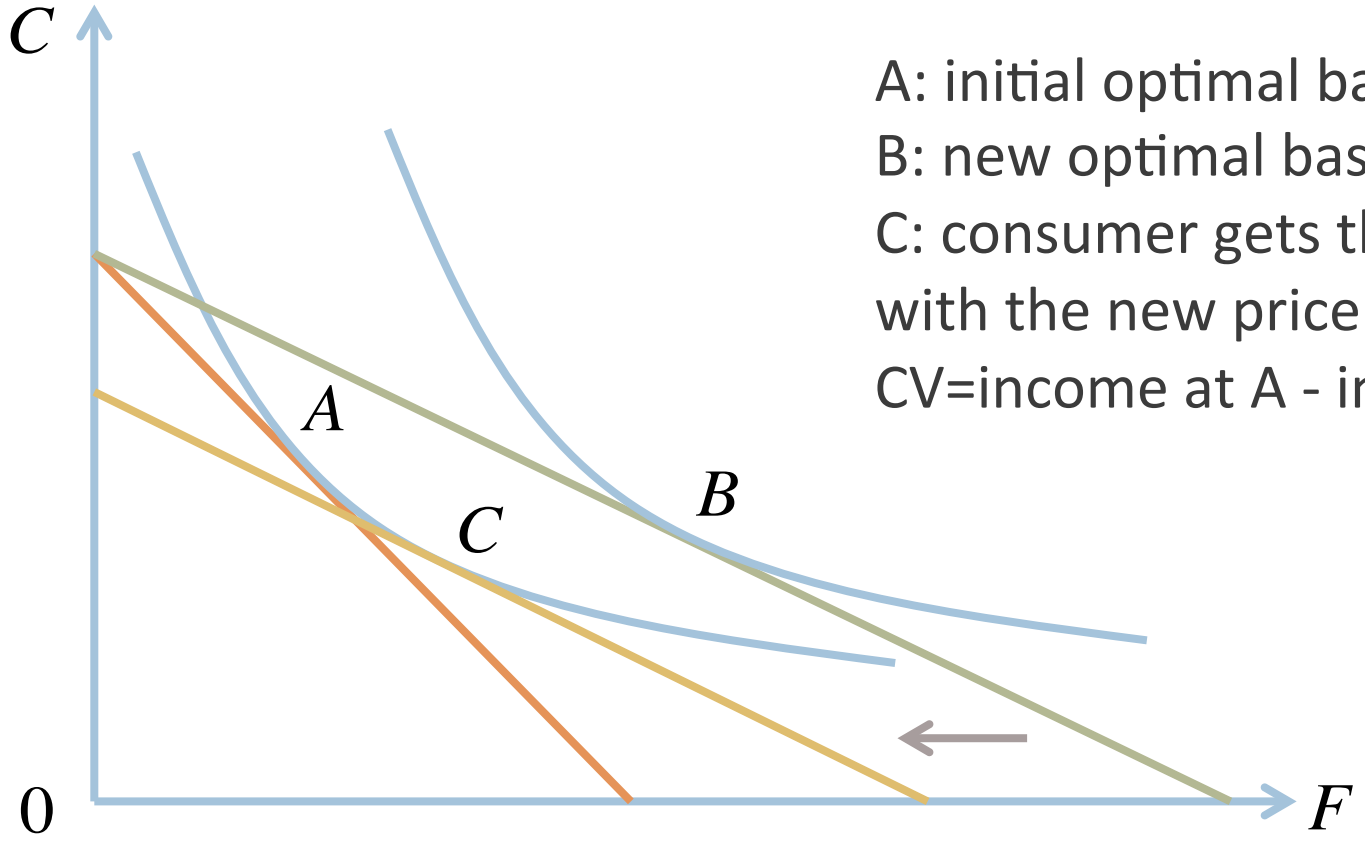
- Definition 4.5 *Compensating variation* (CV) measures the amount of money (income) the consumer is willing to give up after the price drop to be just as well off as before the price drop

consumer can save

- The initial optimal basket is A
- Suppose the price of food drops
- Given the new price, the optimal basket that generates the same level of utility as basket A is basket C
- CV=income at A - income at C

CV is the difference bet how much money u need initially to get that utility level - how much money u need now after price decrease to get the same utility as before.

Compensating Variation in Graph



A: initial optimal basket
B: new optimal basket
C: consumer gets the old utility with the new price
CV=income at A - income at C

Equivalent Variation: An Example

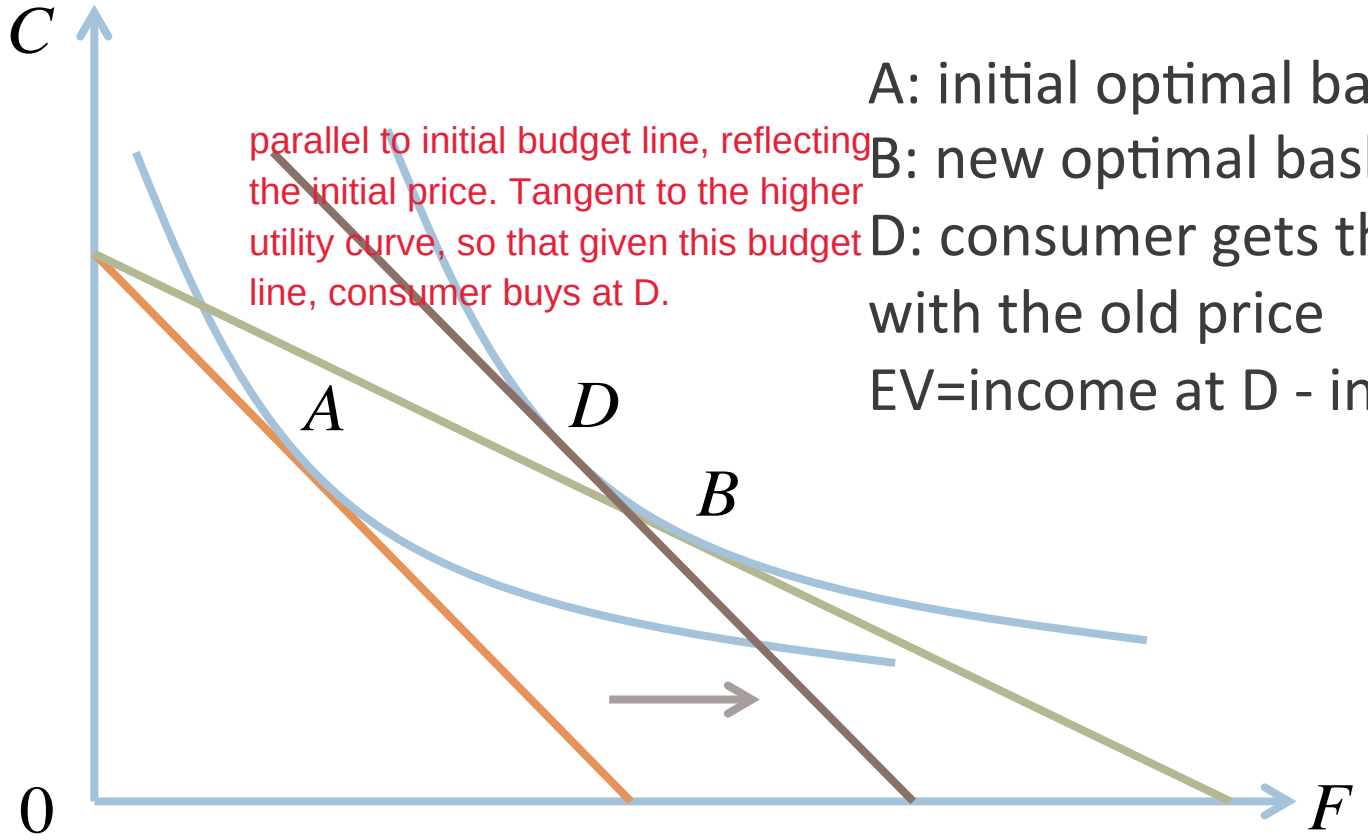
- Suppose the consumer buys food and clothing and has an income of $100
  - At the initial optimal basket, his utility is 20
- Suppose food becomes cheaper
  - At the new optimal basket, his utility is 30
- Before the price drop, if the consumer wants to get a utility of 30, the consumer needs an income of $120
- The equivalent variation is $120-$100=$20
  - Before the price drop, if the consumer wants to get the same level of utility as after the price drop, he needs an additional income of $20, thus the benefit of the price drop is equivalent to $20

When we do compensating variation, we take the initial utility as the benchmark (if u still want to get utility 20, how much do u need to spend now).
For equivalent variation, we take the new utility as the benchmark. Suppose food price didn't change, to get utility 30, how much money would u need? Intuitively, need >$100.

Equivalent Variation: Definition

- Definition 4.6 *Equivalent variation* (EV) measures the additional amount of money (income) the consumer needs before the price drop to be as well off as after the price drop
- The initial optimal basket is A
- Suppose the price of food drops
- The new optimal basket is B
- Given the initial price, the optimal basket that generates the same level of utility as basket B is basket D
- EV=income at D - income at A

Equivalent Variation in Graph



parallel to initial budget line, reflecting the initial price. Tangent to the higher utility curve, so that given this budget line, consumer buys at D.

A: initial optimal basket
B: new optimal basket
D: consumer gets the new utility with the old price
EV=income at D - income at A

So before food becomes cheaper, if we want to get the higher indiff curve, need to buy basket D and need to spend this amt of money. After food becomes cheaper, we just need to buy B.
How much money do we need? income at B = income at A coz from A to B, no change in income, only change in price.

Example: Calculating CV and EV

- Suppose the consumer has utility function

$$U(F,C) = FC$$

- Suppose price of food is \$2, price of clothing is \$2, income is \$10
- Optimal basket (A) is *F*=2.5, *C*=2.5, consumer's utility is 6.25
- Suppose price of food decreases to \$1
- Then new optimal basket (B) is *F*=5, *C*=2.5, consumer's utility is 12.5

Example: Calculating CV and EV Cont'

- Basket C must satisfy

$$FC = 6.25$$

$$\frac{C}{F} = \frac{1}{2}$$

tangency point bet the indiff curve and intermediate budget line

- Basket C is F=3.54, C=1.77
- To afford C, the consumer needs an income of

calculate how much money the consumer needs to buy this basket C, given the new price.

$$P_F F + P_C C = 1 \times 3.54 + 2 \times 1.77 = 7.08$$

- Thus CV=10-7.08=$2.92
  - The utility gain from the price decrease is equivalent to $2.92

Example: Calculating CV and EV Cont'

- Basket D must satisfy

FC = 12.5

MRS C/F = 2/2 = 1

old price coz u are asking for me to get the new utility with the old price, which basket do I buy?

- Basket D is F=3.54, C=3.54
- To afford D, the consumer needs an income of

$$P_F F + P_C C = 2 \times 3.54 + 2 \times 3.54 = 14.16$$

Initially if price of food didn't change, still $2, to get utility 12.5, need to spend $14.16. But now because food price decreases to $1, just need to spend $10 to get utility 12.5.

- Thus EV=14.16-10=$4.16
  - The utility gain from the price decrease is equivalent to $4.16