

# **Price Change: Income and Substitution Effects**

# THE IMPACT OF A PRICE CHANGE

- ◆ Economists often separate the impact of a price change into two components:
  - the **substitution effect**; and
  - the **income effect**.

# THE IMPACT OF A PRICE CHANGE

- ◆ The **substitution effect** involves the substitution of good  $x_1$  for good  $x_2$  or vice-versa due to a change in **relative prices** of the two goods.
- ◆ The **income effect** results from an increase or decrease in the consumer's **real income** or **purchasing power** as a result of the price change.
- ◆ The sum of these two effects is called the **price effect**.

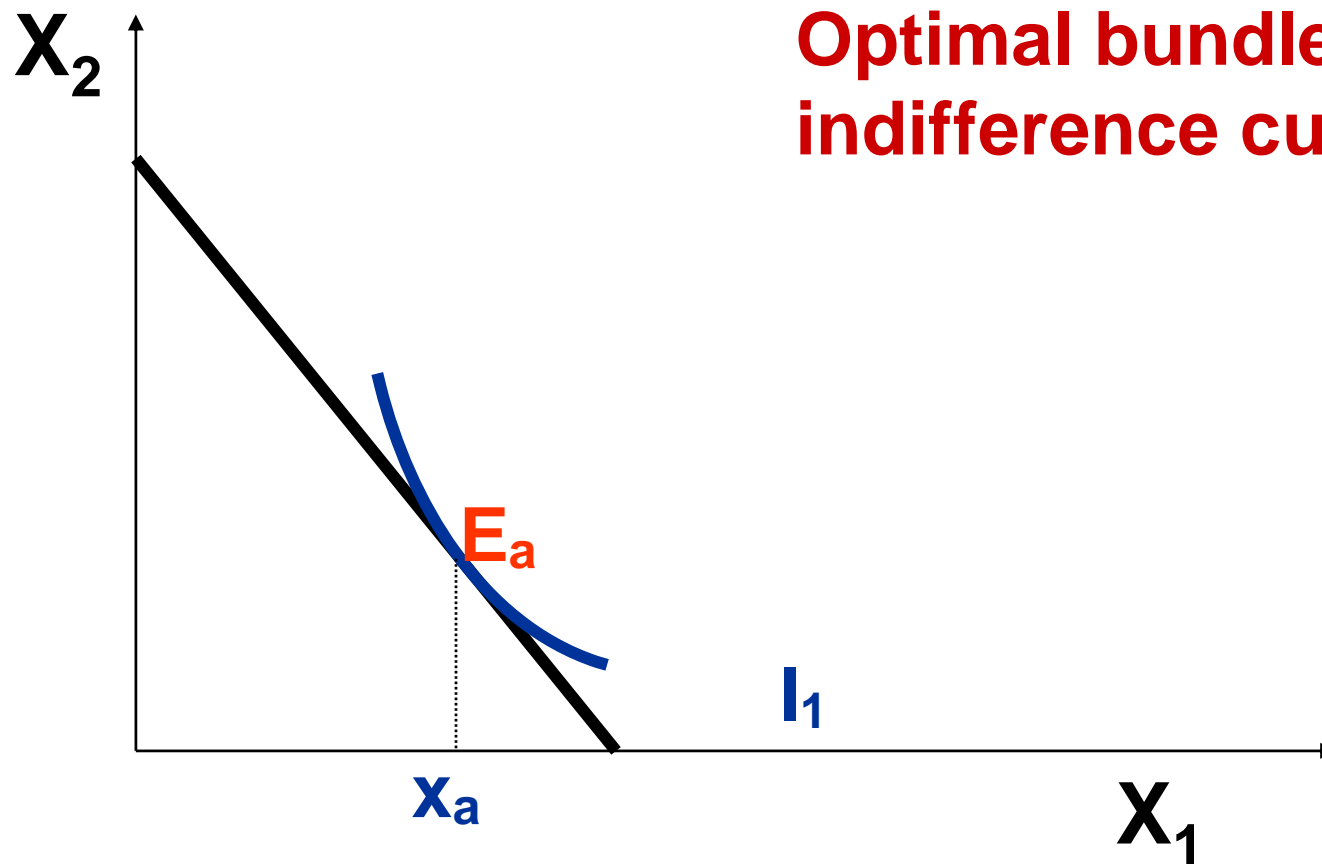
# THE IMPACT OF A PRICE CHANGE

- ◆ The decomposition of the price effect into the income and substitution effect can be done in several ways
- ◆ There are two main methods:
  - (i) The **Hicksian** method; and
  - (ii) The **Slutsky** method

# THE HICKSIAN METHOD

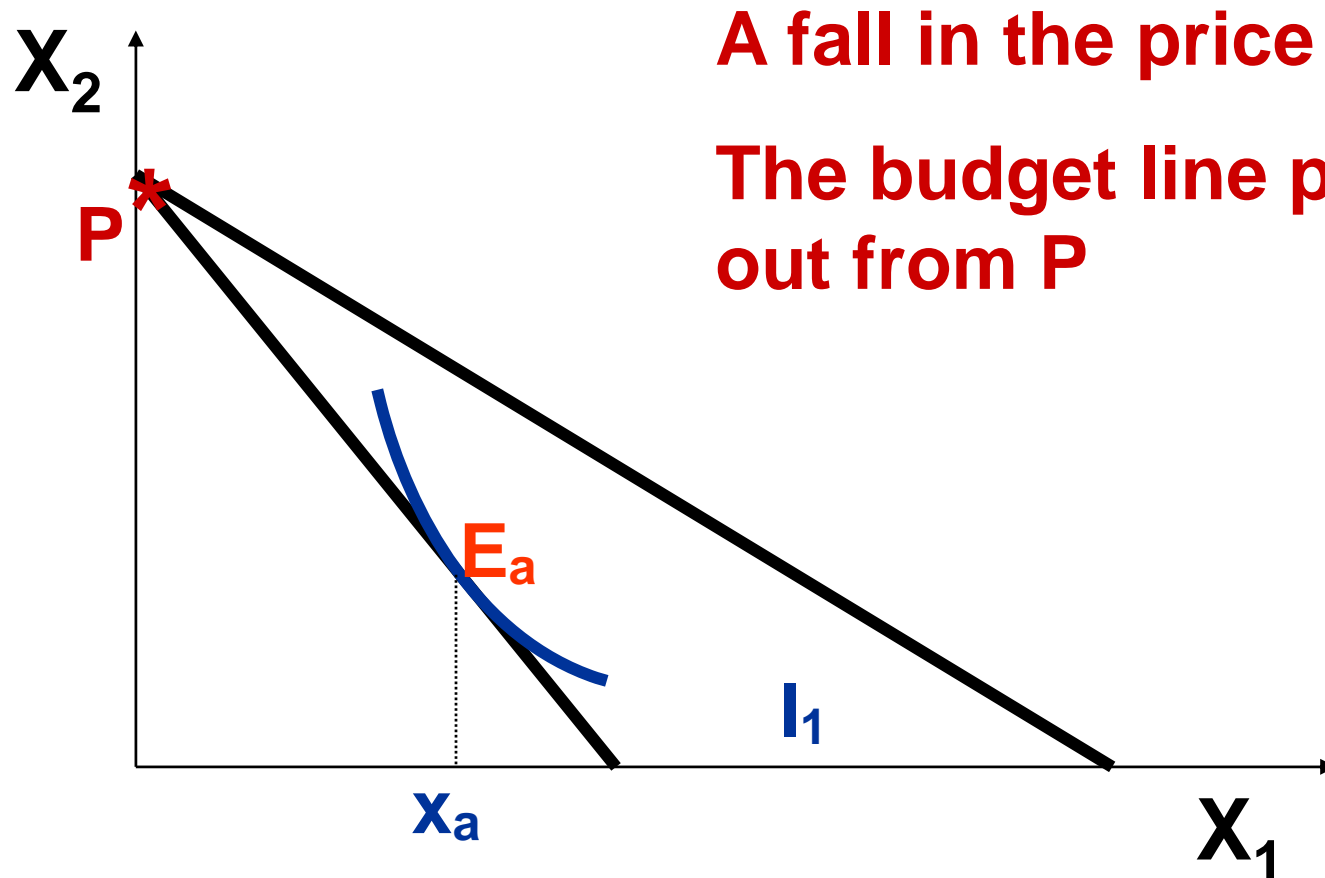
- ◆ **Sir John R.Hicks (1904-1989)**
- ◆ **Awarded the Nobel Laureate in Economics (with Kenneth J. Arrow) in 1972 for work on general equilibrium theory and welfare economics.**

# THE HICKSIAN METHOD



**Optimal bundle is  $E_a$ , on indifference curve  $I_1$ .**

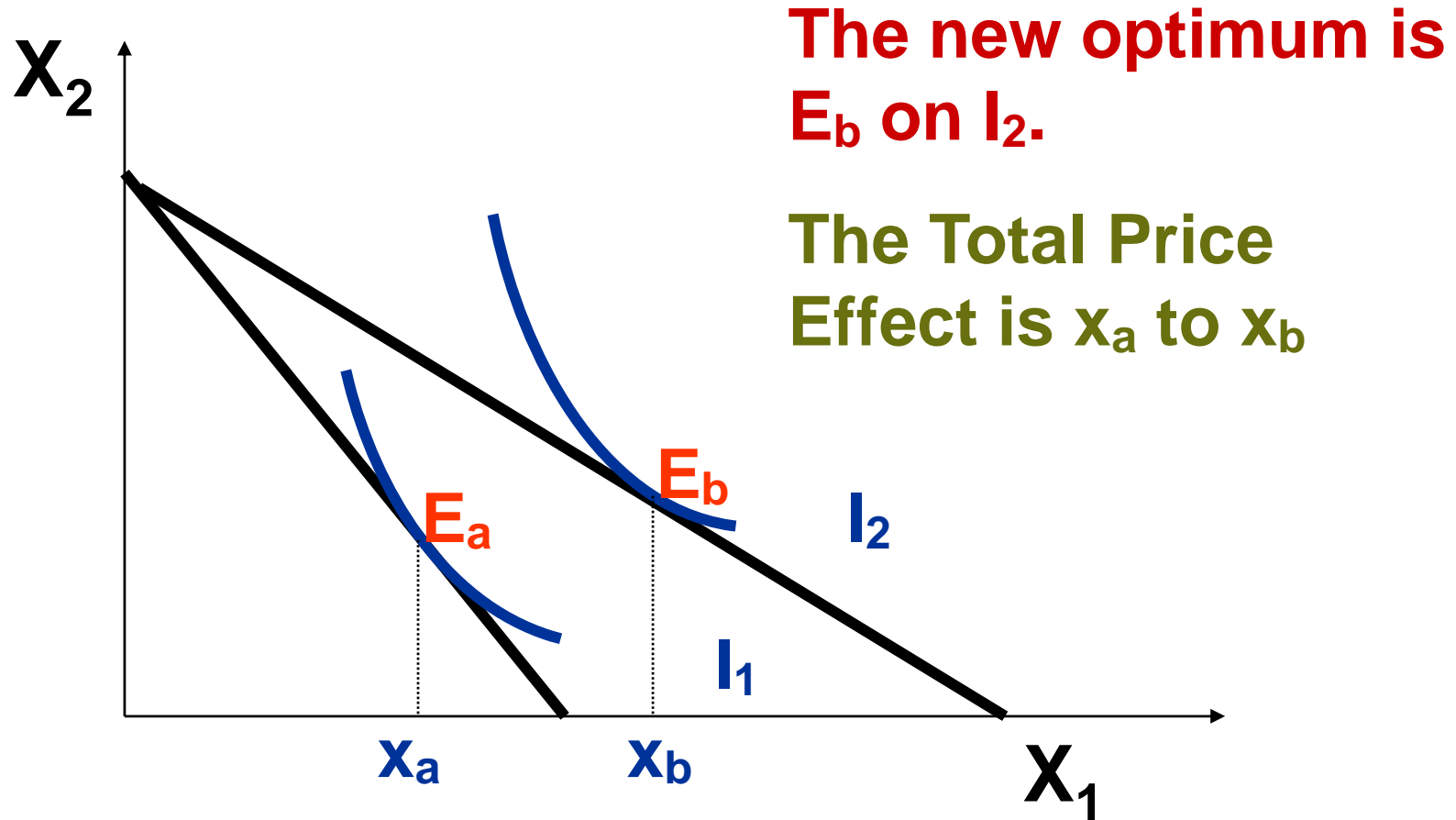
# THE HICKSIAN METHOD



A fall in the price of  $X_1$

The budget line pivots out from  $P$

# THE HICKSIAN METHOD

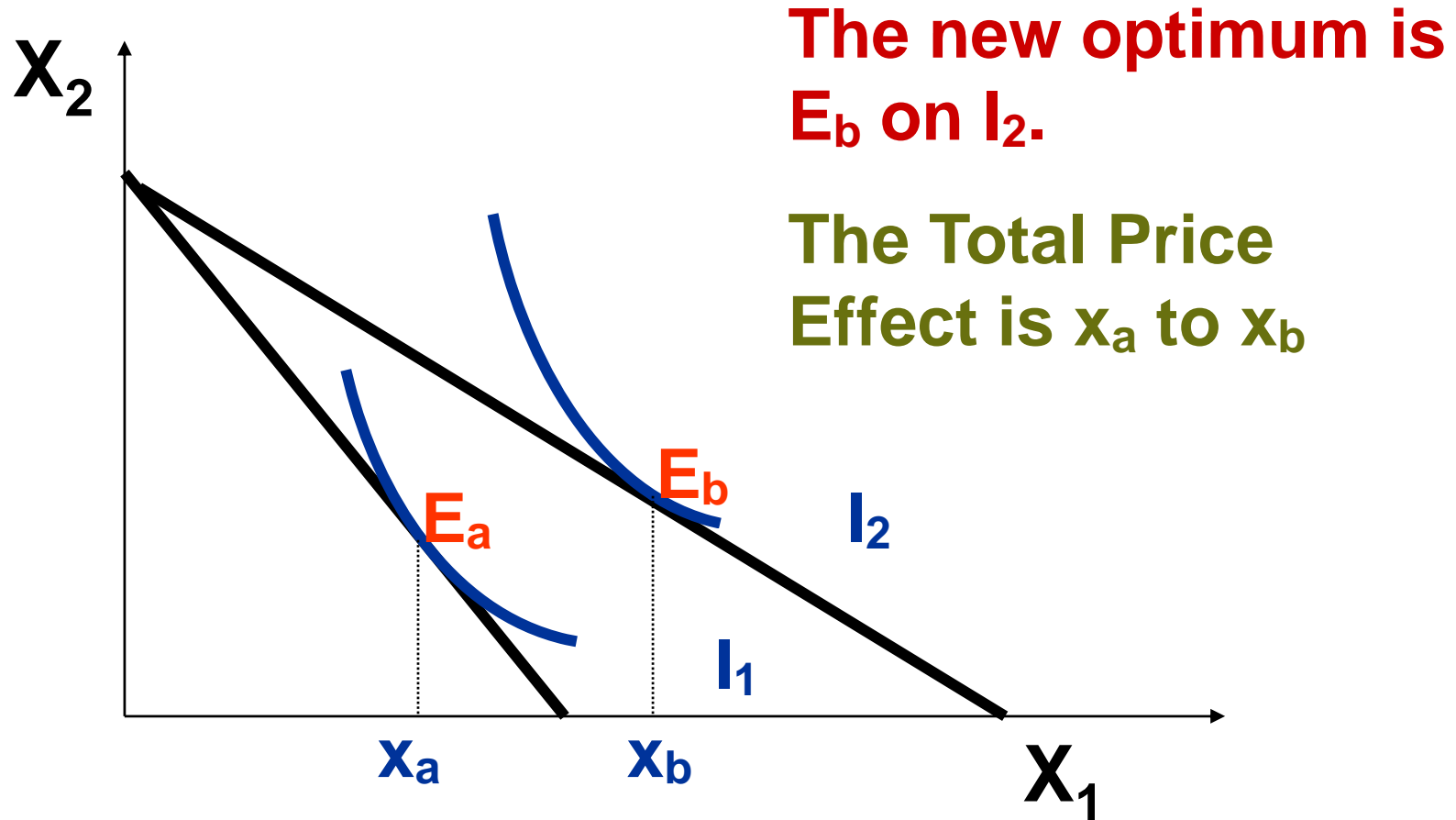




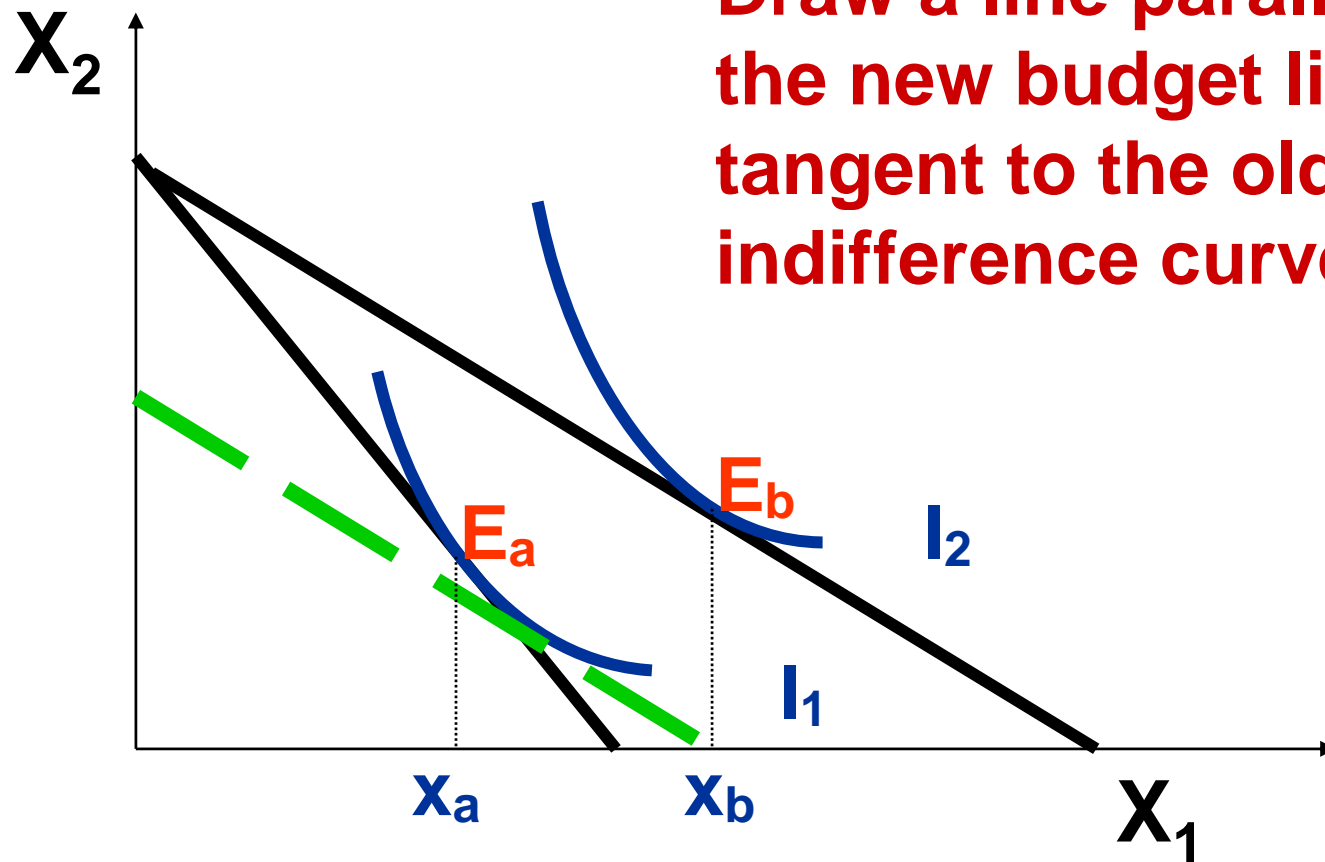
# THE HICKSIAN METHOD

- ◆ **To isolate the substitution effect we ask....**  
“what would the consumer’s optimal bundle be if s/he faced the new lower price for  $X_1$  but experienced no change in real income?”
- ◆ **This amounts to returning the consumer to the original indifference curve ( $I_1$ )**

# THE HICKSIAN METHOD

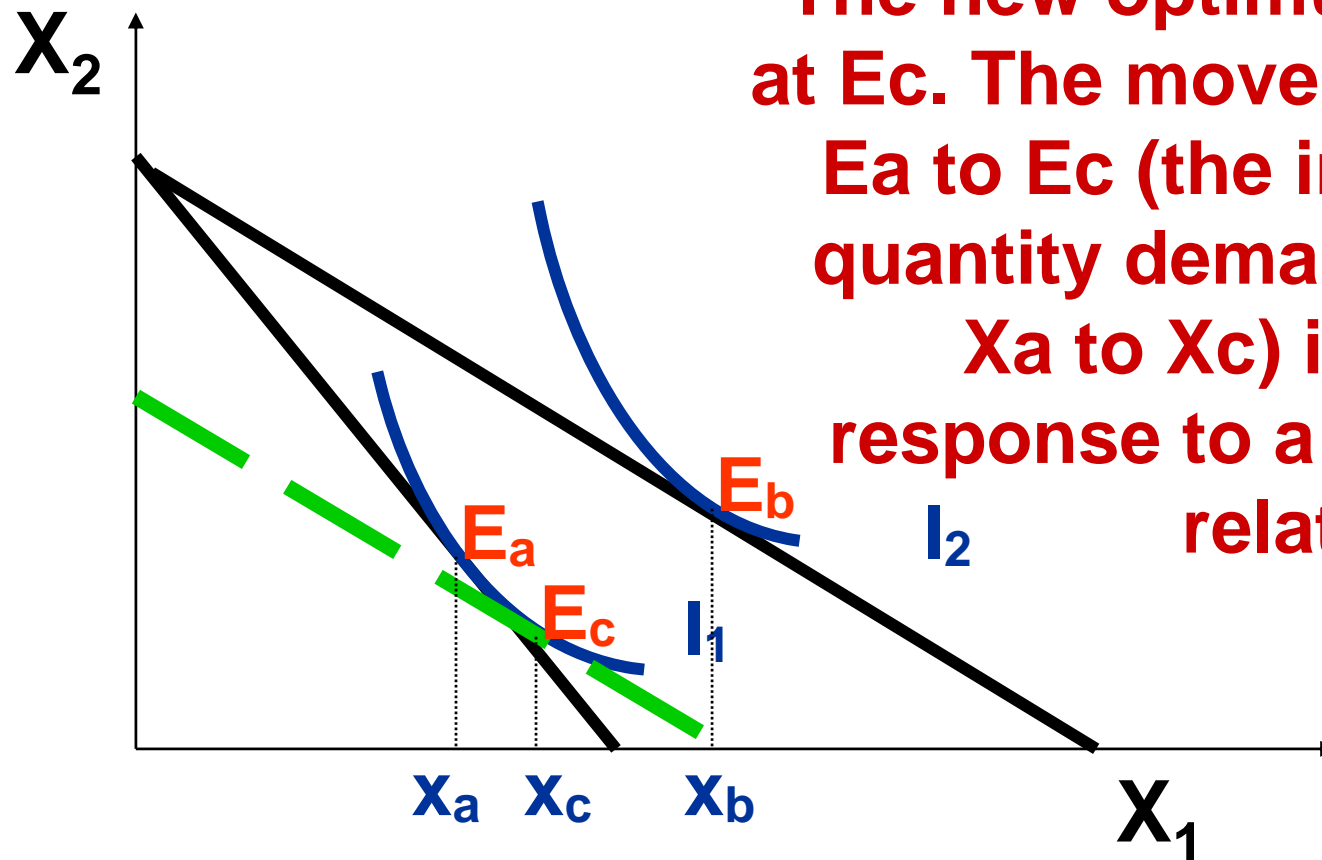


# THE HICKSIAN METHOD



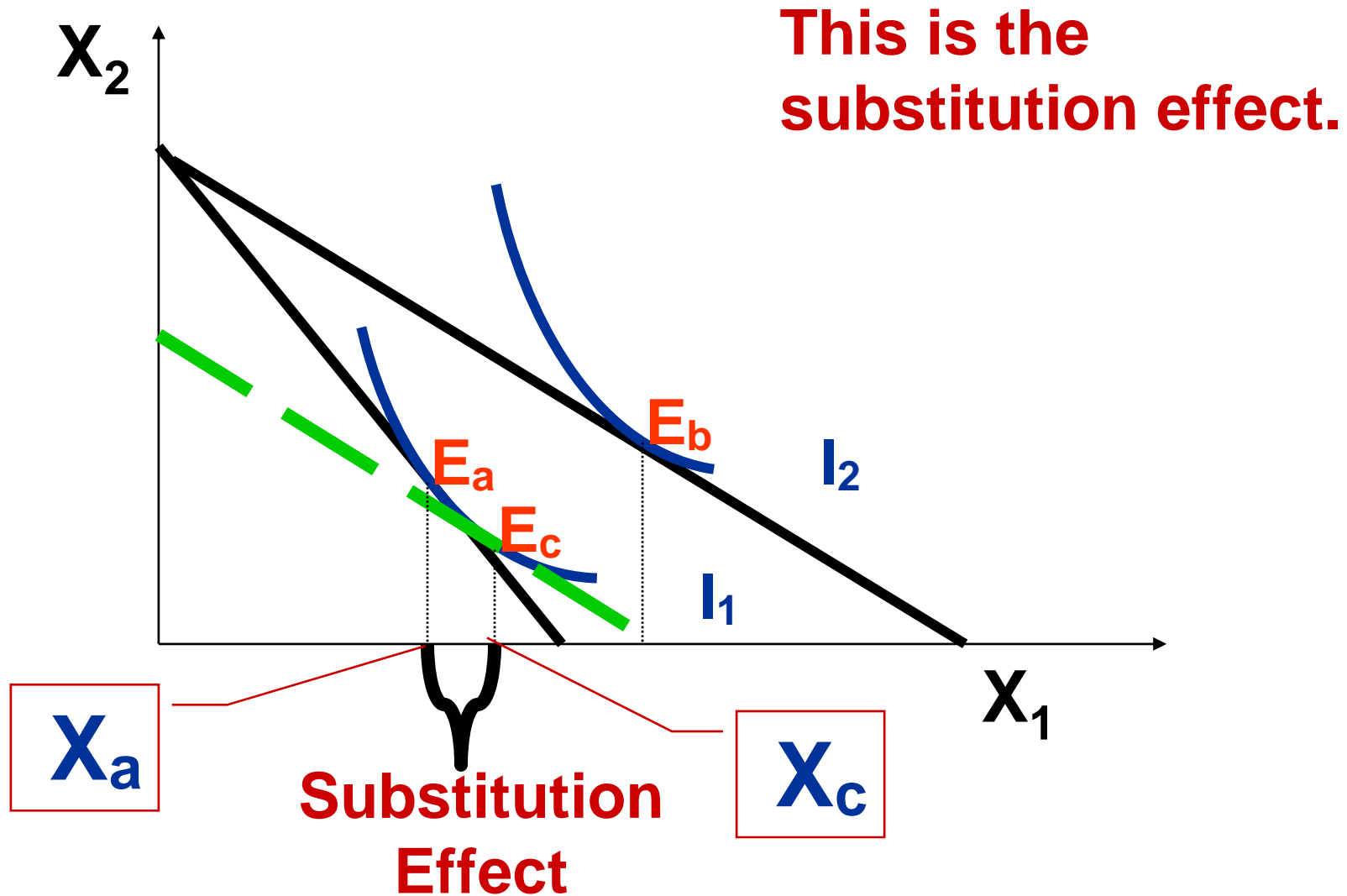
**Draw a line parallel to the new budget line and tangent to the old indifference curve**

# THE HICKSIAN METHOD



The new optimum on  $I_1$  is at  $E_c$ . The movement from  $E_a$  to  $E_c$  (the increase in quantity demanded from  $X_a$  to  $X_c$ ) is solely in response to a change in relative prices

# THE HICKSIAN METHOD

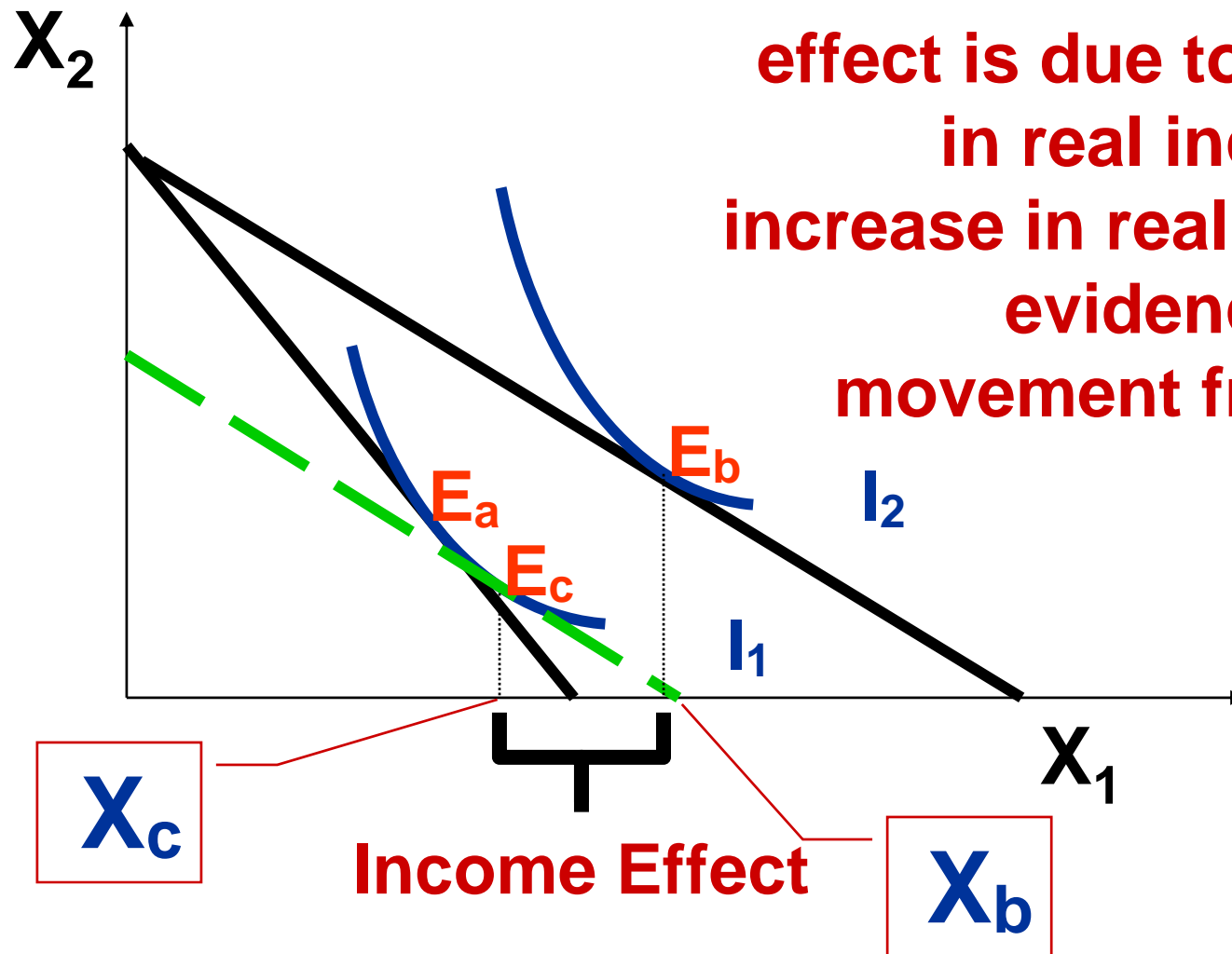


# THE HICKSIAN METHOD

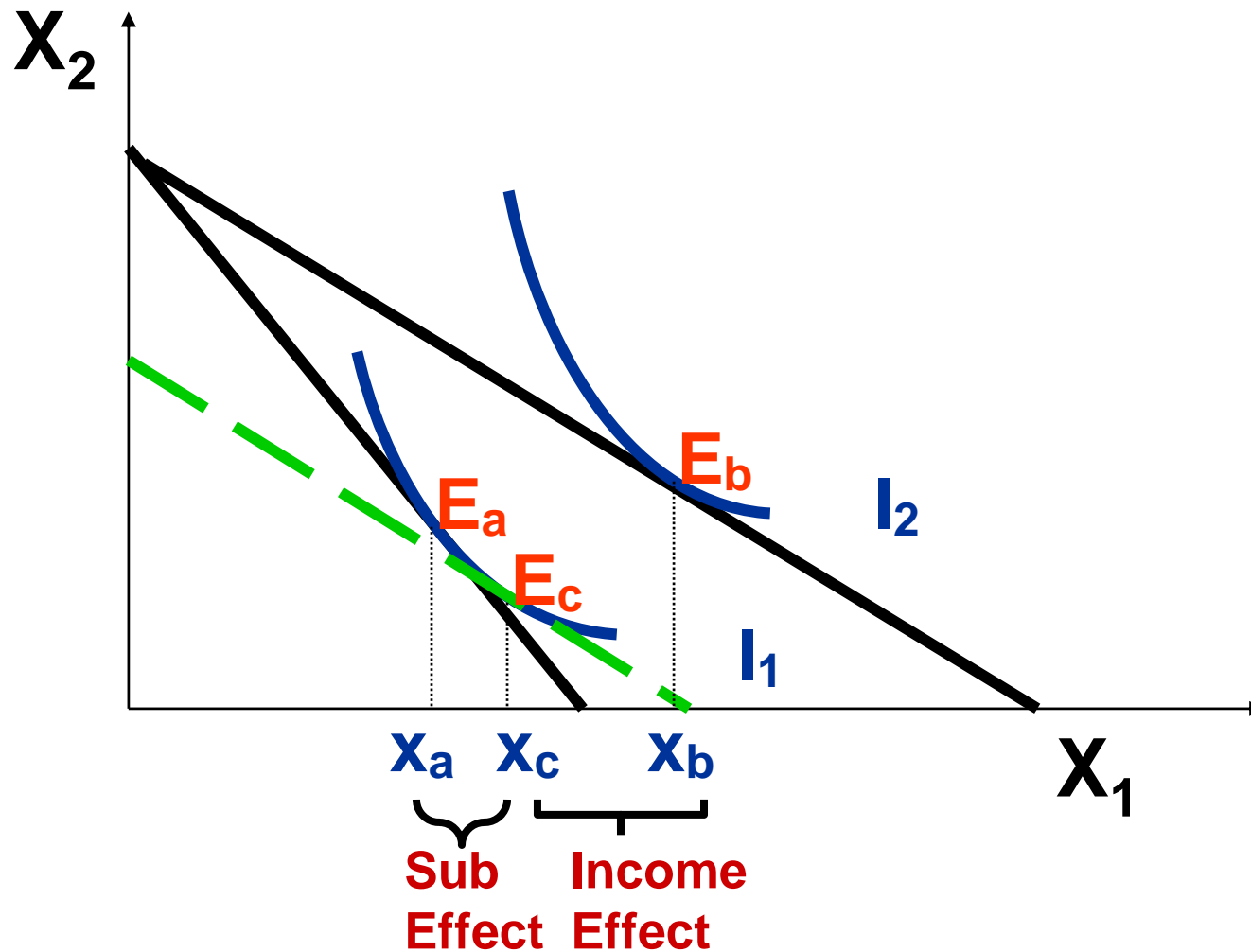
- ◆ **To isolate the income effect ...**
- ◆ **Look at the remainder of the total price effect**
- ◆ **This is due to a change in real income.**

# THE HICKSIAN METHOD

The remainder of the total effect is due to a change in real income. The increase in real income is evidenced by the movement from  $I_1$  to  $I_2$

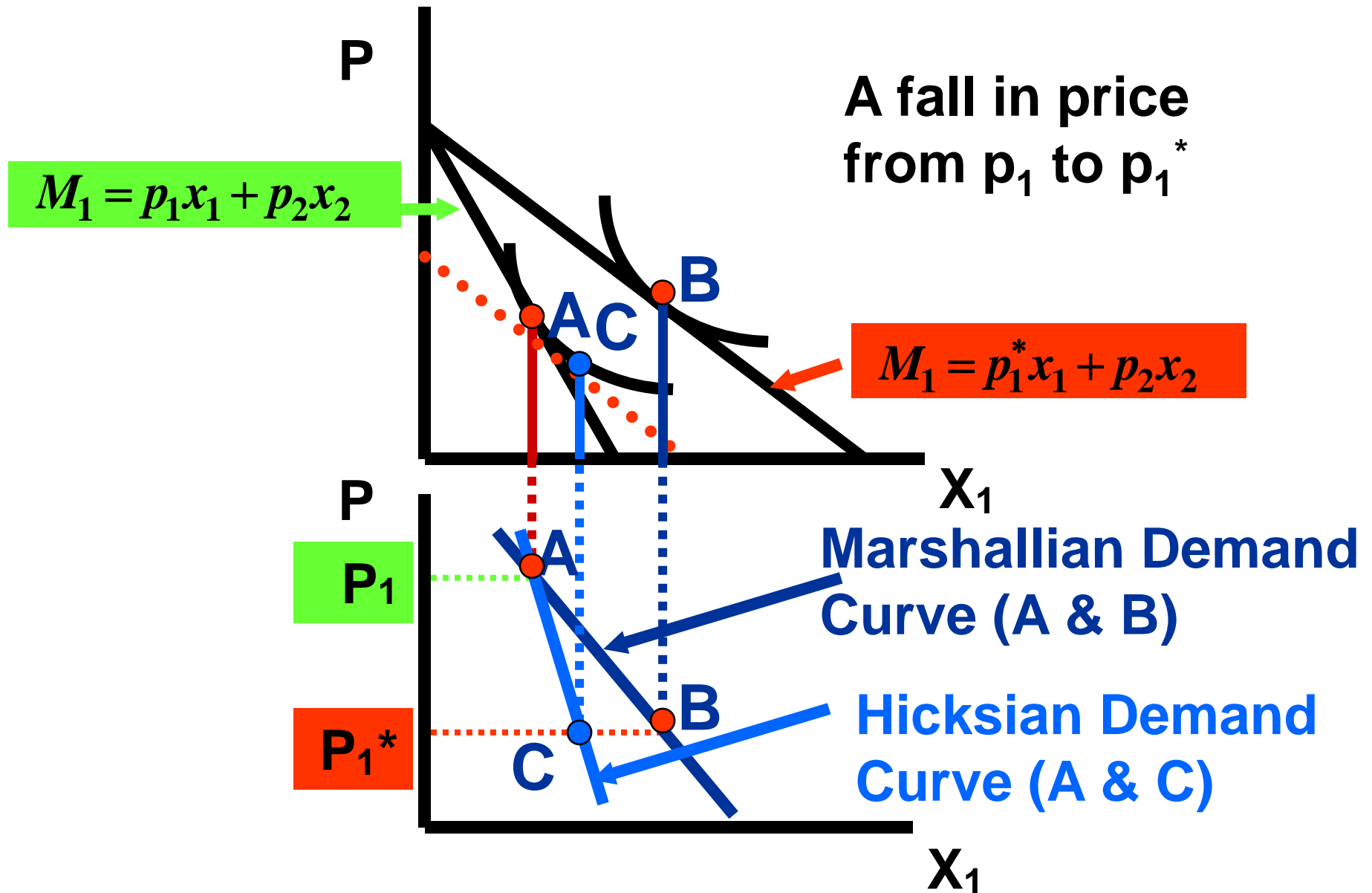


# THE HICKSIAN METHOD





# HICKSIAN ANALYSIS and DEMAND CURVES



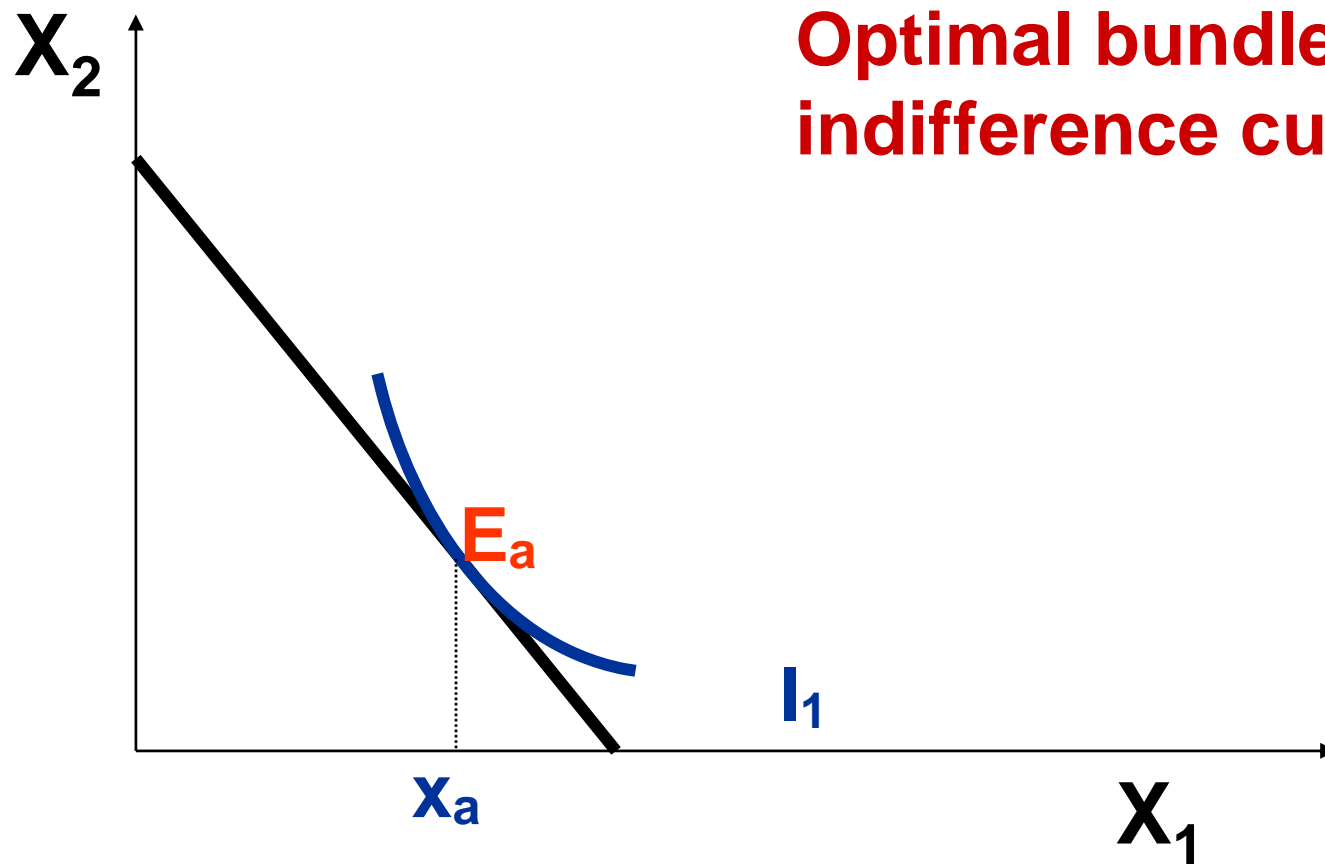
# HICKSIAN ANALYSIS and DEMAND CURVES

**Hicksian (compensated) demand curves cannot be upward-sloping (i.e. substitution effect cannot be positive)**

# THE SLUTSKY METHOD

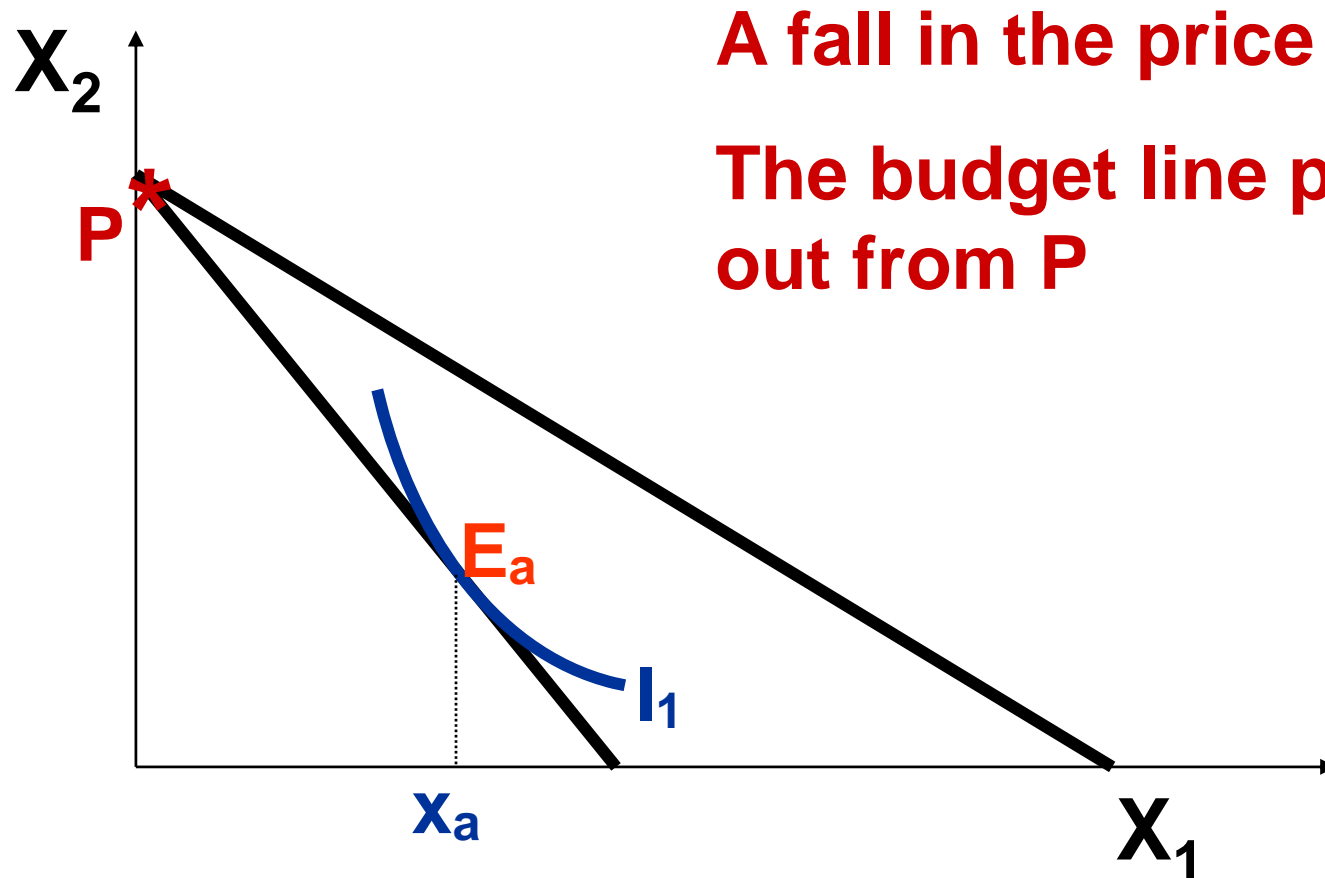
- ◆ **Eugene Slutsky (1880-1948)**
- ◆ **Russian economist expelled from the University of Kiev for participating in student revolts.**
- ◆ **In his 1915 paper, “On the theory of the Budget of the Consumer” he introduced “Slutsky Decomposition”.**

# THE SLUTSKY METHOD



**Optimal bundle is  $E_a$ , on indifference curve  $I_1$ .**

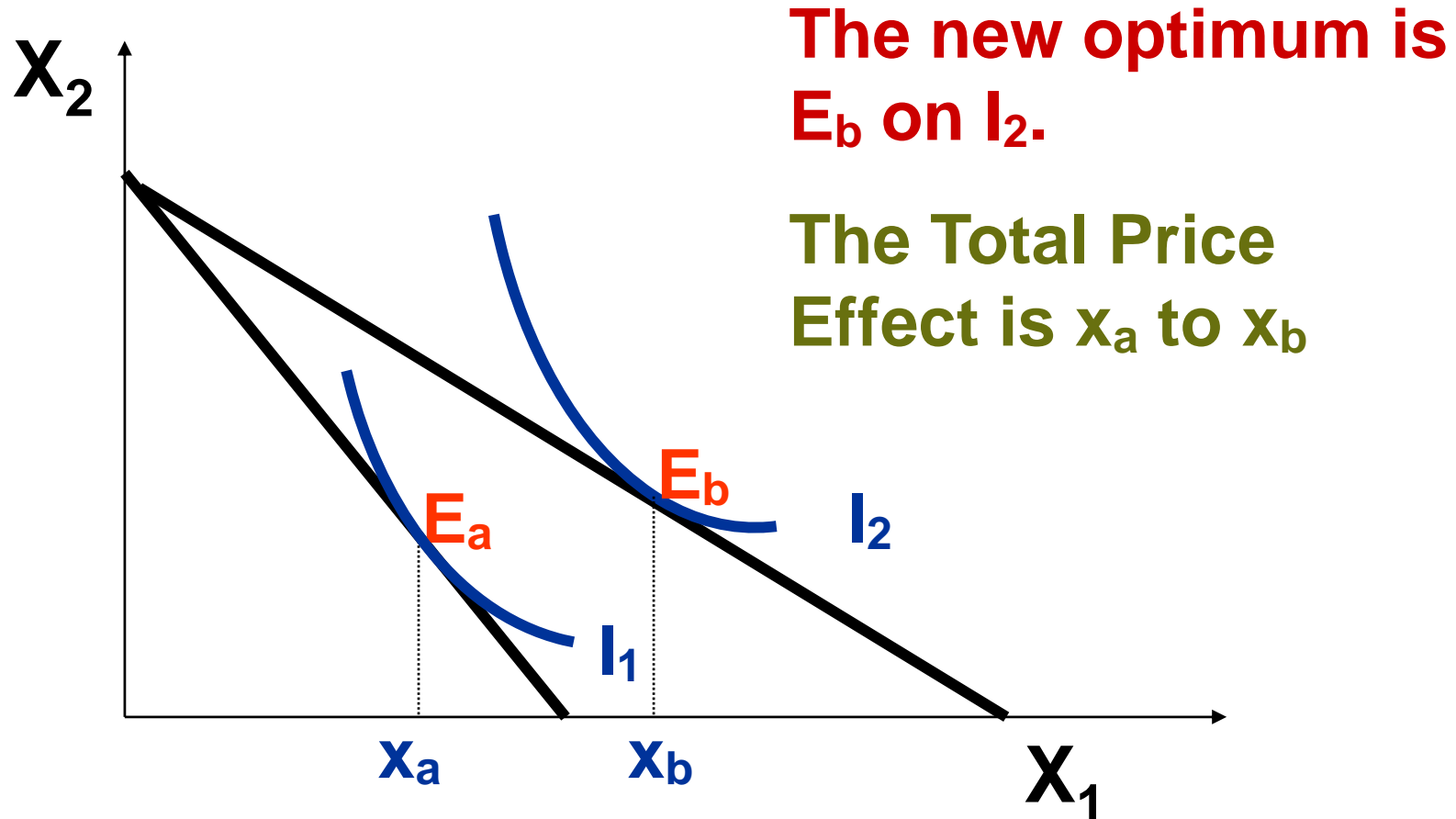
# THE SLUTSKY METHOD



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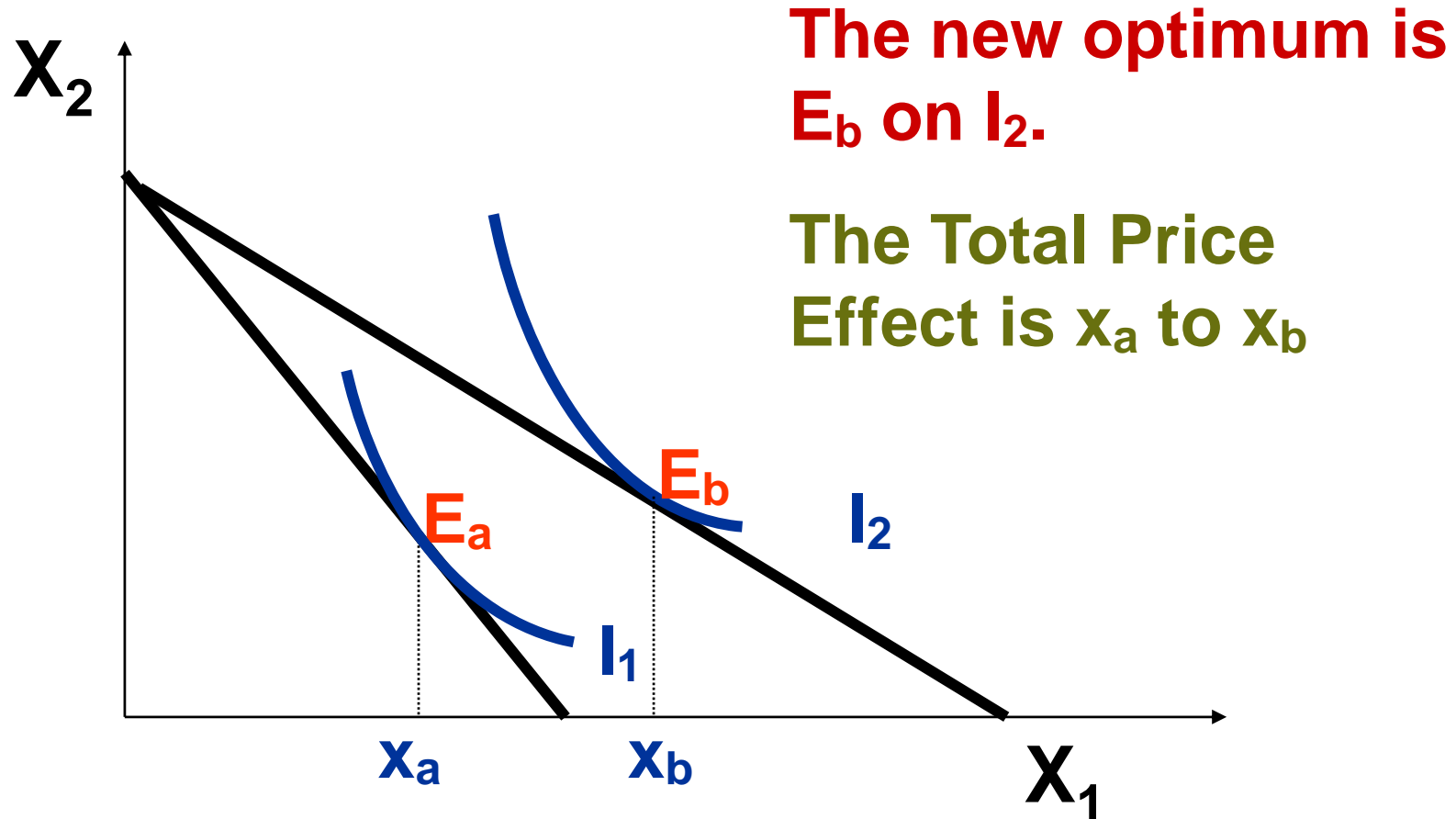
- ◆ **Slutsky claimed that if, at the new prices,**
  - **less income is needed to buy the original bundle then “real income” has increased**
  - **more income is needed to buy the original bundle then “real income” has decreased**
- ◆ **Slutsky isolated the change in demand due only to the change in relative prices by asking “What is the change in demand when the consumer’s income is adjusted so that, at the new prices, s/he can just afford to buy the original bundle?”**

# THE SLUTSKY METHOD

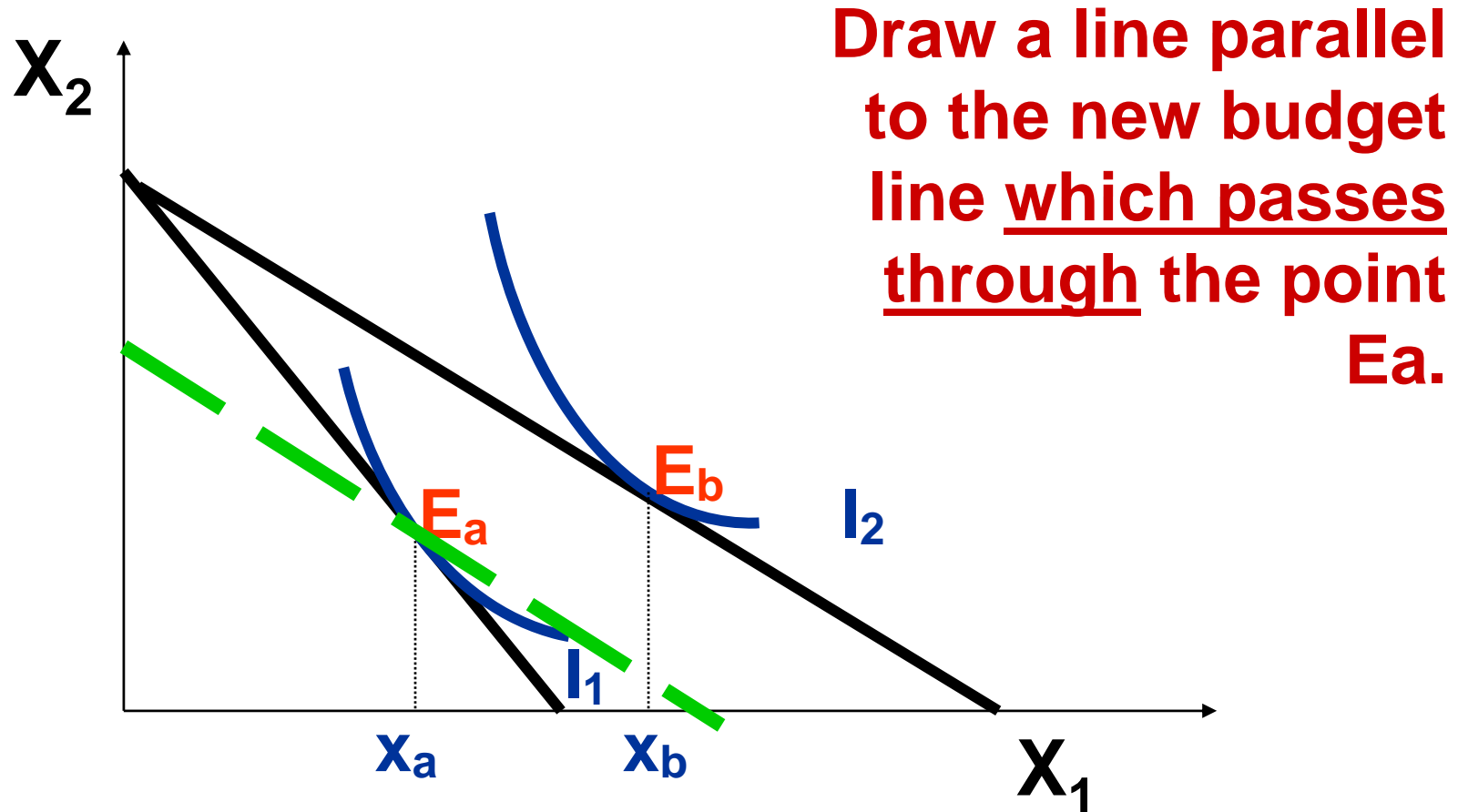
- ◆ **To isolate the substitution effect we adjust the consumer's money income so that s/he can just afford the original consumption bundle.**
- ◆ **In other words we are holding purchasing power constant.**



# THE SLUTSKY METHOD

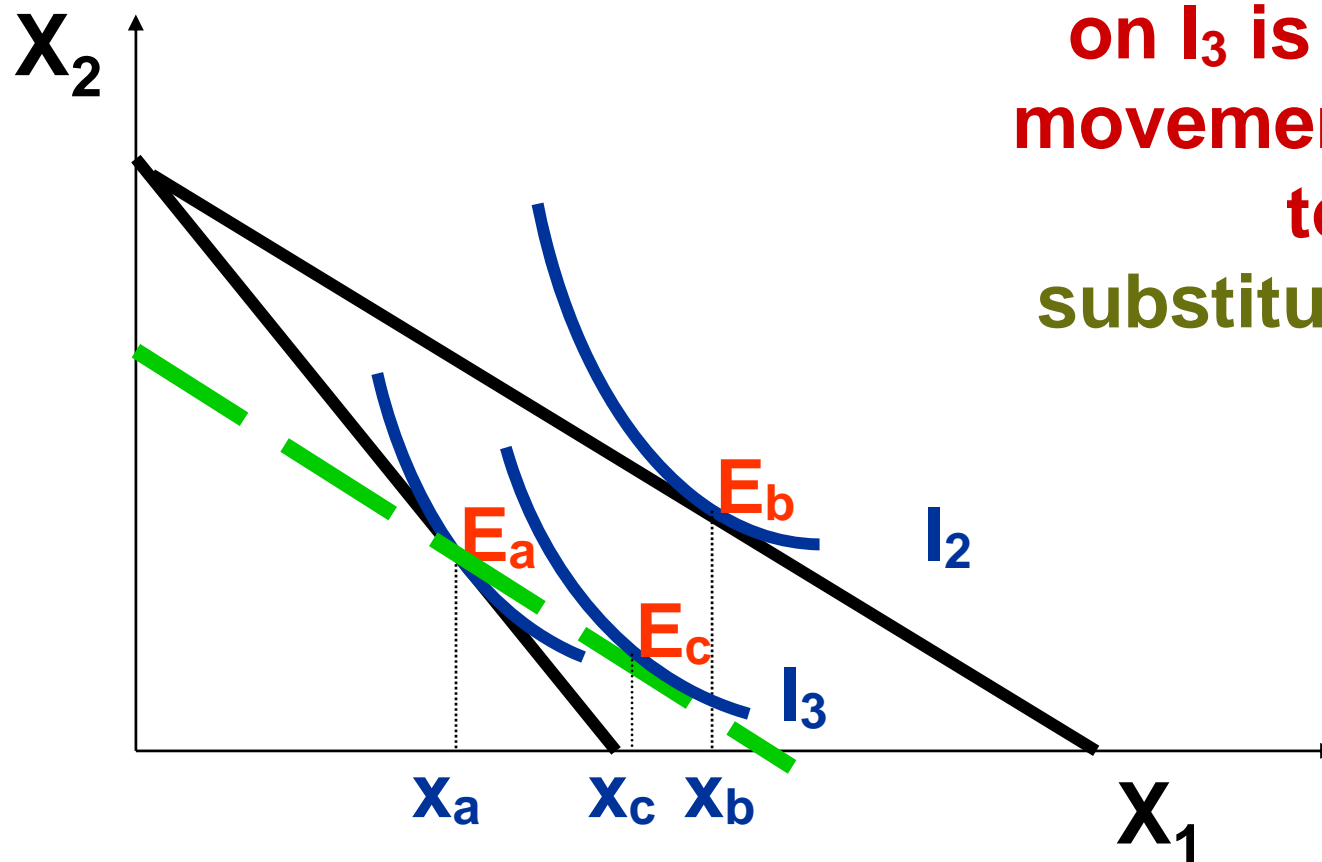


# THE SLUTSKY METHOD



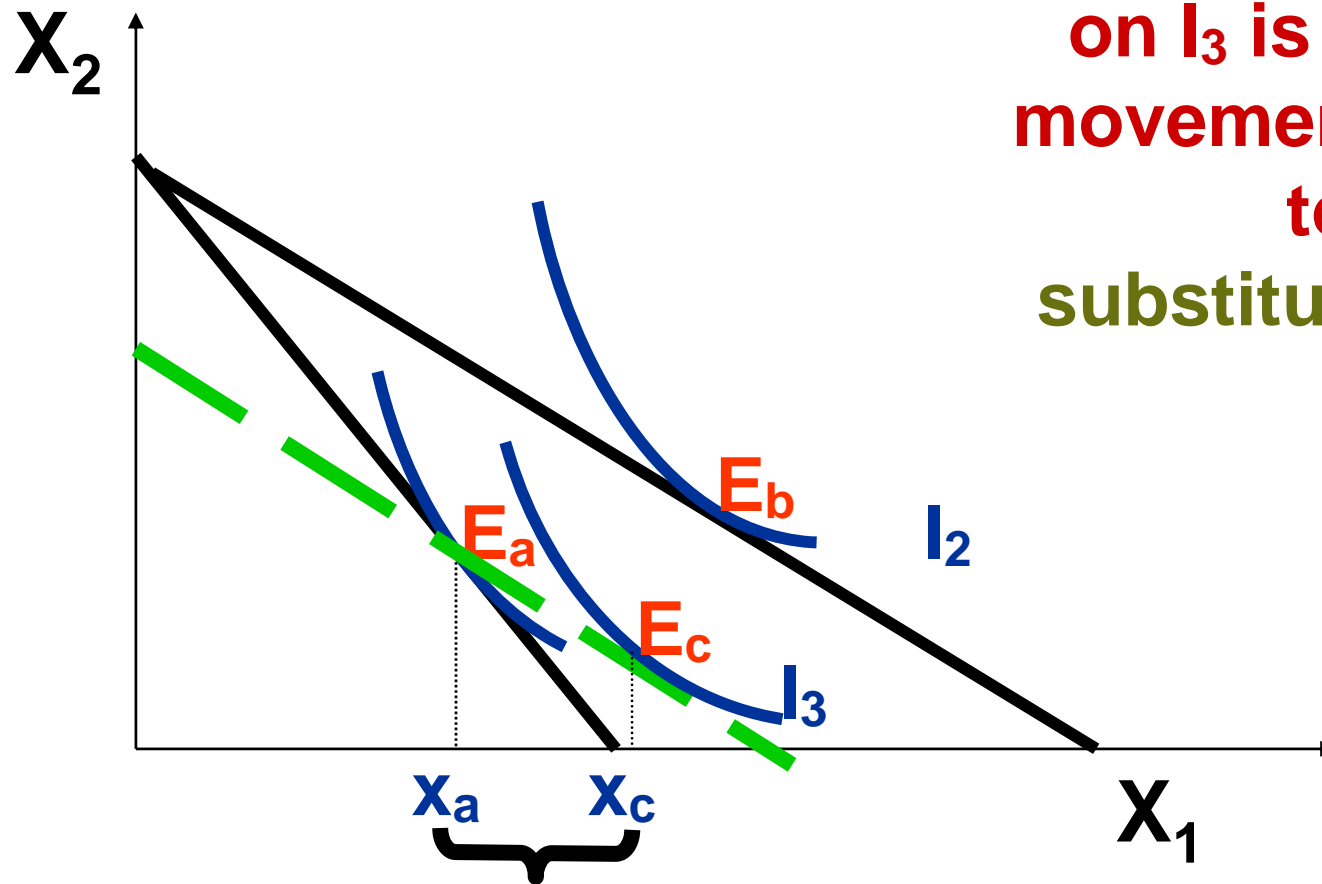
# THE SLUTSKY METHOD

The new optimum on  $I_3$  is at  $E_c$ . The movement from  $E_a$  to  $E_c$  is the substitution effect



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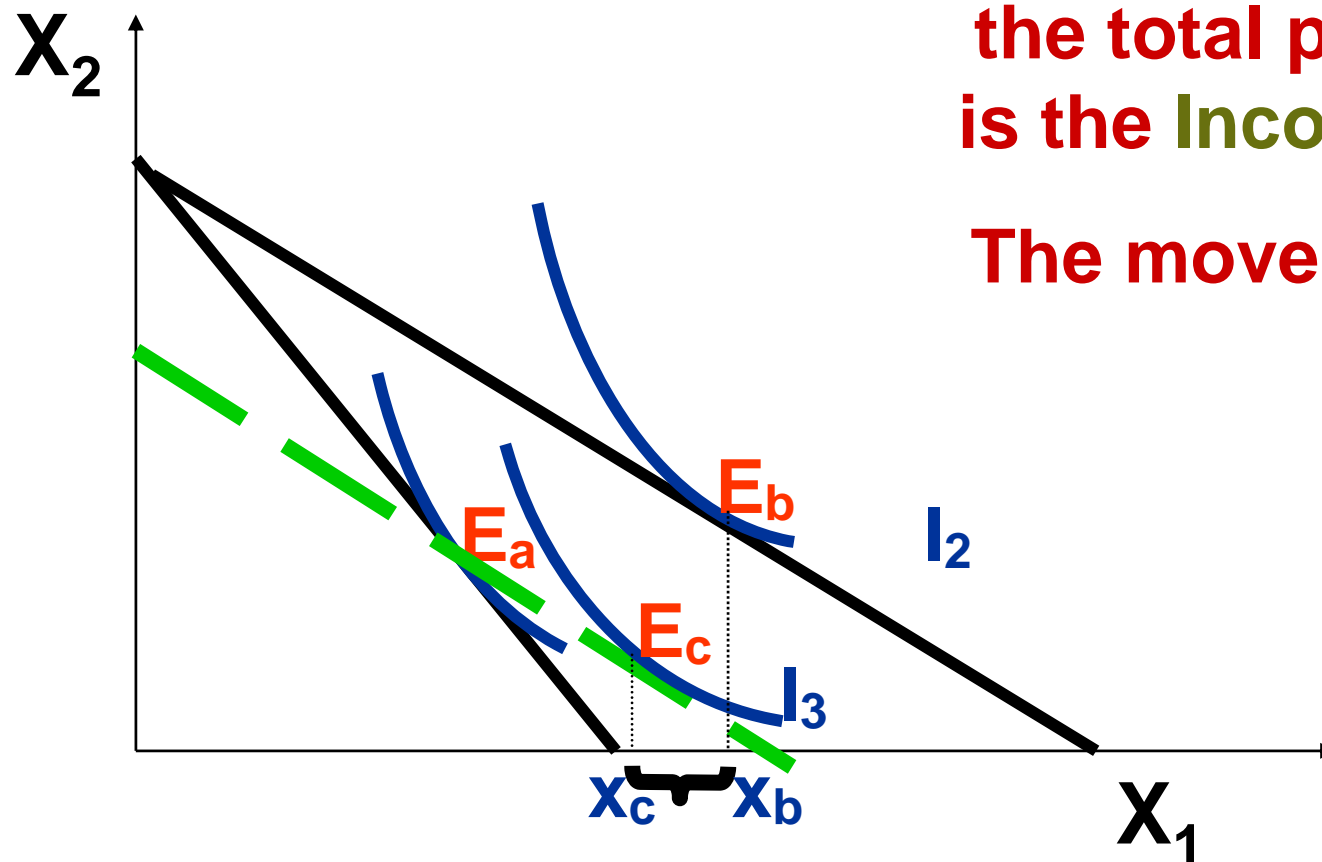


**Substitution Effect**

# THE SLUTSKY METHOD

The remainder of the total price effect is the **Income Effect**.

The movement from  **$E_c$**  to  **$E_b$** .



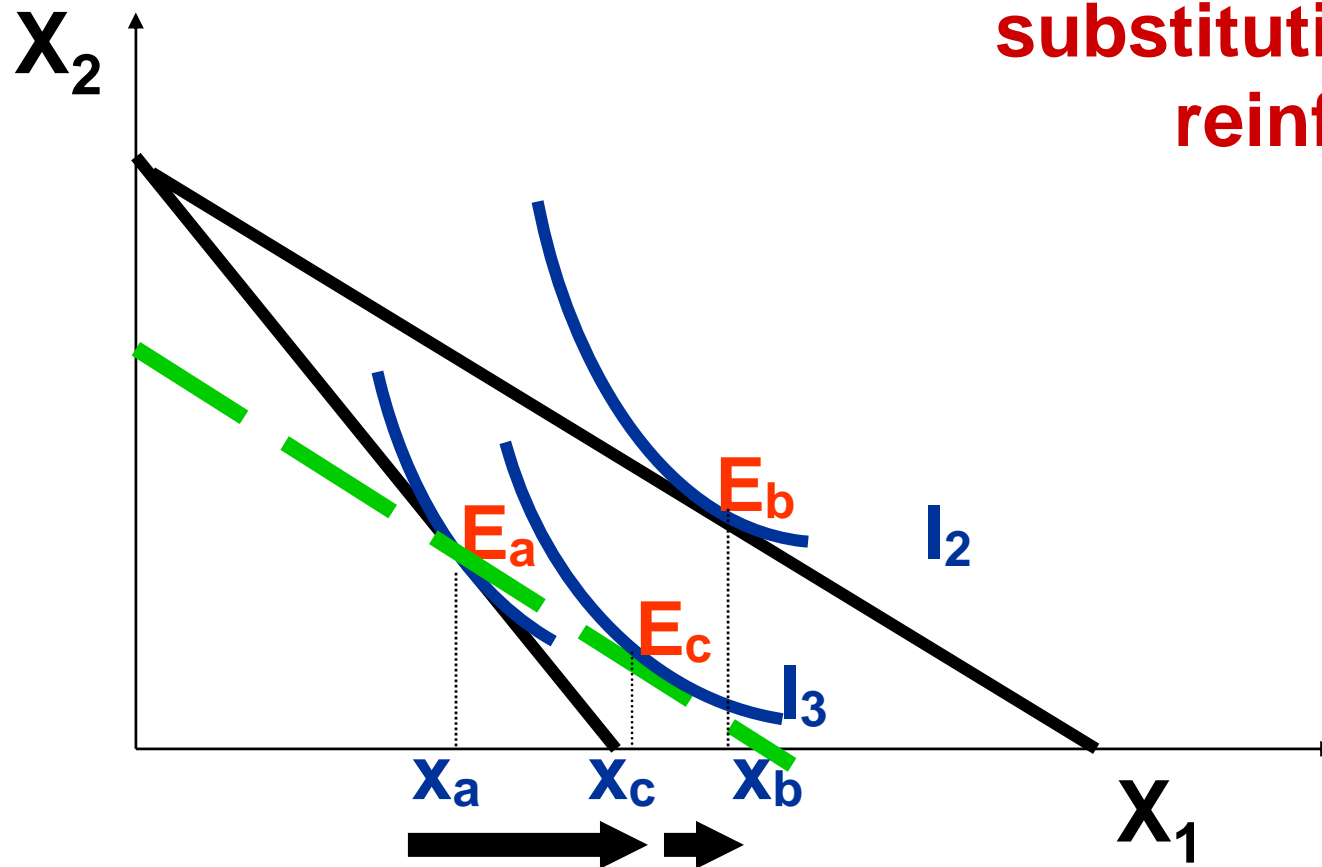
**Income Effect**

# THE SLUTSKY METHOD for NORMAL GOODS

- ◆ **Most goods are normal (i.e. demand increases with income).**
- ◆ **The substitution and income effects reinforce each other when a normal good's own price changes.**

# THE SLUTSKY METHOD for NORMAL GOODS

**The income and  
substitution effects  
reinforce each  
other.**



# THE SLUTSKY METHOD for NORMAL GOODS

- ◆ **Since both the substitution and income effects increase demand when own-price falls, a normal good's ordinary demand curve slopes downwards.**
- ◆ **The “Law” of Downward-Sloping Demand therefore always applies to normal goods.**



# THE SLUTSKY EQUATION

Let

$$M_1 = p_1 x_1 + p_2 x_2$$

be the original budget constraint

and let

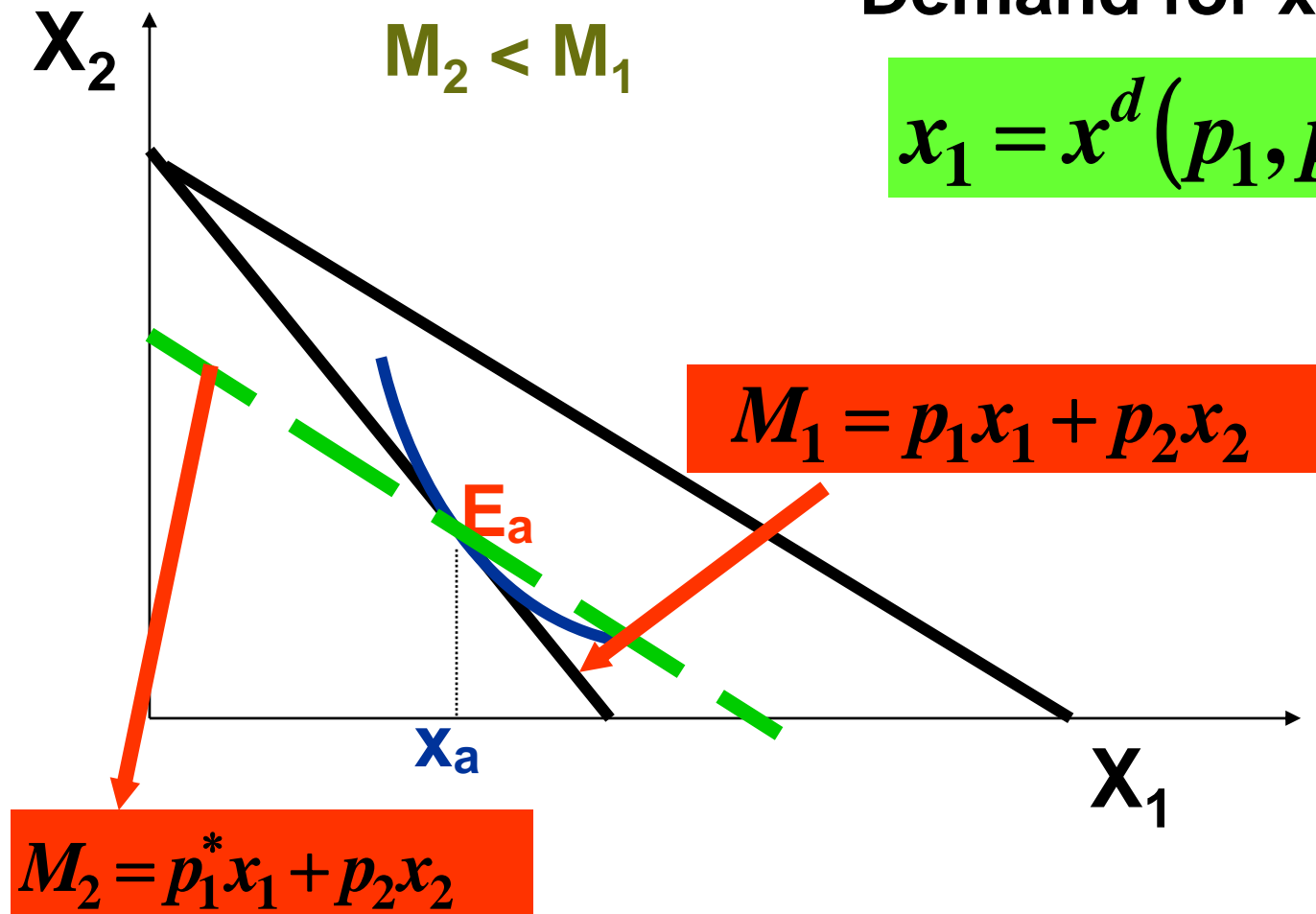
$$M_2 = p_1^* x_1 + p_2 x_2$$

represent the budget constraint after the Slutsky compensating variation in income has been carried out.

# THE SLUTSKY EQUATION

Demand for  $x_1$  is

$$x_1 = x^d(p_1, p_2, M)$$



# THE SLUTSKY EQUATION

$$M_2 - M_1$$

$$\Delta M = M_2 - M_1 = (p_1^* x_1 + p_2 x_2) - (p_1 x_1 + p_2 x_2)$$

$$\Delta M = M_2 - M_1 = p_1^* x_1 + p_2 x_2 - p_1 x_1 - p_2 x_2$$

$$\Delta M = M_2 - M_1 = p_1^* x_1 - p_1 x_1$$

$$\Delta M = M_2 - M_1 = x_1 (p_1^* - p_1)$$

$$\Delta M = x_1 \Delta p_1 \quad \text{as} \quad (p_1^* - p_1) = \Delta p_1$$

gives the change in money  
income needed to  
consume the original  
bundle of goods (at  $E_A$ )

$$\Delta M = x_1 \Delta p_1$$

# THE SLUTSKY EQUATION

**The demand curve holding M constant is given by**

$$\Delta x_1 = x^d(p_1^*, p_2, M_1) - x^d(p_1, p_2, M_1) \quad (1)$$

**which is the change in demand for  $x_1$  due to the change in its own price, holding M and the price of  $x_2$  constant**

# THE SLUTSKY EQUATION

The income effect is given by

$$\Delta x_m = x^d(p_1^*, p_2, M_1) - x^d(p_1^*, p_2, M_2) \quad (2)$$

The change in demand due to the Slutsky substitution effect is given by

$$\Delta x_s = x^d(p_1^*, p_2, M_2) - x^d(p_1, p_2, M_1) \quad (3)$$

# THE SLUTSKY EQUATION

**Given**

$$\Delta x_1 = x^d(p_1^*, p_2, M_1) - x^d(p_1, p_2, M_1) \quad (1)$$

$$\Delta x_m = x^d(p_1^*, p_2, M_1) - x^d(p_1^*, p_2, M_2) \quad (2)$$

$$\Delta x_s = x^d(p_1^*, p_2, M_2) - x^d(p_1, p_2, M_1) \quad (3)$$

**Claim**

$$\Delta x_1 = \Delta x_s + \Delta x_m \quad (4)$$

**Show this by substituting equations (1), (2) and (3) into equation (4)**

# THE SLUTSKY EQUATION

$$\Delta x_1 = \Delta x_s + \Delta x_m$$

Divide across by  $\Delta p_1$

$$\frac{\Delta x_1}{\Delta p_1} = \frac{\Delta x_s}{\Delta p_1} + \frac{\Delta x_m}{\Delta p_1}$$

Recall

$$\Delta M = x_1 \Delta p_1$$

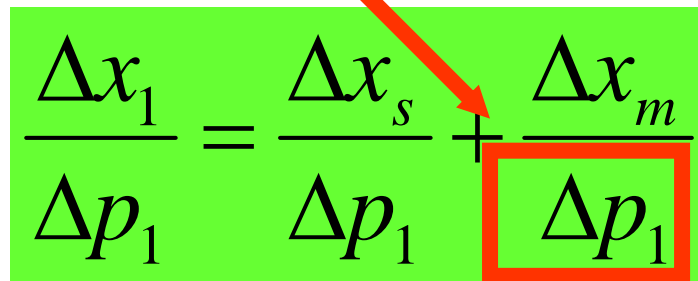
so

$$\Delta p_1 = (-) \Delta M / x_1$$

# THE SLUTSKY EQUATION

**Substituting**

$$\Delta p_1 = (-)\Delta M / x_1$$


$$\frac{\Delta x_1}{\Delta p_1} = \frac{\Delta x_s}{\Delta p_1} + \frac{\Delta x_m}{\Delta p_1}$$

**Gives**

$$\frac{\Delta x_1}{\Delta p_1} = \frac{\Delta x_s}{\Delta p_1} - \frac{\Delta x_m}{\Delta M} x_1$$

**THE  
SLUTSKY  
EQUATION**

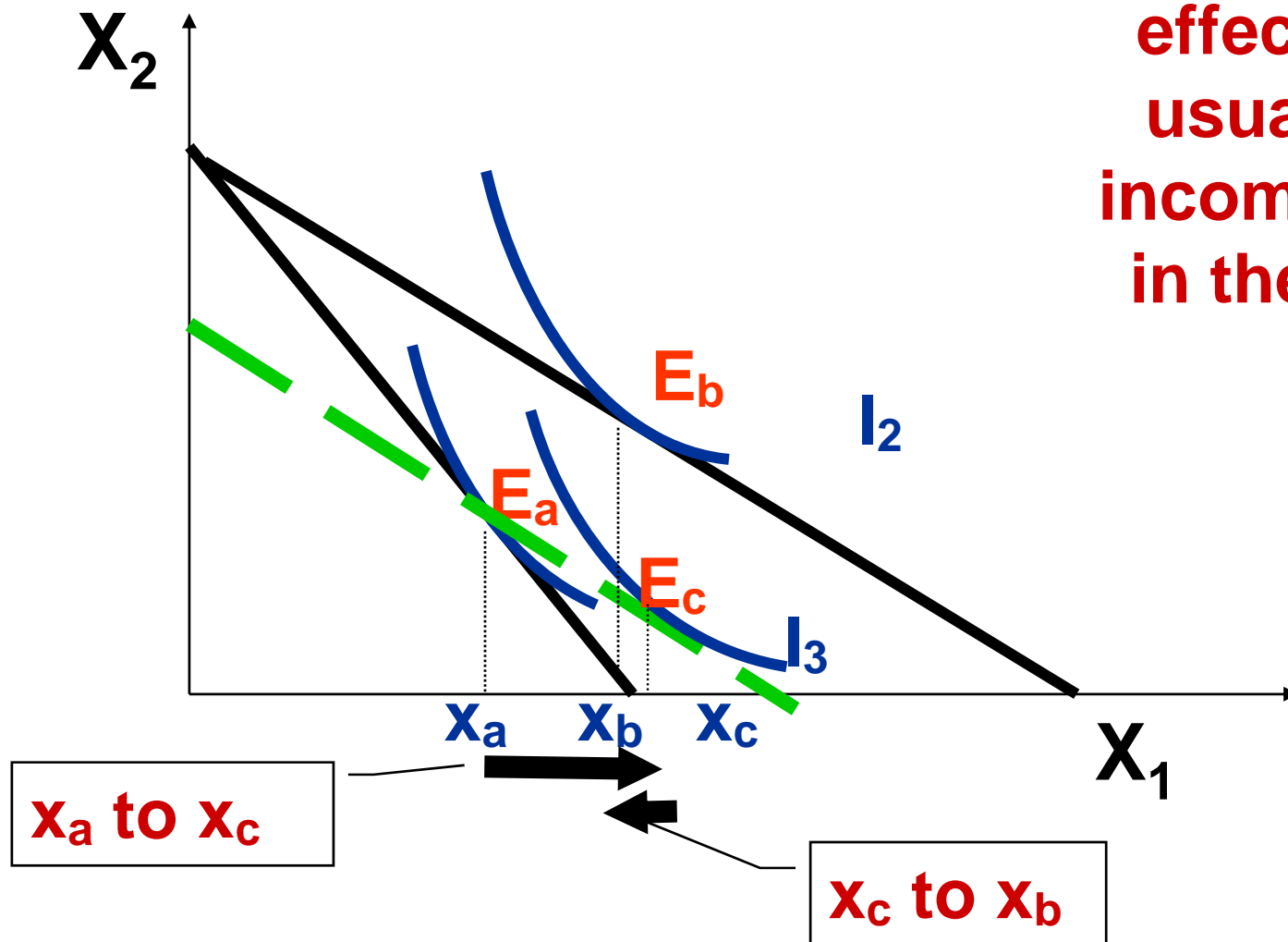


# THE SLUTSKY METHOD: INFERIOR GOODS

- ◆ **Some goods are (sometimes) inferior (i.e. demand is reduced by higher income).**
- ◆ **The substitution and income effects “oppose” each other when an inferior good’s own price changes.**

# THE SLUTSKY METHOD: INFERIOR GOODS

The substitution effect is as per usual. But, the income effect is in the opposite direction.

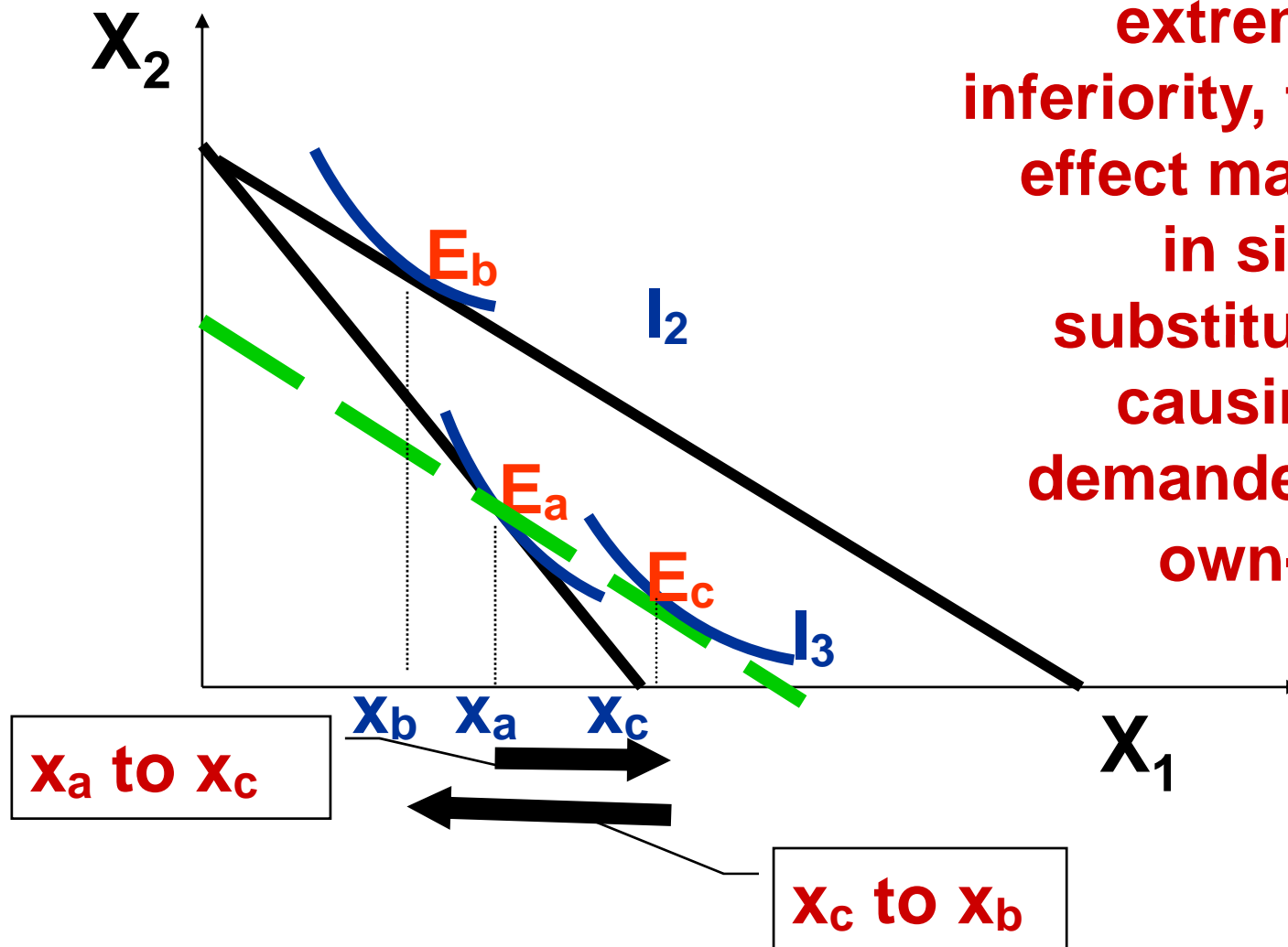


# GIFFEN GOODS

- ◆ **In rare cases of extreme inferiority, the income effect may be larger in size than the substitution effect, causing quantity demanded to rise as own price falls.**
- ◆ **Such goods are Giffen goods.**
- ◆ **Giffen goods are very inferior goods.**

# THE SLUTSKY METHOD for INFERIOR GOODS

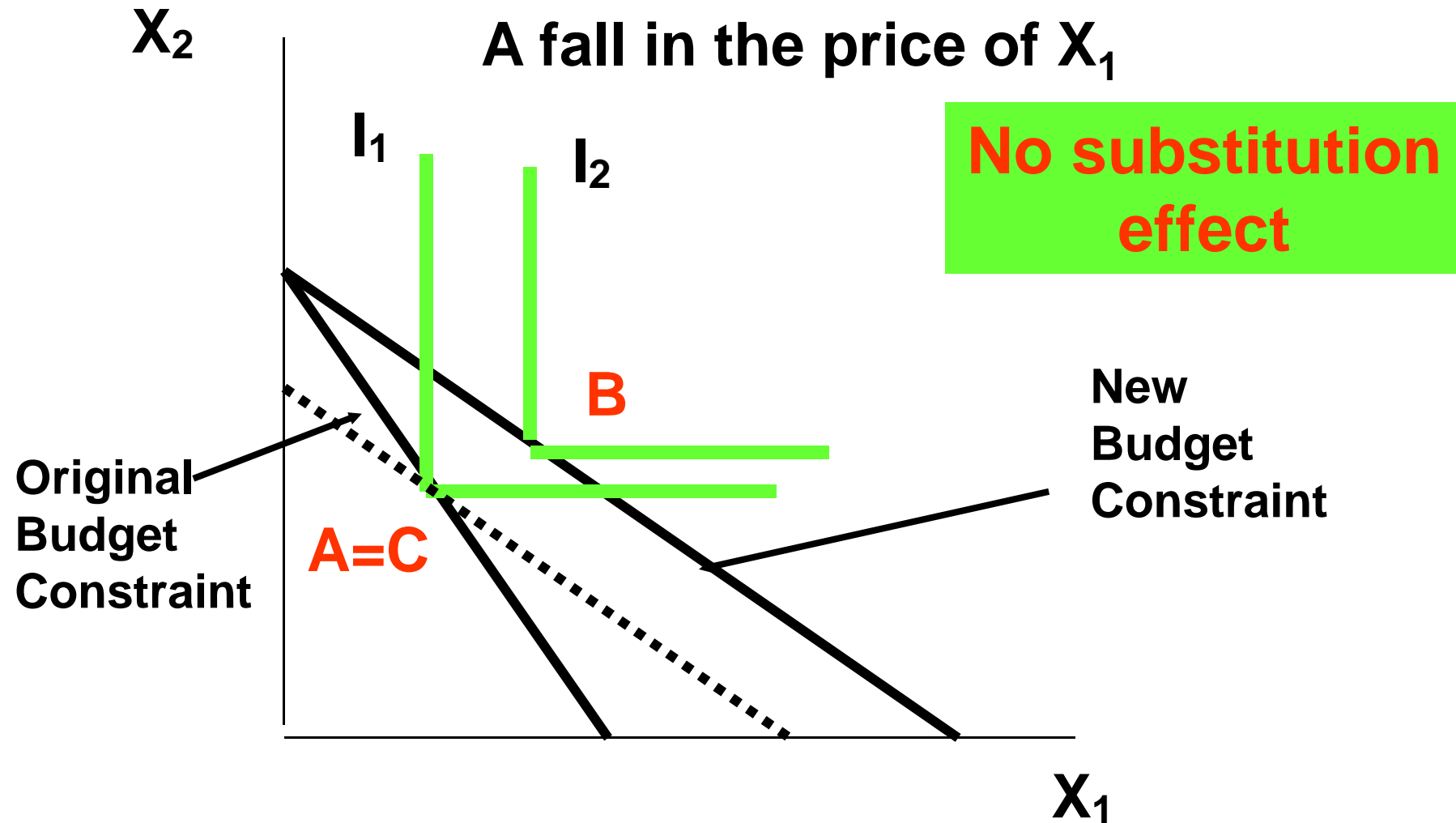
In rare cases of extreme income-inferiority, the income effect may be larger in size than the substitution effect, causing quantity demanded to fall as own-price falls.



# SLUTSKY'S EFFECT FOR GIFFEN GOODS

- ◆ **Slutsky's decomposition of the effect of a price change into a pure substitution effect and an income effect thus explains why the "Law" of Downward-Sloping Demand is **violated** for very inferior goods.**

# DECOMPOSITION of TOTAL PRICE EFFECT: PERFECT COMPLEMENTS



# **DECOMPOSITION of TOTAL PRICE EFFECT PERFECT SUBSTITUTES**

**?**