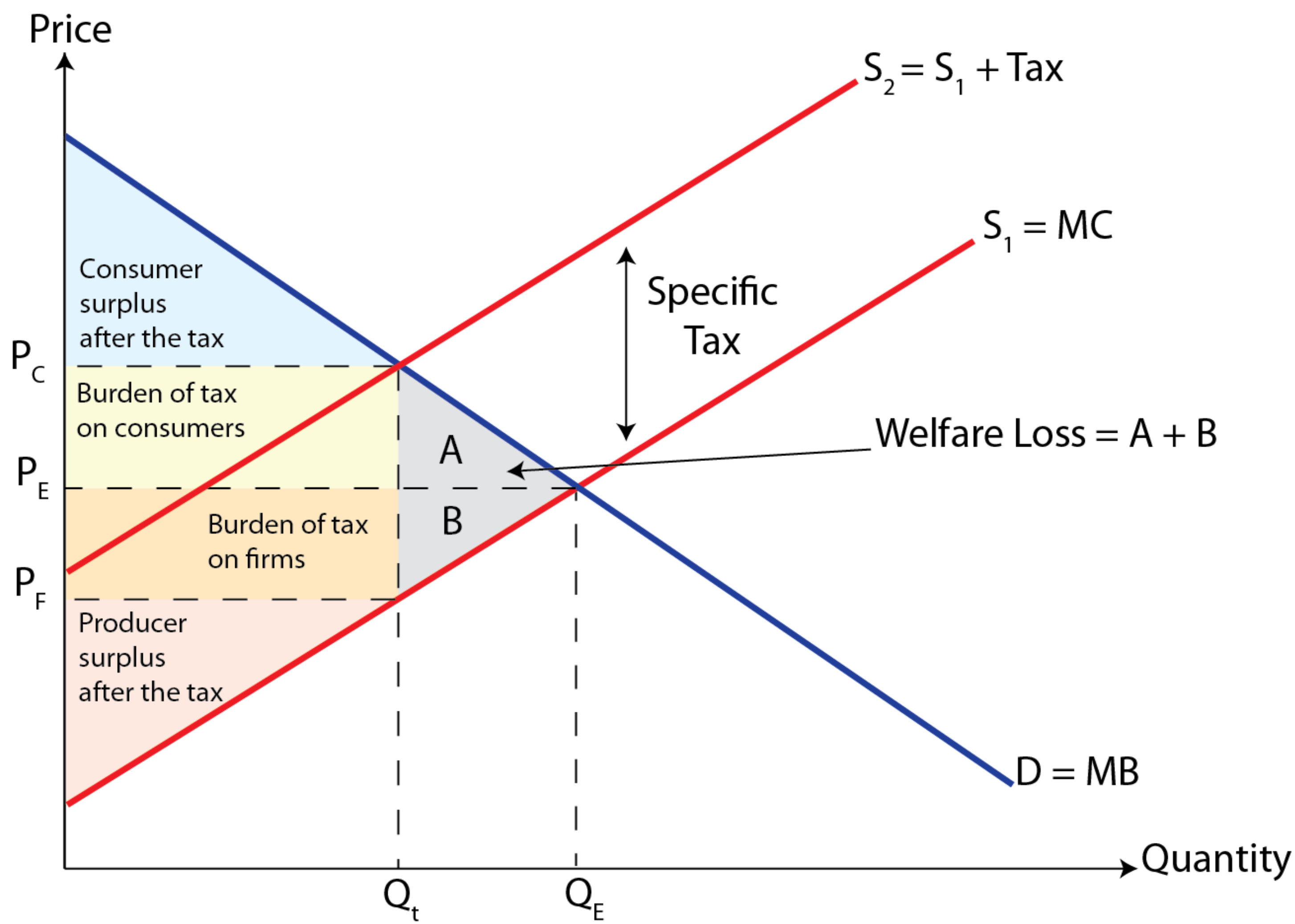
Tax & Subsidies and Linear Functions

Overview

- Given a supply function of the general form $\mathbf{Q_S = c + dP}$
  - Whenever there is a *downward shift* of the function by **s** units, where **s** is the subsidy per unit we replace **P** by **P + s**. The new supply function therefore becomes $\mathbf{Q_S = c + d(P + s)}$.
  - Whenever there is a *upward shift* of the function by **t** units, where **t** is the tax per unit we replace **P** by **P − t**. The new supply function therefore becomes $\mathbf{Q_S = c + d(P - t)}$.

	Original Function	Revised Function
Taxes (**t**)	$\mathbf{Q_s = c + dP}$	$\mathbf{Q_s = c + d(P - t)}$
Subsidy (**s**)	$\mathbf{Q_s = c + dP}$	$\mathbf{Q_s = c + d(P + s)}$

Recap- Indirect Taxes



Tax Incidence and Linear Functions

- Linear functions can be used for the analysis of tax incidence
- **Example;** Suppose the demand and supply of cigarettes can be modeled as follows, $\mathbf{Q_D = 1600 - 200P}$ and $\mathbf{Q_S = 600 + 300P}$

Linear supply and demand schedules: Cigarettes		
Price (P)	**Quantity demanded (Q_D)**	**Quantity supplied (Q_S)**
5	600	2100
4	800	1800
3	1000	1500
2	1200	1200
1	1400	900
0	1600	600

- We can determine the equilibrium price and quantity, algebraically

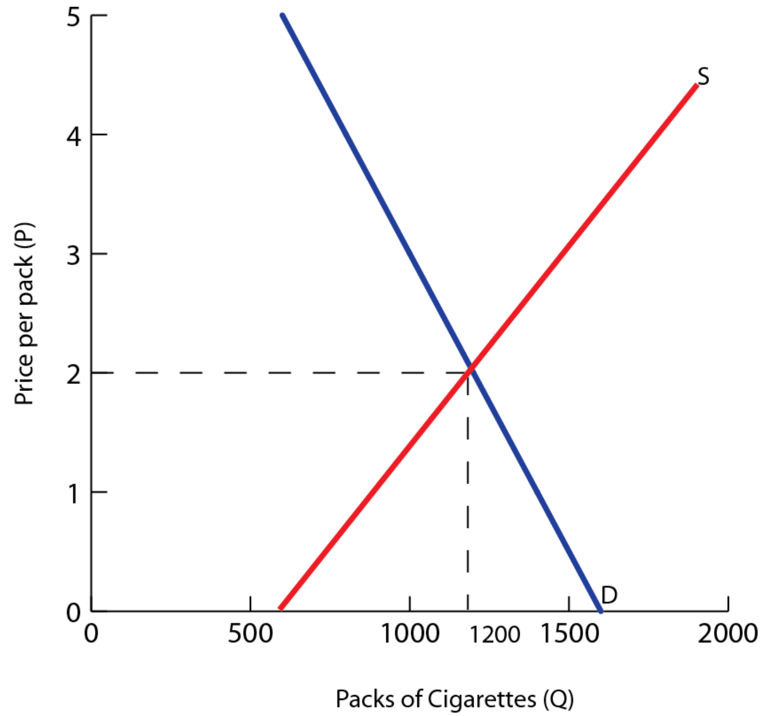
$$\mathbf{Q_d = Q_s}$$

$$\mathbf{1600 - 200P = 600 + 300P}$$

$$\mathbf{500P = 1000}$$

Therefore, $\mathbf{P_E = \$2}$ and $\mathbf{Q_E = 1200}$ **units**

Therefore the equilibrium price is $2 and the quantity is 1200 units



Example; Tax on Cigarettes

- **Example;** Suppose the government places a $1 tax on each pack of cigarettes
  - The tax is a cost imposed on the producers of cigarettes, so whatever the price consumers pay, $1 must be given over to the government
  - Therefore, producers will receive $1 less than the new equilibrium price
  - The new supply function can be expressed as ,$\mathbf{Q_S = 600 + 300(P - 1)}$ or by simplifying we get $\mathbf{Q_S = 300 + 300P}$
  - To determine the new equilibrium, we set the new supply equal to demand

$Q_d = Q_s$

$300 + 300P = 1600 - 200P$

$500P = 1300$

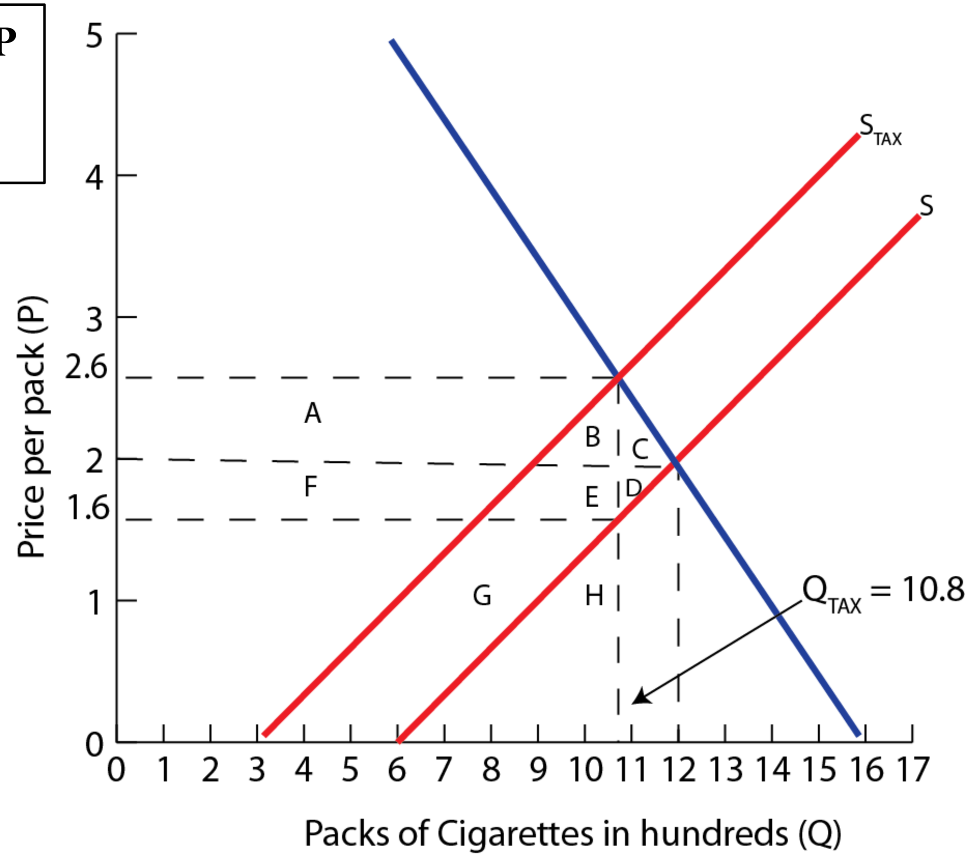
Therefore, $P_E = \$2.6$ and $Q_E = 1080$ **unit**

Therefore the equilibrium price is \$2.6 and the quantity is 1080 units

$1080 = 600 + 300P$

$480 = 300P$

$P = \$1.60$



Calculate

1) Tax Revenue
2) Consumer Tax Burden
3) Producer Tax Burden
4) Δ Consumer Surplus
5) Δ Producer Surplus
6) Welfare Loss

- Because the demand for cigarettes is relatively inelastic, the larger burden of the tax is passed on to consumers.

- We can also analyze the impact of the tax on various other factors,

- **Tax revenue:** is shown by the area **A + B + E + F** and is equal to **$1 × 1080 = $1080**

- **Consumer tax burden:** is represented by the area **A + B** and is equal to **($2.60 - $2) × 1080 = $648**

- **Producer tax burden:** is represent by the area **F + E** and is equal to **($2 - $1.60) × 1080 = $432**

- **Effect on consumer surplus:** the loss of the consumer surplus is **A + B + C** which is equal to **$648 + 0.5(72) = $684**

- **Effect on producer surplus:** the loss of producer surplus is represented by **D + E + F** and is equal to the producer burden plus the area of **D** which is **\$432 + 0.5(48) = \$456**

- **Welfare loss from the tax:** overall, the amount of both consumer and producer surplus in the cigarette market falls because of the tax

  - The total loss in consumer and producer surplus is \$1140

  - **Net welfare loss = ΔG + ΔCS + ΔPS**

    = \$1080 − \$684 − \$456

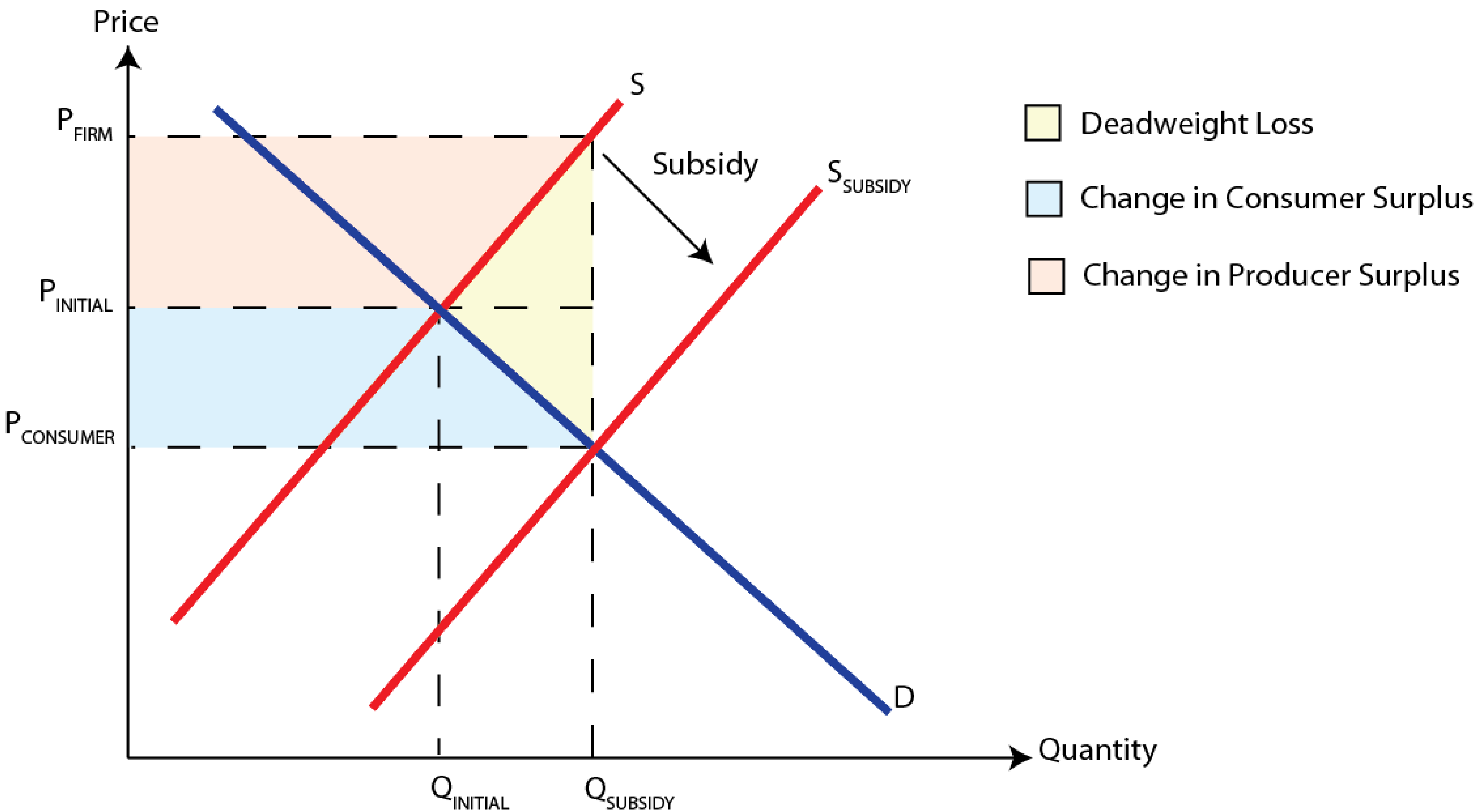
    = \$60

- The tax on cigarettes creates \$1080 of government revenue, but imposes a \$60 welfare loss to society

  - Since consumers and producers of cigarettes lose more welfare than society gains in tax revenue

Subsidies and Linear Functions

Recap- Subsidies



Subsidies and Linear Functions

- Linear functions can be used for the analysis of subsidies
- **Example;** Suppose the demand and supply of cotton can be modeled as follows, $\mathbf{Q_D = 30 - 4P}$ and $\mathbf{Q_S = 6 + 2P}$

Linear supply and demand schedules: Cigarettes		
Price (P)	**Quantity demanded (Q_D)**	**Quantity supplied (Q_S)**
6	6	18
4	14	14
3	18	12
2	22	10
1	26	8
0	30	6

- We can determine the equilibrium price and quantity, algebraically

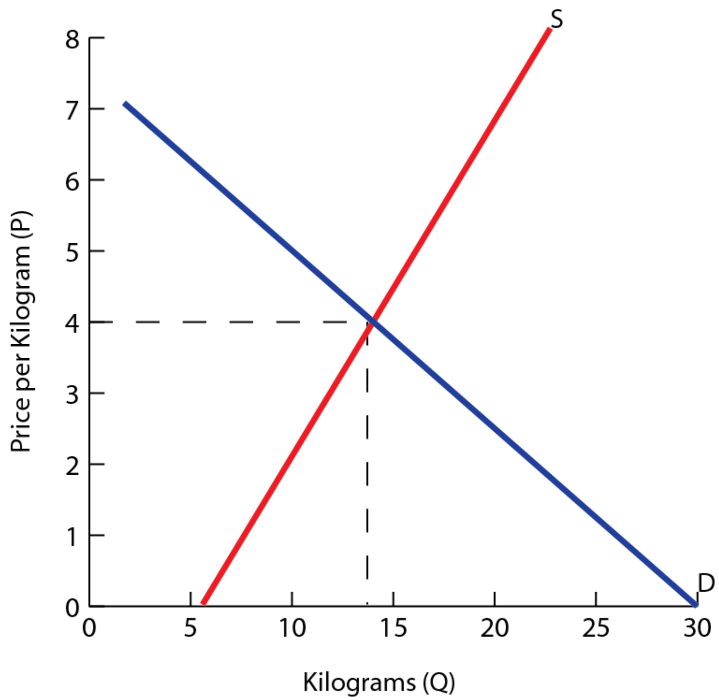
$$Q_d = Q_s$$

$$30 - 4P = 6 + 2P$$

$$6P = 24$$

Therefore, P_E = **\$4** and Q_E = **14 units**

Therefore the equilibrium price is $4 and the quantity is 14 units



Example; Subsidy on Cotton

- **Example;** Suppose the government places a $3 subsidy on each kilogram of cotton
  - The producers will now receive $3 more per kilogram produced than the price the consumers pay
  - The new supply function can be expressed as , $\mathbf{Q_S = 6 + 2(P + 3)}$ or by simplifying we get $\mathbf{Q_S = 12 + 2P}$
  - To determine the equilibrium after the price subsidy, we set the new supply function equal to demand

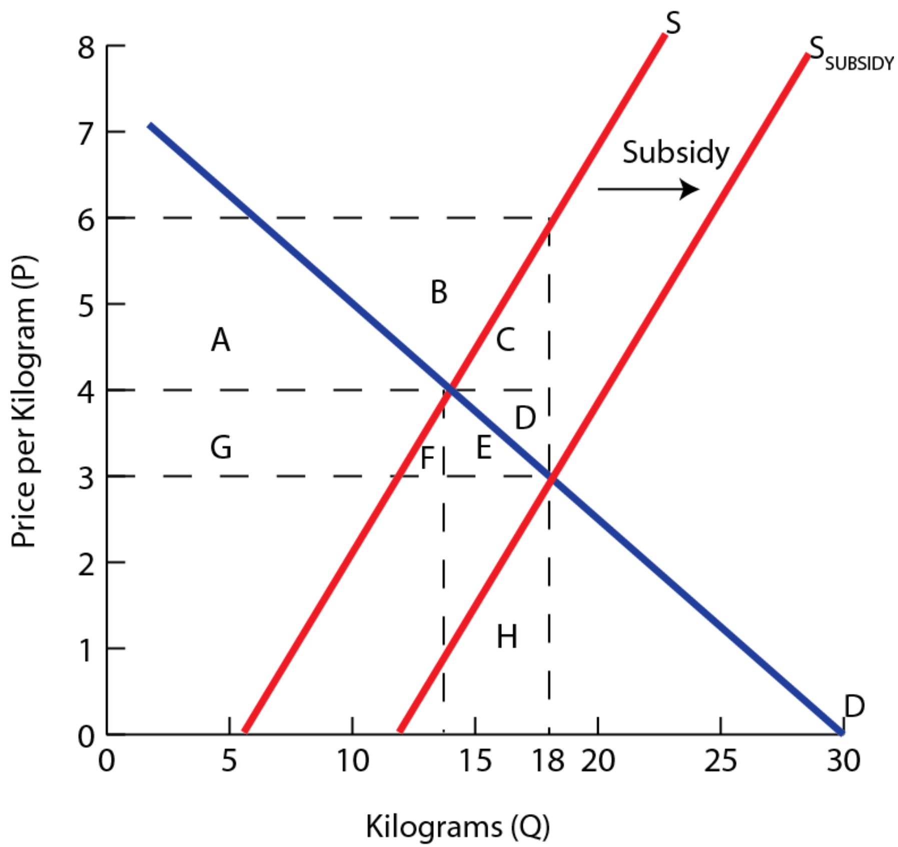
$$Q_d = Q_s$$

$$12 + 2P = 30 - 4P$$

$$6P = 18$$

Therefore, $P_E = \$3$ and $Q_E = 18$ **units**

Therefore the equilibrium price is $3 and the quantity is 18 units



Calculate

1) Government Spending
2) Δ Consumer Surplus
3) Δ Producer Surplus
4) Welfare Loss

- Both consumer and producer welfare increases as a result of a subsidy,

- **Change in consumer surplus:** the increase in the consumer surplus is **E + F + G** since consumers now enjoy a lower price and greater quantity. This is equal to **$16** million

- **Change in producer surplus:** the increase in producer surplus is **A + B** which is equal to **$32** million

- **Increase in total consumer and producer welfare:** the subsidy increases producer and consumer welfare by **$48** million

- We also need to take into the account the cost to taxpayers and society of subsidizing cotton grower

  - **Total cost of the subsidy:** is **A + B + C + D + E + F + G** and is equal to **$3 × 18 = $54** million

- **Net effect on welfare:** the cost of the subsidy was **$54** million, but the benefit was only **$48** million, so the net loss of welfare for society was **$6** million

- **Deadweight (welfare) loss:** is represented by the area of triangle **C + D** which is equal to **$6** million

- The subsidy creates a deadweight loss for society as a whole

  - The taxpayer money used to subsidize cotton growers exceeds the increase in cotton growers and consumers welfare by **$6** million