Pigouvian taxes (and subsidies)

Definition – Pigouvian Taxes are taxes levied to internalize a negative externality in a market. Pigouvian Subsidies are levied to internalize a positive externality in a market. Both methods correct an inefficient market by adjusting the quantity in the market to the socially optimal level.

Source: https://www.investopedia.com/terms/p/pigoviantax.asp

Intuition – If consuming or producing something in the market results in an unaccounted for cost to society, the government may want to make consuming or producing that good more expensive so we do less of it. Similarly, the government may want to make consuming or producing a good that has a benefit to society cheaper to produce or consume so society will do more of it.

Mathematical / Technical

Q^M, P^M: quantity and price at market equilibrium.

Q^*, P^*_{cons}: quantity and consumer price at the social equilibrium.

Q^*, P^*_{prod}: quantity and producer price at social the equilibrium.

Pigouvian Tax:

- $MC(Q)$: private Marginal Cost at any quantity Q.
- $SMC(Q)$: Social Marginal Cost at any quantity Q.
- The correct Pigouvian tax equals the difference between the prices on the SMC curve and the MC curve at Q^*. The price at Q^* on the SMC curve is P^*.

$$tax = SMC(Q^*) - MC(Q^*)$$

- The revenue collected is $tax \cdot Q^*$.

Pigouvian Subsidy:

- $MB(Q)$: private Marginal Benefit at any quantity Q.
- $SMB(Q)$: Social Marginal Benefit at any quantity Q.
- Pigouvian Subsidy amount equals the difference between the prices on the SMB curve and the MB curve at Q^*. The price at Q^* on the SMB curve is P^*. The consumer will pay the price at Q^* on the PMB curve.

$$subsidy = SMB(Q^*) - MB(Q^*)$$

- The total pay out is $subsidy \cdot Q^*$.

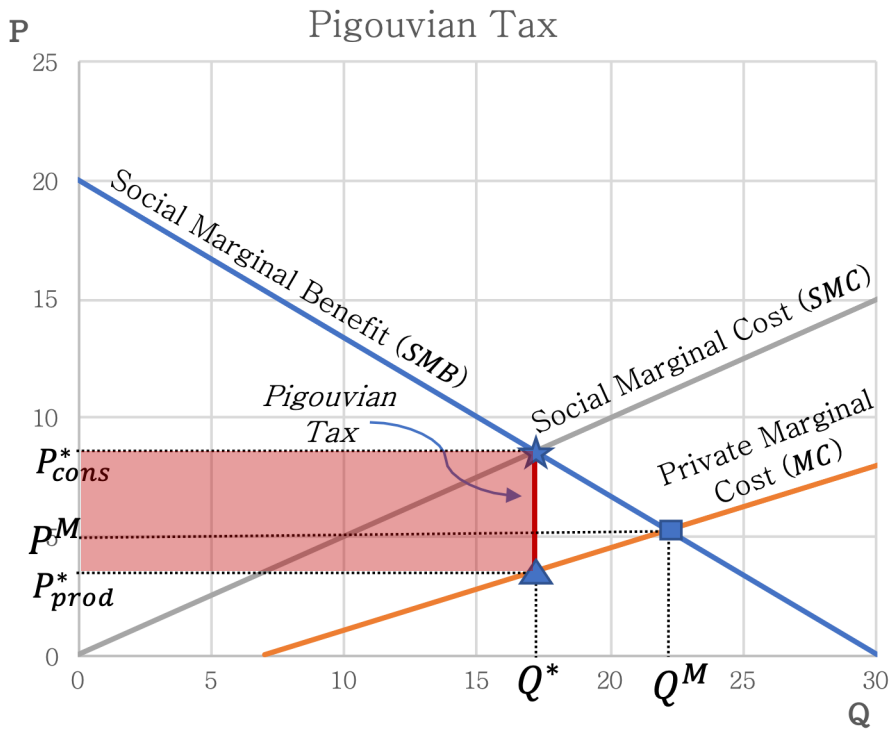
Real-world aspects – Gas Guzzler Taxes: Part of 1978 Energy Tax Act, gas guzzler taxes are extra taxes on cars with especially inefficient engines. The intent of these taxes are to reduce the production and consumption of inefficient passenger cars.[a]

Cigarette Taxes: States levy taxes on cigarette packs in an attempt to lower consumption. The states each set their own tax rates However, they have had mixed results in actually reducing tobacco consumption. There is evidence that higher tax rates lead to a small decrease in smoking. However, it would take a massive tax, around 100% to have a 5% reduction in cigarette consumption.[b]

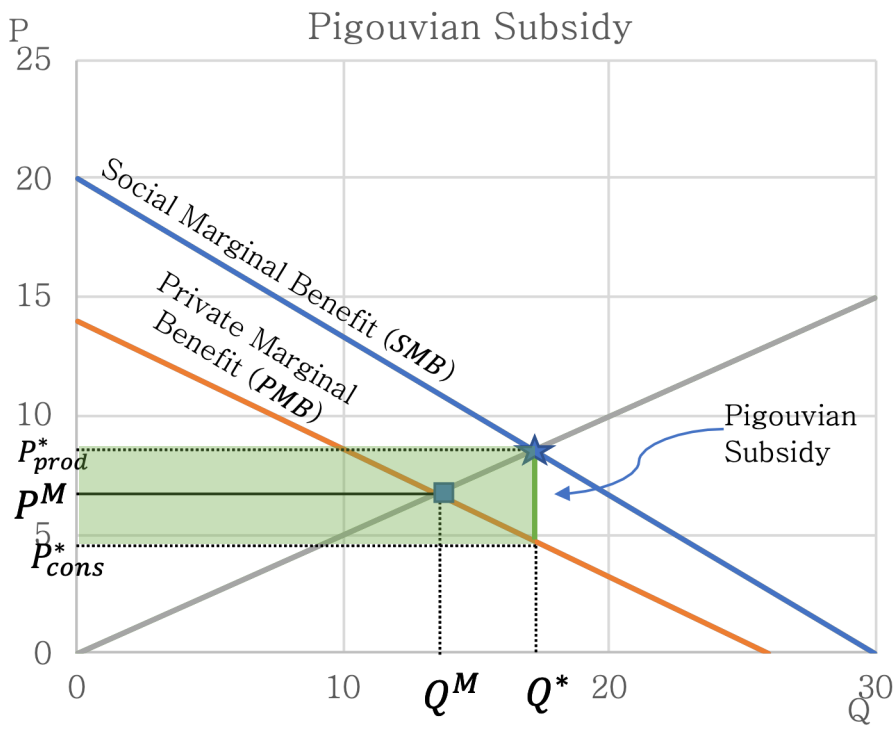
Sugar Sweetened Beverages: Tax on sugary drinks in an attempt to reduce consumption. A concern is that this tax could disproportionally harm low income families. Research has found that the benefits from implementing a tax on sugary beverages will outweigh the costs.[c]

Sources: [a] tinyurl.com/y6uoz663, [b] tinyurl.com/ydy2aw9q, [c] tinyurl.com/yc7okdwh

Graphical – Internalizing externalities with prices



Internalizing a negative producer externality with a Pigouvian tax. Q^M and P^M represent the market quantity and price, respectively. The Pigouvian tax raises consumer price to P^*_{cons}, and because of the law of demand, reduces quantity to Q^*, the socially optimal level. Tax revenues collected are $tax \cdot Q^*$, the red shaded rectangle.



Internalizing a positive consumer externality with a Pigouvian subsidy. The subsidy increases price to producers to P^*_{prod} but lowers the price that consumers pay to P^*_{cons}, thus the quantity increases to Q^*. The government must pay out the amount $subsidy \cdot Q^*$, the green shaded rectangle, thereby subsidizing all units, even those produced without the subsidy.

Practice questions –

1. Your town has a battery factory 1 mile away. Recent research shows this factory is releasing toxic chemicals into the air. Would a Pigouvian subsidy or tax be more appropriate for fix this inefficient market? Why?

2. Keeping hives of honey-bees costs \$1000/hive, the marginal benefit is $3000 - 2Q$. The social benefit per hive is constant. How big must the Pigouvian subsidy be to incentivize the socially optimal number of beehives, $Q* = 1050$, and why?

3. Smoking cigarettes is bad for others' health; it is estimated that smoking each additional pack of cigarettes costs others $\$4 + 0.5Q$ in future medical bills. $MC = 5$. $MB = 45 - 0.25Q$. How big must a Pigouvian tax be to reduce smoking down to the socially optimal level and why?

Numerical solutions: **2.** $subsidy$ = \$100/hive ; **3.** tax = \$27/pack.