Efficient and Equitable Taxation

EC313 - Public Economics: Taxation

Justin Smith

Wilfrid Laurier University

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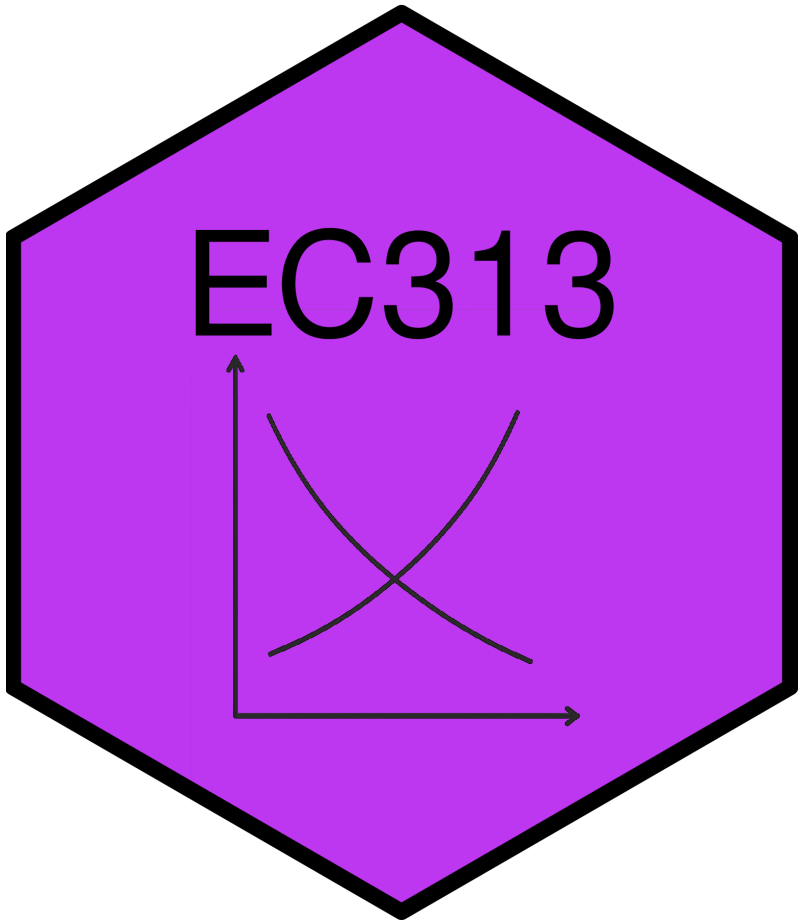

Goals of This Section

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- Discuss the effects of price changes on consumer behaviour
- Introduce the concept of excess burden of a tax
- Show how to measure excess burden using indifference curves
- Show how to measure excess burden using demand/supply curves
- Show equivalent interpretation with elasticities
- Discuss factors that affect excess burden

Optimal Taxation

Introduction

- As we have discussed, government raise taxes mainly to raise revenue
- But taxes involve costs
  - The direct cost of the revenue raised
  - Additional costs from distortions in behaviour (excess burden)
- Given that revenue needs to be raised, how should taxes be designed to minimize costs?
- Optimal taxation addresses this question

Model

- Question of optimal taxation is answered with a model
- A representative citizen consumes two goods, X and Y
  - Prices of these goods are P_X and P_Y
- Person can also work and earn wage w
  - Person has T hours available for work (h) or leisure (L)
  - These are the only two uses of time, so $T = h + L$
- Their budget constraint in this context is

$$w(T - L) = P_X X + P_Y Y$$

- Constraint says that income is split between spending on goods X and Y

Model

- If you rearrange the budget constraint, you can write it as

$$wT = P_X X + P_Y Y + wL$$

- Shows that "full income" is split between spending on goods X and Y and spending on leisure
  - Full income is wT because if all time was worked, income would be wT
  - Price of leisure is w because each hour of leisure foregoes w in earnings
- Suppose we tax goods X, Y, and L at rate t
- Then the budget constraint becomes

$$wT = (1+t)P_X X + (1+t)P_Y Y + (1+t)wL$$

Model

- Rearranging gives

$$wT = (1 + t)(P_X X + P_Y Y + wL)$$

$$\frac{wT}{1 + t} = P_X X + P_Y Y + wL$$

- In this setup, a tax on all goods and leisure is equivalent to a reduction in full income by a factor of $\frac{1}{1+t}$
  - We saw this in one of the practice questions

Model

- If we could tax all goods and leisure at the same rate, we would not distort behaviour
  - People would still choose the same combination of goods and leisure
- Why?
  - Because relative prices are unchanged
  - The commodity taxes are equivalent to a lump-sum tax that reduces income
- But in practice, we cannot tax all goods and leisure at the same rate
  - We cannot tax leisure directly
  - Can only tax X and Y in this setup
- Taxing some goods (X and Y) but not others (L) distorts relative prices and leads to excess burden

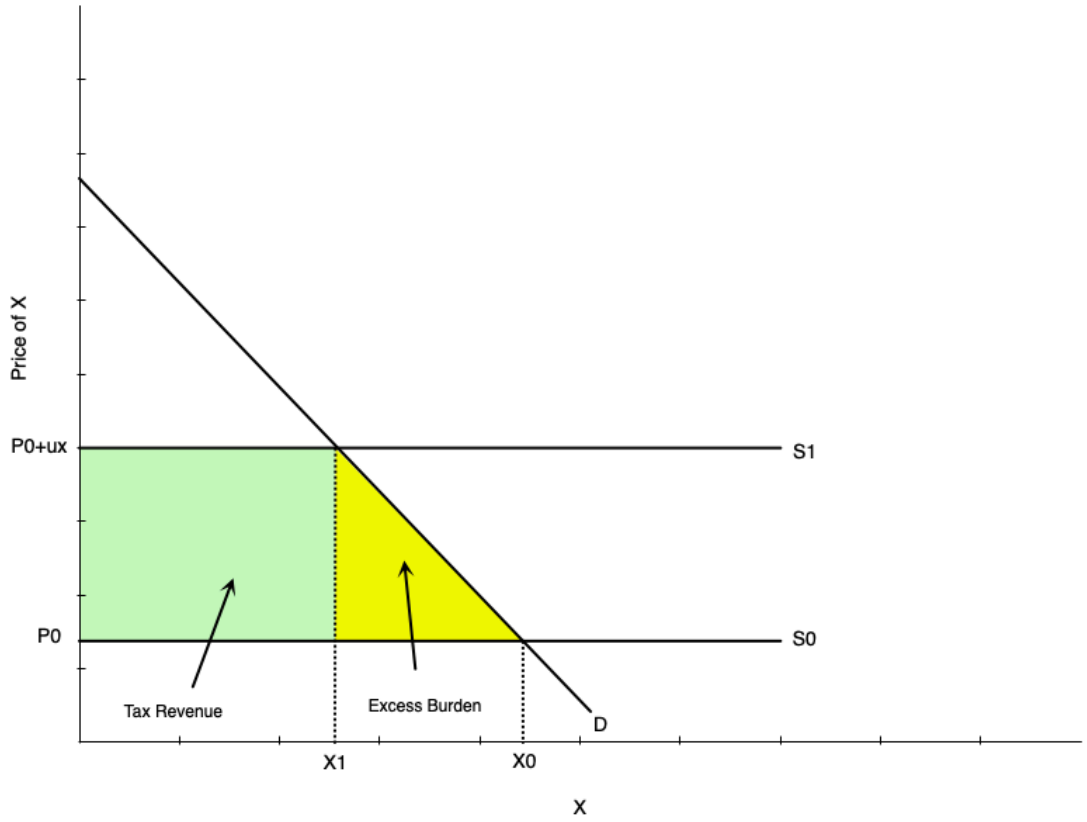
Ramsey Rule

- Question then becomes: If we cannot tax all goods at the same rate, how should we tax them?
- One option is **neutral taxation**: taxing X and Y at the same rate
  - This is simple and easy to administer
  - But it still distorts behaviour and creates excess burden
- The optimal method is the **Ramsey Rule**: tax goods so that the percent reduction in quantity demanded is the same for all goods
  - Equivalently, tax goods so that the marginal excess burden of the last dollar of revenue raised is the same for all goods
- The next few slides establish this result

Ramsey Rule

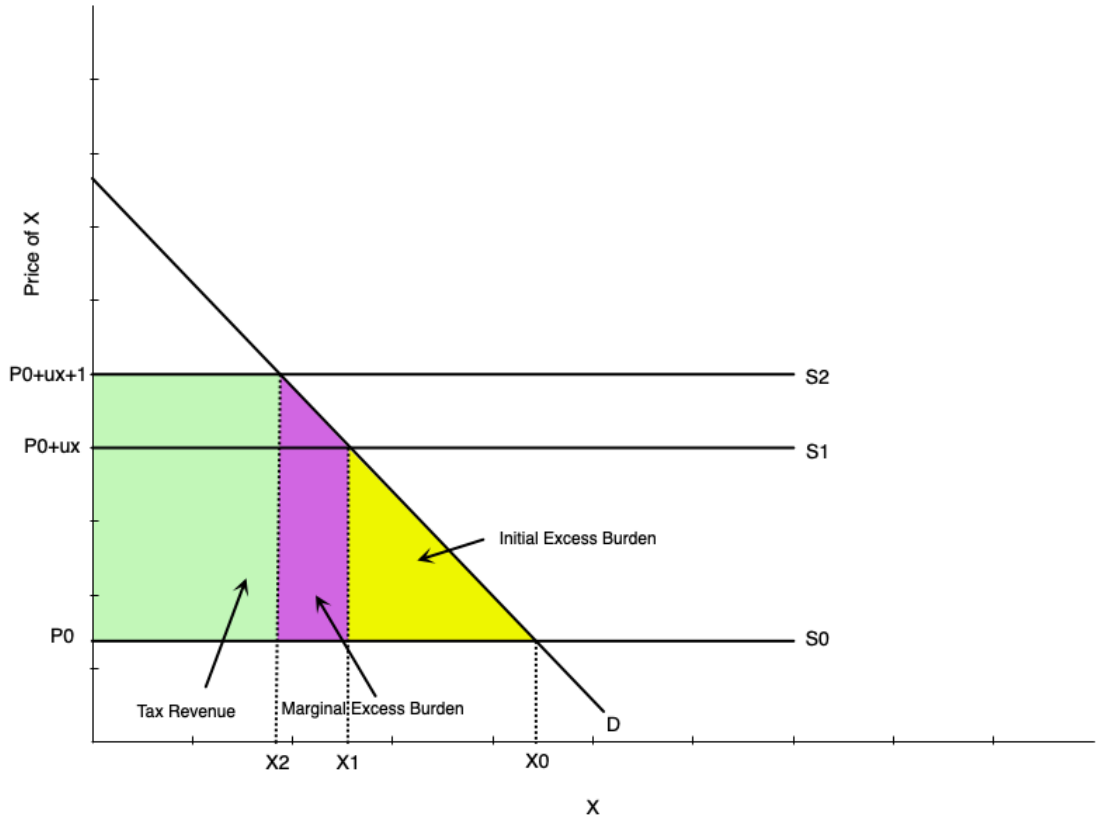
- Consider again two goods, X and Y, with prices P_X and P_Y
- Pretend that goods are neither substitutes nor complements
  - Simplifies the analysis because changes in their prices do not affect each other's demand
  - Results still hold for substitutes and complements, but analysis is more complex
- Also pretend the supply curve is horizontal
  - Consumers face the entire economic incidence of the tax
  - Again simplifies the analysis because we do not have to consider supply side effects
- Consider a unit tax u_X on good X

Ramsey Rule



- Consumer initially consumes X_0 at price P_0
- After tax u_X is imposed, price rises to $P_0 + u_X$
- Consumer reduces consumption to X_1
- As we have learned this involves an excess burden
  - Equals area of yellow triangle
  - Represents the loss in consumer surplus

Ramsey Rule



- Now imagine raising the tax further from u_X to $u_X + 1$
- The additional excess burden created is the **marginal excess burden**
  - Equals area of purple triangle
- Part of that excess burden was tax revenue (purple rectangle)
- Other part is additional loss in consumer surplus (purple triangle)

Ramsey Rule

- The marginal excess burden of the tax on good X is the purple area
  - Equals area of the purple triangle plus the purple rectangle
- To compute that mathematically, set $\Delta x = X_1 - X_2$
- The total area is then

$$(\frac{1}{2}\Delta x \times 1) + (\Delta x u_X)$$

- As noted in the textbook, if we pretend that $\frac{1}{2}\Delta x$ is very small, we can ignore it
  - So marginal excess burden is approximately $\Delta x u_X$

Ramsey Rule

- Going one step further, note that the slope of the demand curve is

$$\frac{u_X}{\Delta X} = \frac{1}{\Delta x}$$

  - $\Delta X = X_0 - X_1$, the initial change in quantity demanded from the initial tax
  - Both represent the rise over the run
- Rearranging gives

$$\Delta x u_X = \Delta X$$

- The marginal excess burden of the tax on good X is approximately ΔX
  - The change in quantity demanded from the initial tax

Ramsey Rule

- What about the change in revenue?
- Initially revenue was larger green rectangle plus purple rectangle
- After, it is larger green rectangle plus smaller green rectangle
- The marginal tax revenue is therefore the smaller green rectangle minus the purple rectangle

$$(X_2 \times 1) - (\Delta x u_X)$$

- We previously saw that $\Delta x u_X = \Delta X$
- We also know that $X_2 = X_1 - \Delta x$
- Subbing in gives us

$$X_1 - \Delta x - \Delta X$$

Ramsey Rule

- IF we pretend that Δx is very small, we can ignore it
  - So marginal tax revenue is approximately $X_1 - \Delta X$
- The marginal excess burden *per dollar of additional revenue* is

$$\frac{\Delta X}{X_1 - \Delta X}$$

- If we repeat this exact exercise for good Y, we find that the marginal excess burden per dollar of additional revenue is

$$\frac{\Delta Y}{Y_1 - \Delta Y}$$

Ramsey Rule

- If we set them equal

$$\frac{\Delta X}{X_1 - \Delta X} = \frac{\Delta Y}{Y_1 - \Delta Y}$$

- Which simplifies to the **Ramsey Rule**

$$\frac{\Delta X}{X_1} = \frac{\Delta Y}{Y_1}$$

- If you multiply both sides by 100 to express this as a percentage, it says percent change in quantity demanded of X equals percent change in quantity demanded of Y

Ramsey Rule with Elasticities

- Economists enjoy expressing things in terms of elasticities
- The price elasticity of demand is

$$\eta_X = \frac{\Delta X}{\Delta P_X} \times \frac{P_X}{X}$$

- Rearrange that to get

$$\frac{\Delta X}{X} = \eta_X \times \frac{\Delta P_X}{P_X}$$

- Substitute that into the Ramsey Rule to get

Ramsey Rule with Elasticities

- In this case, consider instead an ad valorem tax that makes the price rise to $P_X(1 + t_X)$
- The numerator of this fraction is then $\Delta P_X = P_X(1 + t_X) - P_X = P_X t_X$
- Substituting into the equation on the previous slide gives

$$\frac{\Delta X}{X} = \eta_X \times t_X$$

- the Ramsay Rule then becomes

$$\eta_X t_X = \eta_Y t_Y$$

- Equivalently

$$\frac{t_X}{t_Y} = \frac{\eta_Y}{\eta_X}$$

Ramsey Rule with Elasticities

- The **inverse elasticity rule** says that the optimal tax rate on a good is inversely proportional to its price elasticity of demand
  - If good Y has a high elasticity relative to good X, then t_X should be higher than t_Y
- Why?
  - Because a tax on a good with a high elasticity will cause a large reduction in quantity demanded
  - This creates a large excess burden
  - So to minimize excess burden, tax goods with high elasticities less

Corlett-Hague Rule

- Recall that we could not tax leisure directly
  - And therefore could not apply an efficient (lump-sum equivalent) tax
  - This created the excess burden
- Corlett-Hague suggest approximating a leisure tax by taxing goods that are complements (used together with) to leisure
  - Examples: tax sporting equipment, household appliances, recreational vehicles, etc.
- This indirectly lowers demand for leisure and acts like a tax on leisure
- Gets us a bit closer to the most efficient outcome

Equity in Taxation

- Ramsey rule implies taxing goods that are inelastic more heavily
- Makes sense when those goods are socially undesirable (e.g., cigarettes, alcohol)
- But what if those goods are necessities (e.g., food, clothing, housing, medicine)?
- Problematic for a few reasons, but one is that it lacks **vertical equity**
  - Vertical equity: people with greater ability to pay should pay more in taxes
- You can modify the Ramsey rule to account for vertical equity
  - A modified rule may tax necessities less heavily
  - Essentially allows for larger excess burden to achieve greater equity

Summary

- In the real world we cannot achieve the efficient outcome of a lump-sum tax to raise government revenue
- Distortionary taxes change behaviour and create an excess burden
- We can design the tax system to minimize the excess burden
- The Ramsey rule gives that optimal design
- But tax efficiency is not the sole consideration
  - Equity is also important
  - The optimal rule can change to account for equity considerations

References

References

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