

## Module 10

### Lecture 37

#### Topics

10.21 Optimal Commodity Taxation

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10.30 Optimal Income Taxes

#### 10.21 OPTIMAL COMMODITY TAXATION

- Now combine lessons on incidence and efficiency costs to analyze optimal design of commodity taxes
- What is the best way to design taxes given equity and efficiency concerns?
- Note that two factors must be balanced when setting optimal commodity taxes:  
*The **elasticity rule**:* Tax commodities with low elasticities.  
*The **broad base rule**:* It is better to tax a wide variety of goods at a lower rate, because deadweight loss increases with the square of the tax rate.  
Thus, the government should tax all of the commodities that it is able to, but at different rates.  
How to determine these rates? → Ramsey Rule

- Note:
  - Optimal commodity tax literature focuses on linear (t.x) tax system
  - Non-linear (t(x)) tax systems considered in income tax literature

## 10.22 OPTIMAL TAX THEORY: RAMSEY RULE

- Ramsey Tax Problem (1927)
- Government sets taxes on uses of income in order to accomplish two objectives:
  - Raise total revenue of amount R
  - Minimize utility loss for agents in economy

## 10.23 RAMSEY MODEL

Key Assumptions

- Lump sum taxation prohibited
- Cannot tax all commodities (leisure untaxed)
- Production prices fixed (and normalized to 1)
- The goal of the Ramsey Rule is to minimize deadweight loss of a tax system while raising a fixed amount of revenue.

## 10.24 RAMSEY RULE TO INVERSE ELASTICITY RULE

- The Ramsey Rule is:

$$\frac{MDWL_i}{MR_i} = \lambda$$

$$\Rightarrow \text{Tax rate} = \frac{\lambda}{\text{elasticity of demand}}$$

- It sets taxes across commodities so that the ratio of the marginal deadweight loss to marginal revenue raised is equal across commodities.
- The **inverse elasticity rule**, which expresses the Ramsey result in an elasticity form, allows us to relate tax policy to the elasticity of demand.

- The government should set taxes on each commodity inversely to the demand elasticity.
  - Less elastic items are taxed at a higher rate.

## 10.25 RAMSEY RULE: DERIVATION

The purpose of the government is to raise a certain level of revenue & the aim is to collect this revenue most efficiently i.e. to minimize the DWL in raising the revenue. So the problem is to min DWL subject to the Revenue constraint:

$$\begin{aligned} \min_{t_i} & (DWL_1 + DWL_2 + \dots + DWL_n) \\ \text{s.t. (Revenue target)} & \underline{R} = R_1 + R_2 + \dots + R_n \end{aligned}$$

$R_i$  = Revenue raised by tax in good i.

The government chooses a set of tax rates  $t_i$  to solve this optimization problem.

Thus, the objective function of the Ramsey problem is:

$$(DWL_1 + \dots + DWL_n) - \lambda(R_1 + R_2 + \dots + R_n - \underline{R})$$

First Order Conditions with respect to tax rate  $t_i$  can then be written as:

$$\begin{aligned} & \frac{\partial(DWL_1)}{\partial t_1} - \lambda \frac{\partial R_1}{\partial t_1} = 0 \\ \rightarrow & \quad \quad \quad \vdots \\ & \frac{\partial(DWL_i)}{\partial t_i} - \lambda \frac{\partial R_i}{\partial t_i} = 0 \\ \Rightarrow & \boxed{\frac{MDWL_i}{MR_i} = \lambda \forall i.} \text{ Ramsey Rule} \end{aligned}$$

Where  $MDWL_i$  is marginal Dead weight loss from  $tax_i$  and  $MR_i$  is the marginal revenue from  $tax_i$ .

Recall:

$$DWL = \frac{1}{2} \frac{e_s \cdot e_d}{e_s - e_d} * t^2 * \frac{Q}{P}$$

For competitive market with perfectly elastic supply

$e_s \rightarrow \infty$  & normalize prices so that  $P = 1$

$$\Rightarrow DWL = -\frac{1}{2} e_d * t^2 * Q$$

$$\Rightarrow MDWL = -e_d \cdot t \cdot Q$$

Since,  $\frac{MDWL}{MR} = \lambda$ ,  $\lambda$  is the value of additional government revenues.

Therefore,

$$\Rightarrow \frac{-e_d \cdot t \cdot Q}{Q} = \lambda \quad \left[ \text{Note that; } MR = \frac{d}{dt}(Qt) = Q \right]$$

$$\Rightarrow \boxed{t = -\frac{1}{e_d} \cdot \lambda} \rightarrow \text{Inverse Elasticity Rule}$$

## 10.26 RAMSEY RULE: APPLICATION

- An interesting application of these rules is price reform in Pakistan.
- Deaton (1997) found that the Pakistan government was paying subsidies for wheat and rice, and was collecting taxes on oils and fats.

### Demand for Various Commodities in Pakistan

| Good    | Subsidy | Price Elasticity |
|---------|---------|------------------|
| Wheat   | 40%     | -0.64            |
| Rice    | 40%     | -2.08            |
| Oil/Fat | -5%     | -2.33            |

- The subsidies generate overconsumption of wheat and rice, and lead to particularly large efficiency losses for rice.
- The tax on oils/fats also generates deadweight loss.
- Using a framework similar to Ramsey's, Deaton suggested a tax reform that would increase efficiency and be revenue neutral: reduce the tax on oils and fats, and make up for the lost tax revenues by reducing the subsidies to rice and wheat.
- However, Deaton also found that distributional considerations might offset some of these conclusions.

- Wheat and fats/oils were consumed quite heavily by the poor, but rice was consumed fairly evenly throughout the income distribution. This suggests not to decrease the wheat subsidy on equity grounds.

## 10.27 OPTIMAL INCOME TAXATION

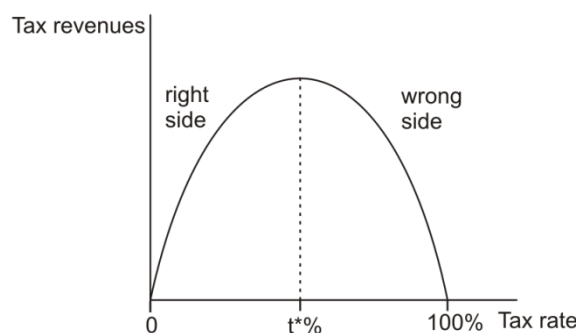
- In most countries income tax is a bigger component of government revenue than commodity taxation
- In designing optimal income tax, the concern is still to minimize **efficiency** loss subject to revenue requirements
- However, **equity** is also an important consideration while designing income taxes. Generally there are equity efficiency tradeoffs.

## 10.28 OPTIMAL INCOME TAXES: BEHAVIORAL EFFECTS

- Raising tax rates will likely affect the size of the tax base. Raising tax rate on labor income has two effects:
  - Tax revenues rise for a given level of labor income.
  - Workers reduce their earnings, shrinking the tax base.
- At high tax rates, this second effect becomes important.

## 10.29 LAFFER CURVE

- This relationship between tax rates and tax revenue is summarized by the **Laffer curve** – part of supply-side economics.
- If tax rates are too high and we are on the wrong side of the Laffer curve, lowering tax rates increases revenue.



The Laffer curve demonstrates that at some point, tax revenue falls.

**Figure 37.1**

At very low tax rates, workers will choose to work in order to generate income. These low taxes raise revenue because they are assessed on a large base. As tax rates increase, however, the tax base will eventually begin to shrink. The tax base is the number of hours workers choose to work times their wages. As taxes increase, workers cut back on hours worked, reducing the size of the tax base and ultimately the total tax revenue generated. It is clear that a tax of zero will raise no revenue and that a 100% marginal tax rate will completely deter work. It is not completely clear, however, where in the wide range between zero and 100% the work deterrence effects of a high marginal tax rate offset the revenue generation of high taxes. This, in the end is an empirical question:

### 10.30 OPTIMAL INCOME TAXES

The goal of optimal income tax analysis is to identify a tax schedule that maximizes social welfare, while recognizing that raising taxes has conflicting effects on revenue.

- The condition for optimal income tax is similar to the one for commodity tax - tax rates are set across groups such that:

$$\frac{MU_i}{MR_i} = \lambda$$

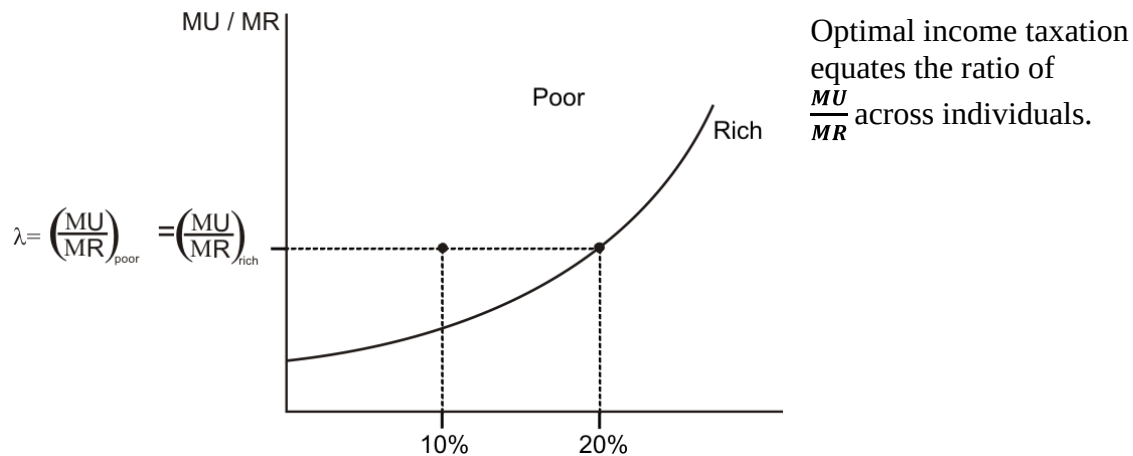
- Where  $MU_i$  is the marginal utility of individual  $i$  from income/consumption and  $MR$  is the marginal revenue from taxing that individual.
- However, as with optimal commodity taxation, this relationship represents a compromise between two considerations:
  - **Vertical equity:** Social welfare is maximized when people with low marginal utility (high levels of consumption) are taxed more than people with high marginal utility (low levels of consumption), for the same level of tax revenue
  - **Behavior responses:** As taxes rise on a group, people in that group respond by working less – reducing the size of the tax base and hence tax revenue.

$$\begin{array}{l} \max_{t_i} V = \sum u_i \\ \text{st. } \sum R_i = \underline{R} \end{array}$$

$$\Rightarrow \text{FOC: } \frac{MU_i}{MR_i} = \lambda$$

Recall that:

In commodity taxation the tradeoff is between: tax inelastic commodities more and spread taxes broadly to minimize tax rates.



**Figure 37.2**

- Figure 37.2 shows that optimal income taxation equates the MU – MR ratio across individuals, leading to a higher tax rate for the rich.
- Start from a situation when there is no tax: the government wants to introduce a small tax of 1%. In this situation MU/MR is much lower for a rich person than for a poor person because the rich is already at a very high consumption so MU low and marginal revenue collected high.
- So MU/MR is much lower for rich
- As we tax the rich more, the ratio MU/MR rises. MU rises since consumption is falling and MR falls since behavioral response means that labor supply falls and hence taxable income base falls.
- The simultaneous rise in MU and fall in MR with higher taxes raises the MU/MR ratio at an increasing rate. So the curves slope up at increasing rate.
- At some point when tax rate for the rich is high enough, for a specific rate on the poor, their MU/MR will be above that of the rich.