Lectures 9 and 10: Optimal Income Taxes and Transfers

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Lecture Notes for Ec426

Agenda

1. Redistribution vs. Efficiency
2. The Mirrlees optimal nonlinear income tax problem:
    1. The optimal high-income tax rate
    2. The general optimal nonlinear income tax
3. Commodity vs income taxation [Atkinson-Stiglitz]
4. Optimal transfer programs

The Two Fundamental Theorems of Welfare Economics

- **First Theorem**: Under (*i*) perfect competition, (*ii*) no externalities/internalities, and (*iii*) perfect information, the competitive equilibrium is Pareto efficient.

- **Second Theorem**: Under (*i*) convex preferences and technology, (*ii*) no externalities/internalities, and (*iii*) perfect information, any Pareto efficient allocation can be achieved as a competitive equilibrium with appropriately selected endowments.

Efficiency vs Equality

Is there a trade-off between efficiency and equality?

- Not according to the second welfare theorem, which says that *any* Pareto efficient allocation can be achieved as an equilibrium
- A strong assumption is made: The government can observe and redistribute exogenous endowments using individual lump-sum taxes/transfers
- In practice, redistribution takes place through taxes, not on endowments, but on choices. Such taxes are distortionary and lead to Pareto inefficiency $\Rightarrow$ a trade-off between efficiency and equality

First Best vs Second Best

- Consider model with heterogeneity in innate ability (the endowment in the second welfare theorem)
- A **first-best** redistribution scheme is based on innate ability.
- However, ability is known only to the individual (**asymmetric information**). The government observes earnings instead
- Because earnings are a choice variable, earnings-based redistribution induces high-ability individuals to reduce earnings and "masquerade" as low-ability individuals
- Optimal income tax theory analyzes the **second-best** redistribution scheme - given the information constraint

The Mirrlees Paper

Mirrlees (1971) is the first rigorous treatment of optimal income taxation

- It is the central paper in modern public finance (Nobel prize in 1996)
- Widely known paper because it started the literature on asymmetric information (moral hazard and adverse selection)
- Hugely influential in mechanism design, contract theory, IO, auction theory, etc.

Individuals

A continuum of individuals with heterogeneous and exogenous skill w distributed according to $f(w)$, $F(w)$ solve the following problem

$$\max_h u(wh - T(wh), h)$$

$$\text{FOC:} \qquad w(1 - T'(wh))u'_c + u'_h = 0 \;\Rightarrow\; h = h(w)$$

- Perfect competition and linear technology $\Rightarrow$ skill = wage rate
- Individuals have identical preferences $u(c, h)$
- Budget is $c = wh - T(wh)$
- $T(\cdot)$ is a general tax function (embodying transfers)

Government

The government solves the problem

$$\max_{T(.)} W = \int_{\underline{w}}^{\bar{w}} \Psi\left(u\left(wh - T\left(wh\right), h\right)\right) f\left(w\right) dw$$

$$\text{subject to} \int_{\underline{w}}^{\overline{w}} T(wh) f(w) dw \geq R \qquad \text{[GBC, multiplier } \mu\text{]}$$

$$\text{and} \quad w(1 - T'\left(wh\right)) u'_c + u'_h = 0 \quad \text{[IC]}$$

- Additively separable Bergson-Samuelson social welfare function $\Psi\left(.\right)$ where $\Psi' > 0$, $\Psi'' \leq 0$
- This formulation assumes the Spence-Mirrlees single crossing condition (see Salanie (2003) for details)

Results In The Early Literature

Mirrlees (1971) solved the general problem using the Hamiltonian approach

- Formulas are complex and hard to interpret. Very few results on the shape of optimal tax schedules

Three results in the early literature:

1. Optimal marginal tax rate is zero at the top [Sadka (1976); Seade (1977)]
2. Optimal marginal tax rate is zero at the bottom if the lowest skill is positive and everybody works [Seade (1977)]
3. Optimal marginal tax rates are always between 0 and 1 [Seade (1977)]

Recent Literature

Piketty (1997), Diamond (AER 1998), and Saez (RES 2001):

- Relate optimal tax formulas to labor supply elasticities.
- Link theory to data on income distributions and empirical elasticities
  - Allow for statements about the optimal marginal tax rate profile
- Perturbation approach to deriving optimal tax formulas (considering small tax reforms around the optimum)

Before considering the full optimal tax schedule, we will consider an easier subproblem: what is the optimal high-income tax rate?

Derivations I

- Assume a constant marginal tax rate τ above a given income level $\bar{z}$
- Individuals $i = 1, ..., N$ in the top bracket where individual i has earnings $z^i \geq \bar{z}$
- Mean income is $z_m \equiv \frac{\sum_i z^i}{N}$
- Assume no income effects so that $z^i = z^i\,(1-\tau)$
- Earnings elasticity $\varepsilon^i \equiv \frac{dz^i/z^i}{d(1-\tau)/(1-\tau)}$. Assume $\varepsilon^i = \bar{\varepsilon}$ at the top
- Denote by μ the marginal value of public funds, by α^i the social marginal utility of income to individual i, and define $g^i \equiv \alpha^i/\mu$. Assume $g^i = \bar{g}$ at the top

Derivations II

Raise τ slightly by $d\tau$. Three effects on social welfare:

1. Mechanical revenue effect:
$$dM = \sum_i (z^i - \bar{z}) \cdot d\tau = [z_m - \bar{z}] \cdot N \cdot d\tau$$

2. Behavioral revenue effect:
$$dB = \sum_i \tau \cdot dz^i = -\bar{\varepsilon} \cdot \frac{\tau}{1-\tau} \cdot z_m \cdot N \cdot d\tau.$$

3. Direct welfare effect:
$$dW = -\bar{g} \cdot dM$$

At the optimum, we must have $dM + dB + dW = 0$

The Marginal Tax Rate

The optimal top marginal tax rate:

$$\frac{\bar{\tau}}{1-\bar{\tau}} = \frac{1}{\bar{\varepsilon}} \cdot \left[\frac{z_m - \bar{z}}{z_m}\right] \cdot [1 - \bar{g}]$$

where $\frac{z_m - \bar{z}}{z_m} \in [0, 1)$ depends on the income distribution, and reflects the relative strength of mechanical and behavioral effects

The optimal marginal tax rate $\overline{\tau}$ is

1. decreasing in the social welfare weight on the rich $\bar{g}$
2. decreasing in the earnings elasticity at the top $\bar{\varepsilon}$
3. increasing in the income distribution variable $\frac{z_m - \bar{z}}{z_m}$

No Distortion At The Top

- To obtain the tax rate at the upper bound of the income distribution, let the threshold $\bar{z}$ be equal to the upper-bound income
  - In this case, we have $z_m = \bar{z}$ so that $\frac{z_m - \bar{z}}{z_m} = 0 \;\Rightarrow\; \bar{\tau}$ is zero at the top
- This result holds even when the gov't does not value the marginal consumption of the rich ($\bar{g} = 0$)
- Intuition: Close to the upper bound, the mechanical welfare gain of raising taxes, $(1 - \bar{g})dM$ is negligible relative to the behavioral welfare loss dB

Practical Relevance Of Zero Top Rate

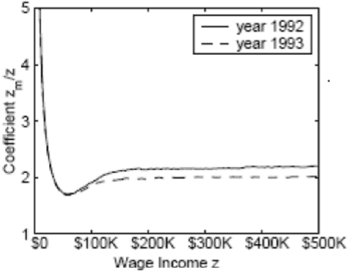
Examine $(z_m - \bar{z})/z_m$ in empirical earnings distributions

- For the U.S., Saez (2001) shows that $z_m/\bar{z} \approx 2$ (so that $(z_m - \bar{z})/z_m \approx 0.5$) from \$150,000 to \$30 million
- Distributions with constant $(z_m - \bar{z})/z_m$ are Pareto distributions
- In general, upper tails of empirical distributions are roughly Pareto
- Pareto distribution: $\text{Prob}(\text{income} \geq z) = k/z^a$ where $a > 1$ measures the thinness of the upper tail
- We have $(z_m - \bar{z})/z_m = 1/a$

No-distortion-at-the-top result is not practically relevant as $(z_m - \bar{z})/z_m$ starts dropping to zero only at extreme incomes.

- The top-bracket in a piecewise linear system would not be affected by the result

RATIO $Z_m/\bar{Z}$ IN THE UNITED STATES, 1992-93



Source: Saez (2001)

Soaking The Rich

- With a Pareto tail and in the special case where $\overline{g} = 0$, we have

$$\overline{\tau} = \frac{1}{1 + a\overline{\varepsilon}}$$

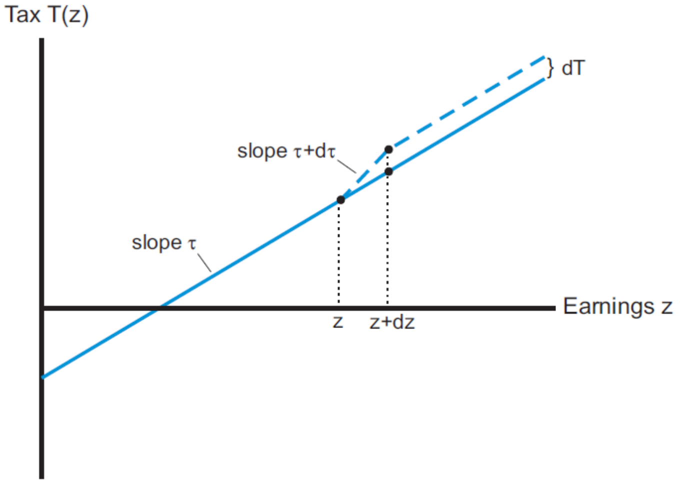
- This is the top Laffer rate and generalizes the formula for the flat/linear revenue maximizing tax rate $\frac{1}{1+\varepsilon}$
- If the gov't does not value the marginal consumption of the rich, it will collect as much revenue as possible from them
- This would be optimal for a Rawlsian social planner who cares only about the worst-off individuals in society

General Optimal Non-Linear Income Tax

General Mirrlees problem: Determine the tax function $T(z)$ at each z [see Diamond (1998)]

- Assume no income effects, $\varepsilon(z) = \frac{\partial z}{\partial(1-\tau(z))}\frac{1-\tau(z)}{z}$
- Normalize total population to 1. Earnings distributed according to distribution function $F(z)$ and density function $f(z)$
- Denote by $g(z) \equiv \frac{\alpha(z)}{\mu}$ the social marginal value of consumption (in terms of public funds) for taxpayers at income z. Define $G(z) \equiv \frac{\int_z^\infty g(s)f(s)ds}{1-F(z)}$
- Consider a perturbation around the optimum: Increase marginal tax rate $\tau \equiv T'(z)$ by a small amount $d\tau$ in a small interval $(z, z+dz)$

PERTUBATION AROUND THE OPTIMAL TAX SCHEDULE



Effects of Small Tax Reform

1. Mechanical revenue effect:

$$dM = dz \cdot d\tau \cdot (1 - F(z))$$

2. Behavioural revenue effect:

$$dB = -\varepsilon(z) \cdot \frac{d\tau}{1-\tau} \cdot z \cdot \tau \cdot f(z) dz$$

3. Direct welfare effect:

$$dW = -\int_z^\infty g(s) \cdot dz \cdot d\tau \cdot f(s) ds = -G(z) \cdot dM$$

At the optimum, we must have that $dM + dB + dW = 0$

Optimal Marginal Tax Rates

A general characterization of the optimal tax structure:

$$\frac{\tau(z)}{1-\tau(z)} = \frac{1}{\varepsilon(z)} \cdot \left[\frac{1-F(z)}{zf(z)}\right] \cdot [1-G(z)] \qquad (1)$$

This is the Diamond (1998) optimal tax formula

Three elements determine marginal tax rates:

1. The earnings elasticity $\varepsilon(z)$
2. The shape of the income distribution captured by $\frac{1-F(z)}{zf(z)}$
3. Social marginal welfare weights $G(z)$

Optimal Marginal Tax Profile

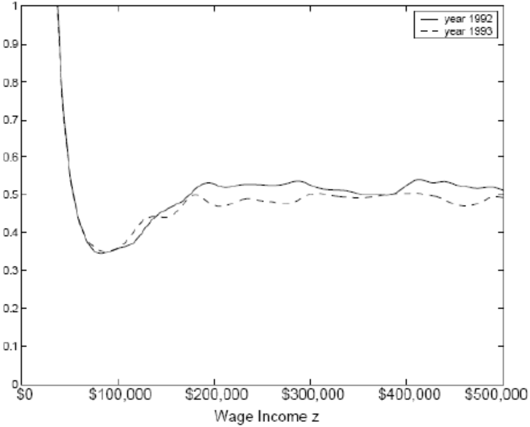
Consider the hazard ratio $r(z) \equiv \frac{1-F(z)}{zf(z)}$:

- At the bottom, $r(z)$ is very high $\Rightarrow \tau(z)$ is very high
- At the top, for a Pareto distribution, we have $r(z) = \frac{1}{a}$
- Empirically, $r(z)$ is strongly decreasing at the bottom, weakly increasing at the middle, and constant at the top

Consider redistributive tastes:

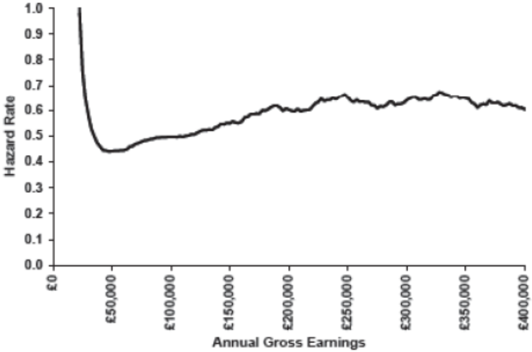
- $G(z)$ is decreasing in z and tends to $\overline{g}$ at the top $\Rightarrow \tau$ increasing other things equal
- Rawlsian case: $G(z) = 0 \Rightarrow$ Laffer rate at each z

HAZARD RATIO [1-F(z)]/[zf(z)] IN THE US, 1992-93



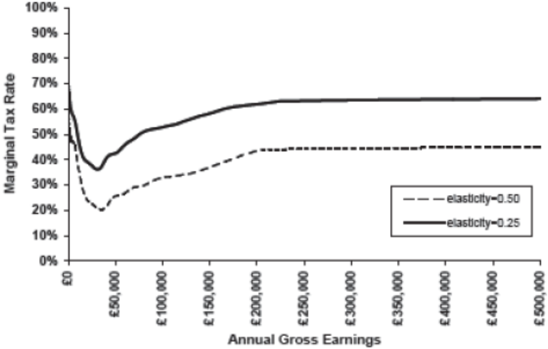
Source: Saez (2001)

HAZARD RATIO [1-F(z)]/[zf(z)] IN THE UK, 2003-04



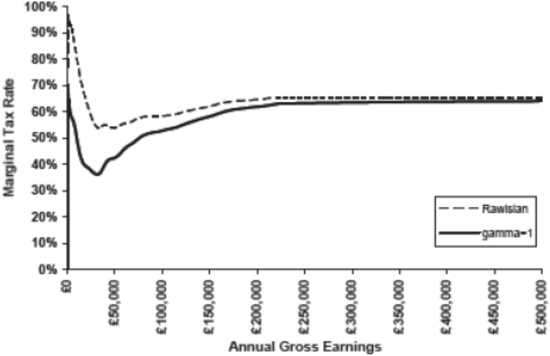
Source: Brewer-Saez-Shepard (2009)

OPTIMAL MARGINAL TAX RATES THE UK (ELASTICITY SENSITIVITY)



Source: Brewer-Saez-Shepard (2009)

OPTIMAL MARGINAL TAX RATES THE UK (REDISTRIBUTIVE TASTE SENSITIVITY)



Source: Brewer-Saez-Shepard (2009)

Income vs Commodity Taxation

Two models:

1. Commodity Taxation: Ramsey model considers differentiated linear tax rates on goods. Many-person extension introduces redistributive motives that call for further differentiation
2. Income Taxation: Mirrlees model calls for progressive non-linear taxation of income

Should we have a mix of both, or only one of them, in order to maximize social welfare?

- This question was first analyzed by Atkinson-Stiglitz (1976), who found a condition under which we don't need commodity taxes

Atkinson-Stiglitz Result

- Utility $u^i = u^i(c_1, ..., c_N, z)$
- Budget $p_1 c_1 + ... + p_N c_N \leq z - T(z)$ where $p_k = q_k + t_k$ and $T(\cdot)$ is a general nonlinear income tax
- Under weak separability of goods and labor plus homogenous preferences for goods, i.e. $u^i = u^i(v(c_1, ..., c_N), z)$, there is no need for commodity taxation
- In this case, the consumption pattern depends only on net-of-tax income, not on type i
- Hence, any redistribution achieved by commodity taxes can be achieved by an income tax and no distortion of commodity prices

Deviations from Atkinson-Stiglitz Result

A positive tax on good k is optimal if

1. Good k is a leisure complement
   - At a given income level, high-ability types have more leisure than low-ability types
   - Hence, a tax on leisure complements can achieve a redistribution across skill levels at a given level of after-tax income
   - Example: Vacation trips. Counter-example: Work uniforms
2. High-skilled types have a higher taste for good k (conditional on income)
   - Again, taxing those goods can achieve a redistribution across skill at a given level of after-tax income
   - Example: Modern art museums. Counter-example: Cigarettes

Application: Capital vs Labor Taxation

- For simplicity, consider the standard 2-period model where individuals work in period 1 and live off savings in period 2
- Utility $u^i = u^i(c_1, c_2, z)$ where c_k is consumption in period k
- Life-time budget constraint $c_1 + \frac{c_2}{1+r(1-t_c)} = z - T(z)$, where t_c is a tax on capital
- Notice that a capital tax works like a differentiated commodity tax with a higher tax on future than on present consumption
- This framework is a special case of the Atkinson-Stiglitz framework

Application: Capital vs Labor Taxation

- Standard specification in macro

$$u^i = u(c_1) + \rho \cdot u(c_2) - v\left(\frac{z}{w_i}\right) \quad (2)$$

  where ρ is the discount factor and w_i is the wage rate (skill) of type i

- (2) satisfies the Atkinson-Stiglitz condition $\Rightarrow$ optimal capital tax is zero; we should tax only labor income
- The controversial part of (2) is not so much separability, but that ρ, $u(\cdot)$ are common across skills
  - This implies that savings provide no signal of skill conditional on earnings and is not helpful for redistribution
- Empirical evidence: Savings propensities are correlated with education (skill) conditional on income, calling for a positive capital tax

Income Transfers in the Mirrlees Model

- The Mirrlees model characterizes the income tax net of transfers at each income level, $T(z)$
- For a government with redistributive preferences, we would have $T(0) < 0$
- We can think of the T-schedule as the combination of (i) an out-of-work transfer $-T(0)$, and (ii) a pattern of marginal tax rates $T'(z)$, showing how the transfer is taxed away as earnings increase
- Our analysis of (ii) shows that $T'(z)$ is very high at the bottom: a redistribution scheme with out-of-work cash transfers that are taxed away rapidly as earnings increase (means-tested cash transfers)

Literature on Transfer Programs

Can we do better than means-tested cash transfers to those out of work?

- Means-tested vs categorical programs (tagging) [Akerlof 1978]
- Out-of-work vs in-work-benefits [Saez 2002]
- Cash vs in-kind programs [Nichols-Zeckhauser 1982]
- Ordeal mechanisms [Nichols-Zeckhauser 1982]

Tagging

If we can identify individual characteristics that are

1. Observable to the government
2. Negatively correlated with ability
3. Immutable for the individual (unresponsive to incentives)

then targeting benefits to such characteristics is optimal

- (1) makes this form of targeting feasible
- (2) ensures that we redistribute from high- to low-ability
- (3) ensures that there is no efficiency cost associated with this redistribution

Tagging in Practice

- We are looking for characteristics that are (1) observable, (2) correlated with earnings capacity, and (3) immutable?
- Potential Candidates:
  - Disability, race, gender, age, height, beauty
  - Single motherhood
- Single motherhood is widely used as a tagging device in many countries.
  - It satisfies (1) and (2), but also (3)?
  - It has been accused by conservatives of destroying the traditional family

Is Single Motherhood Caused By Welfare Incentives?

Evidence suggests that the effect is either very small or non-existent:

- U.S. time series evidence shows that single motherhood has been increasing since the 70s, whereas welfare benefits have been declining
  - Caveat: Hard to draw causal interpretations from time series
- U.S. state/time variation in welfare benefits and single motherhood
  - Single motherhood does not grow (significantly) more in states that are raising benefits relative to others (Moffitt, JEL 1992; Blank, JEL 2002)