LECTURE 7

TAX POLICY

Optimal Commodity Taxation
The definition of taxes

A tax is a compulsory, unrequited payment to general government.

(OECD, 1996)

“...Taxes are unrequited in the sense that benefits provided by government to taxpayers are not normally in proportion to their payments...”

“...General government consists of supra-national authorities, the central administration and the agencies whose operations are under its effective control, state and local governments and their administrations, social security schemes and autonomous governmental entities, excluding public enterprises...”
Distinction between direct and indirect taxes

The direct tax:
- usually collected through an intermediary;
- the most popular intermediary is your employer (income tax);
- it is possible that you have no contact with tax authorities;
- can depend on individual circumstances;
- it is possible to change the average tax rate.
Distinction between direct and indirect taxes

The indirect tax:
- paid by one person but collected from another;
- included in the price, but not always visible on a bill;
- cannot depend on individual circumstances;
- can depend on the object you buy.
## Distinction between direct and indirect taxes

<table>
<thead>
<tr>
<th>Direct taxes</th>
<th>Indirect taxes</th>
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<tbody>
<tr>
<td>+ It is easier to spread equally the tax burden.</td>
<td>+ More stable and systematic source of revenue.</td>
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<td>- Delayed tax revenue.</td>
<td>+ Collection fast and constant.</td>
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<td>- High cost of gathering.</td>
<td>+ Costs are low.</td>
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<td>- Developed tax administration.</td>
<td>- Can impose higher burden on poorer people.</td>
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<td>- People try to avoid them.</td>
<td>- Depend on the cycle.</td>
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“Optimality” criteria for judging tax systems

- Taxes have to be fair (although fairness means different things to different people)
- A good tax system is one which minimizes the resource cost involved in assessing, collecting and paying the taxes (administrative and compliance cost)
- A good tax system minimizes the efficiency cost of taxation, in terms of the distortions they cause in agents’ behaviour
“Optimality” criteria for judging tax systems

- The point of departure of optimal tax theory has been the criterion of efficiency ($3^{rd}$)
- The theory has gradually been extended to take into account distributional considerations ($1^{st}$)
- Administrative costs have so far been ignored in the optimal taxation literature (or studied separately)
- Trade-offs between criteria???
Optimal Tax Systems

- From an efficiency point of view an ideal tax system is one which is consistent with an efficient allocation of resources.
- Solution: lump-sum taxes. Such taxes cannot be altered by action, so that there is no efficiency cost involved as a result of behavioural distortions. They are clearly neutral with respect to all marginal evaluations made by consumers and producers.
- Not a very helpful conclusion for the public finance economist. Lump-sum taxes can not be part of a permanent system.
Optimal Tax Systems

- Even if lump-sum taxes are ruled out, there are still taxes which are consistent with Pareto optimality. For example it has been argued since Pigou (1920) that indirect taxes can be used to improve the efficiency of the market allocation of resources in the presence of externalities.

- But, can the public sector raise all its tax revenue from Pigouvian taxes?

- Thus the optimal taxation literature deals with the second-best problem of making the best of a necessarily distortionary system.
Optimal Tax Systems

- The conclusions of any model on the optimal tax design depend on the set of tax instruments that the model allows to be used.
- The classical models on optimal commodity taxation solve the optimal tax problem assuming that commodity taxes are the only instrument the government can use to achieve its goals.
Optimal Tax Systems

- Two seminal articles:
- The first analytical formulation is given by Ramsey (1927), concentrating on efficiency.
- Diamond and Mirrlees (1972) extended Ramsey’s analysis to include distributional considerations.
Optimal commodity taxation

- The literature of optimal commodity taxation deals with the design of taxes on commodities (e.g. VAT, or alcohol excises).
- Goods and services are obvious things to tax
- But commodity taxation distorts consumer choices and causes inefficiency.
- Because the price of the taxed commodity rises, consumers alter their consumption choices.
- Historical example: window tax in the UK introduced in 1696 and lasted until 1851. The tax was paid on any house with more than six windows.
- Result?
Photo courtesy of Age Fotostock.
Optimal Commodity Taxation

- Commodity taxes are imposed upon purchases of goods
  - transactions are generally public information
  - the taxes drive a wedge between producer and consumer prices
  - this leads to inefficiency and reduces the level of welfare compared to using lump-sum taxes
  - this is the price of incentive-compatible taxation
- On the demand side of the market, income and substitution effects predicts the consequences of a price rise
- For producers the tax is a cost increase and they respond accordingly.
Deadweight Loss

- Lump-sum taxation does not cause any distortions
  - a lump-sum tax is defined by the condition that no change in behavior can affect the level of the tax
- Commodity taxation does cause distortions
  - demand can shift from goods subject to high taxes to goods with low taxes
  - total consumption can be reduced by earning less or saving more.
- It is these substitution effects that are the tax-induced distortions
- The introduction of a commodity tax raises tax revenue but causes consumer welfare to be reduced.
- The deadweight loss of the tax is the extent to which the reduction in welfare exceeds the revenue raised.
Excess Burden Defined

A diagram illustrating the concept of excess burden. The axes represent kilos of corn per year on the vertical axis and kilos of barley per year on the horizontal axis. The graph shows the relationship between tax revenues and the equivalent variation, with points G, M, E₁, E₂, and E₃ indicating different tax revenue levels and corresponding changes in consumption of corn and barley. The diagram highlights the economic concept of excess burden, which represents the loss in consumer surplus due to taxation.
Consider figure 14.1
- the price of the good is $p$
  - before the tax is introduced
- the quantity consumed is $X^0$
- consumer surplus is given by the triangle $abc$

With a tax of amount $t$
- the price rises to $q = p + t$
- the quantity consumed falls to $X^1$
  - consumer surplus falls to $aef$

The tax raises revenue equal to $tX^1$ which is area $cdef$

The deadweight loss ($DWL$) is the triangle $bde$
Deadweight Loss

- Triangle $ebd$ is equal to $[1/2]tdX$ where $dX$ is the change in demand.
- Using the elasticity of demand, we get

$$dX = \frac{\varepsilon^d X^0}{p} dp.$$

- The change in demand $dX = X^0 - X^2$ and the change in price $dp = t$.
- The deadweight loss is

$$DWL = \frac{1}{2} |\varepsilon^d| \frac{X^0}{p} t^2.$$

This is approximate because it assumes that the elasticity is constant.
Deadweight Loss

- The deadweight loss is proportional to the square of the tax rate
  - rises rapidly as the tax rate is increased
- Deadweight loss is proportional to the elasticity of demand
  - will be larger the more elastic is demand
Optimal Commodity Taxation

- Optimal commodity taxes attain the highest level of welfare possible whilst raising the revenue required by the government
  - consumers free to choose their most preferred consumption plans
  - firms choose production to maximise profits
- Welfare is measured using the government’s objective function
- With a single consumer obtain an efficient tax system
- With many consumers obtain an equitable tax system
The literature of optimal commodity taxation deals with the design of taxes on commodities (e.g. VAT, or alcohol excises). Ramsey (1927) did not look at the trade-off between equity and efficiency, but he analysed the problem of designing sales taxes to raise a given amount of revenue at the least possible distortionary cost in a single-person economy (or an economy with many identical people).

The target is to minimize the loss in utility arising from taxation, or equivalently, to maximize social welfare subject to the revenue constraint.
Suppose that there $n$ commodities in the economy and a single form of labour, $l$.

Producer prices are $p$ and the wage rate faced by the consumer is $w$.

The consumer faces consumer prices $q$ and has a budget constraint $qx = wl$.

The government must raise a given amount of revenue, $\bar{R}$ by imposing unit taxes

$$t = (t_1, t_2, \ldots, t_n).$$

where $t_k$ is the difference between consumer price ($q_k$) and producer price ($p_k$).

Assume producer prices to be fixed (constant returns to scale).

Selecting tax structure $\equiv$ choosing a structure for consumer prices.

The preferences of the representative consumer are represented by the indirect utility function $V$, defined over prices, $U = V(q, w)$. 

Optimal commodity taxation: Ramsey
Optimal commodity taxation: Ramsey

Our problem then is to choose $t_i$s so as to maximise consumer utility subject to the revenue constraint of the government, that is

Maximise $V(q, w)$, subject to $R(t) = \sum_k t_k x_k \geq R$ \quad (1)

where $x_k$ is the consumption of the $k$th good by the consumer.
Optimal commodity taxation: Ramsey

The Lagrange function is:

\[ L = V(q,w) + \lambda [R(t) - \overline{R}] \]  \hspace{1cm} (2)
Optimal commodity taxation: Ramsey

- Set the partial derivatives of $L$ with respect to the tax rates equal to zero:

$$
\frac{\partial L}{\partial t_i} \equiv \frac{\partial V}{\partial t_i} + \lambda \frac{\partial R(t)}{\partial t_i} = 0 \quad , \quad i = 1, \ldots, n \quad (3)
$$
Optimal commodity taxation: Ramsey

Note that $\frac{\partial x_k}{\partial q_i} \equiv \frac{\partial x_k}{\partial t_i}$, so that (3) becomes:

$$\frac{\partial V}{\partial t_i} + \lambda \left( x_i + \sum_k t_k \frac{\partial x_k}{\partial q_i} \right) = 0$$

, $i = 1, \ldots, n$ (4)
Optimal commodity taxation: Ramsey

- Using duality in consumer theory, Roy’s identity gives:

\[
\frac{\partial V}{\partial q_i} = -x_i \ \frac{\partial V}{\partial M} = -ax_i \tag{5}
\]

where \( a \) is the marginal utility of income (\( M \)).
Optimal commodity taxation: Ramsey

- The Slutsky equation decomposes the change in demand due to a price change \((\partial x_k/\partial q_i)\) into an income and a symmetric substitution effect:

\[
\frac{\partial x_k}{\partial q_i} = -x_i \frac{\partial x_k}{\partial M} + s_{ki} \quad i, k = 1, \ldots, n
\]  

Where \(M\) is income and \(s_{ki}\) is the substitution effect \(\left(\frac{\partial x_k}{\partial q_i}\right)_{U_i}\)

or the utility-compensated change in demand for the \(k\)th good when the price of the \(i\)th good changes.
Substituting (5) and (6) into (4) and after rearranging and utilizing the fact that the substitution effects are symmetric ($s_{ik} = s_{ki}$),

\[
\frac{\left( \sum_k t_k s_{ik} \right)}{x_i} = -\mathcal{g},
\]

where
\[
\mathcal{g} = 1 - \frac{\alpha}{\lambda} - \sum_k t_k \frac{\partial x_k}{\partial M}
\]

This is the Ramsey tax rule. Notice that $\mathcal{g}$ is a positive number independent of $i$. 
Optimal commodity taxation: Ramsey

Intuitive explanation of the tax rule:

$$\sum t_k s_{ik}$$ can be viewed as a first-order approximation of the compensated change in demand for the $i$th good resulting from the imposition of a vector of taxes, $t$.

The Ramsey rule can be interpreted as saying that the optimal tax rates should be such that the proportional reduction in compensated demand is the same for all commodities.
Optimal commodity taxation: Ramsey

- Implications of the Ramsey rule:
  - Uniform taxes are not efficient from an efficiency point of view.
  - It is quantities that matter, not prices.
  - Prices are only important in so far as they determine demands.
  - The Ramsey rule directs taxation towards goods that are unresponsive to price changes, i.e. “necessities”.
The Ramsey Rule

- The tax rates remain implicit in the Ramsey rule since it focuses on what happens to demand.
- The rule suggests that those goods whose demand is unresponsive to price changes must bear higher taxes.
- Goods that are unresponsive to price changes are typically necessities such as food and housing.
- This tax system would bear most heavily on necessities.
- Low income consumers pay proportionately larger fractions of income in taxes relative to rich consumers.
- The inequitable nature of this is simply a reflection of the single consumer assumption: the optimisation does not involve equity and the solution reflects only efficiency criteria.
The Ramsey Rule: another intuition
(Corlett and Hague, 1953)

- Exploit the existence of an untaxed good, i.e., labour and its relation to leisure.
- The presence of the untaxed good allows the optimal tax formula to be expressed in terms of the complementarity or substitutability of the taxed commodities with the untaxed good.
- Corlett and Hague (1953) take an example with two consumption goods.
The Ramsey Rule: another intuition (Corlett and Hague, 1953)

- Result: if goods differ in their degree of complementarity or substitutability with leisure, efficiency can be improved by taxing more heavily the good that is most complementary with leisure.

- So impose a high tax on e.g. skiing equipment and a low tax on e.g. work uniforms or bus tickets.
Inverse elasticity rule

- The general intuition behind the Ramsey rule is clear, but there is no explicit formula for the calculation of taxes.
- More precise tax rules can be achieved at the expense of additional assumptions.
- Assume all cross-price effects to be zero.
- Take equation (4) as the starting point:

\[
\frac{\partial V}{\partial t_i} + \lambda \left( x_i + \sum_k t_k \frac{\partial x_k}{\partial q_i} \right) = 0
\]

And replace Roy’s identity

\[
\frac{\partial V}{\partial q_i} = -x_i \frac{\partial V}{\partial M} = -ax_i
\]
Inverse elasticity rule

To get:

\[ \alpha x_i = \lambda \left( x_i + \sum_k t_k \frac{\partial x_k}{\partial q_i} \right) \]  \hspace{1cm} (8)

If demands are independent, the only non-zero effect at the sum in the right hand side of (8) is \( t_i \frac{\partial x_i}{\partial q_i} \), so that (8) becomes:

\[ \alpha x_i = \lambda \left( x_i + t_i \frac{\partial x_i}{\partial q_i} \right) \]  \hspace{1cm} (9)
Inverse elasticity rule

- Rearranging and considering that the price elasticity of demand for good \( i \), \( \varepsilon_i \) is \( \left( \frac{\partial x_k / x_i}{\partial q_i / q_i} \right) \), (9) becomes:

\[
\frac{t_i}{p_i + t_i} = \left( \frac{\alpha - \lambda}{\lambda} \right) \frac{1}{\varepsilon_i}
\]

This is the well known inverse elasticities rule, which states that at the optimum, proportional rates of taxes should be inversely related to the price elasticity of demand of the good on which they are levied.

- These observations imply that necessities, which by definition have low elasticities of demand, should be highly taxed.

- Luxuries with a high elasticity of demand should have a low rate of tax.
Inverse elasticity rule

- The inverse elasticity rule is derived by assuming there is a single consumer and that the demand for each good is dependent only upon its own price and the wage rate.
  - there are no cross-price effects between the taxed goods
  - the independence of demands is a strong assumption
- Since there is a single consumer the tax system derived is an efficient one
  - an equitable system may have different characteristics
Application

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**

<table>
<thead>
<tr>
<th>Good</th>
<th>Subsidy</th>
<th>Price Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>40%</td>
<td>-0.54</td>
</tr>
<tr>
<td>Rice</td>
<td>40%</td>
<td>-2.08</td>
</tr>
<tr>
<td>Oil/Fat</td>
<td>-5%</td>
<td>-2.33</td>
</tr>
</tbody>
</table>
Application

- 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.
Optimal commodity taxation in a many-person economy

- The extension of the Ramsey rule to the many-person economy (practically more relevant) is by Diamond and Mirrlees (1971).
- The economy now consists of $H$ individuals.
- The problem is still to maximize social welfare subject to the revenue constraint of the government.
Suppose that there are $n$ commodities in the economy and a single form of labour, $l$.

Producer prices are $p$ and the wage rate faced by the consumer is $w$.

The consumer faces consumer prices $q$ and has a budget constraint $qx = w^l l$.

The government must raise a given amount of revenue, $R$ by imposing unit taxes

$$t = (t_1, t_2, \ldots, t_n).$$

where $t_k$ is the difference between consumer price ($q_k$) and producer price ($p_k$).

Assume producer prices to be fixed (constant returns to scale).

Selecting tax structure $\equiv$ choosing a structure for consumer prices.

Individual welfare is determined in terms of the indirect utility function $V^h$, defined over prices, $U^h = V^h(q, w^h)$. 

Optimal commodity taxation in a many-person economy
Optimal commodity taxation in a many-person economy

Social welfare is determined by a Bergson-Samuelson social welfare function, defined over individual utilities:

\[ W = W(V^1, V^2, \ldots, V^h, \ldots, V^H) \]  \hspace{1cm} (10)

Total demand for commodity \( i \) is expressed as

\[ X_i = \sum_h x^h_i \]
Optimal commodity taxation in a many-person economy

The optimization problem becomes

Maximize \( W (V^1, V^2, \ldots, V^h, \ldots, V^H) \) ,

subject to \( R(t) = \sum_k t_k X_k \geq \bar{R} \)

\( L = W (V^1, V^2, \ldots, V^H) + \lambda \left[ \sum_k t_k X_k - \bar{R} \right] \) \hspace{1cm} (11)
Optimal commodity taxation in a many-person economy

- Set the partial derivatives of $L$ with respect to the tax rates equal to zero:

$$\frac{\partial L}{\partial q_i} = \sum_h \frac{\partial W}{\partial V^h} \frac{\partial V}{\partial q_i} + \lambda \left( X_i + \sum_k t_k \frac{\partial X_k}{\partial q_i} \right) = 0 \quad (12)$$
Optimal commodity taxation in a many-person economy

- Using duality in consumer theory, Roy’s identity gives:

\[
\frac{\partial V^h}{\partial q_i} = -x_i \frac{\partial V^h}{\partial M^h} = -a^h x_i
\]

where \(a^h\) is the marginal utility of income \((M^h)\) of individual \(h\), we have:

\[
\sum_h \frac{\partial W}{\partial V^h} \frac{\partial V^h}{\partial q_i} = -\sum_h \frac{\partial W}{\partial V^h} \alpha^h x_i^h
\]  \hspace{1cm} (13)
Optimal commodity taxation in a many-person economy

- Define

\[ \beta^h = \frac{\partial W}{\partial V^h} \frac{\partial V^h}{\partial M} = \frac{\partial W}{\partial V^h} \alpha^h \] (14)

\( \beta^h \) is very important and can be interpreted as the **social marginal utility of income** for individual \( h \), that is the increase in social welfare resulting from a marginal increase in the income accruing to individual \( h \).
Optimal commodity taxation in a many-person economy

- Replacing (13) and (14) into (12) we get:

$$\sum_{h} \beta^{h} x^{h} = \lambda \left( X_{i} + \sum_{k} t_{k} \frac{\partial X_{k}}{\partial q_{i}} \right)$$

(15)

- Substituting from the Slutsky equation as before, and after some algebraic manipulations (15) becomes:
Optimal commodity taxation in a many-person economy

\[
\sum_h \sum_k \frac{t_k s^h_{ik}}{X_i} = -\left[ 1 - \sum_h \frac{b^h}{H} \frac{x^h_i}{x_i} \right]
\]

where

\[
b^h = \frac{\beta^h}{\lambda} + \sum_k t_k \frac{\partial x^h_k}{\partial M^h}
\]

Remember that \( \beta^h \) is the social marginal utility of income for individual \( h \).
Optimal commodity taxation in a many-person economy

\[ b^h = \frac{\beta^h}{\lambda} + \sum_k t_k \frac{\partial x_k^h}{\partial M^h} \]

\( b^h \) consists of two elements,

(i) the welfare weights (\( \beta^h \)) which depend on the distributional value judgments of the government

(ii) the marginal propensity to pay indirect taxes out of extra income \( t \frac{\partial x^h}{\partial M^h} \).
Optimal commodity taxation in a many-person economy

- Therefore, the tax should be lower
  
  (i) the more the good is consumed by individuals with a high social valuation of income (reflecting equity criteria) and
  
  (ii) the more the good is consumed by individuals with a high marginal propensity to consume taxed goods (reflecting efficiency considerations)
If the demand structure is such that the rich (with low $\beta^h$) have a high propensity to spend their extra income on highly taxed goods at the margin, the two elements in $b^h$ will move in opposite directions.

This will make the spread of $b^h$ lower than the distributional weights alone would imply.

Explicit conflict between equity and efficiency criteria in the design of an optimal tax system.
Optimal commodity taxation in a many-person economy

- How do the two considerations balance?
- It depends on
  - The structure of the demand function (curvature of Engel curves)
  - The form of the differences among the population
  - Government’s aversion to inequality
- If, for example, the government’s aversion to inequality is low and the curvature of the Engel curve is large, efficiency criteria dominate in the determination of optimal tax rates.
- Again explicit calculations of optimal tax rates are not straightforward and additional assumptions have to be made in order to arrive at detailed results.
Extensions of the theory of optimal commodity taxation: Production Efficiency

- Previous analysis essentially ignored production side of economy by assuming that producer prices are fixed.
- Diamond-Mirrlees AER 1971 tackle the optimal tax problem with endogenous production.
- D-M Result: even in an economy where first-best is unattainable (i.e. 2nd Welfare Thm breaks down), it is optimal to have production efficiency – that is, no distortions in production of goods.
- The result can also be stated as follows. Suppose there are two industries, $x$ and $y$ and two inputs, $K$ and $L$. Then with the optimal tax schedule, production is efficient:

$$MRTS_{KL}^x = MRTS_{KL}^y$$

even though allocation is inefficient:

$$MRT_{xy} \neq MRS_{xy}$$
Extensions of the theory of optimal commodity taxation: Production Efficiency

- The condition for production efficiency is that the marginal rate of technical substitution ($MRTS$) between any two inputs is the same for all firms.

- Such a position of equality is attained in the absence of taxation by the profit maximisation of firms in competitive markets:
  - each firm sets the marginal rate of technical substitution equal to the ratio of factor prices
  - factor prices are the same for all firms
  - this induces the necessary equality in the $MRTS$s.

- The same is true when there is taxation provided all firms face the same post-tax prices for inputs so input taxes are not differentiated between firms.
Extensions of the theory of optimal commodity taxation: Production Efficiency

- One implication of the production efficiency theorem is that goods that enter into production processes, such as inputs and intermediate goods, should not be taxed.
- All firms should buy and sell at the same prices, in order for the whole production sector to be efficient.
- If different industries face different relative prices, MRTS between inputs will differ across industries.
- Then, in principle, it would be possible to reallocate inputs and have strictly more of one good while having no less of another.
Policy consequences of production efficiency (continued)

- No taxation of intermediate goods (goods that are neither direct inputs or direct outputs consumed by individuals).
- Goods transactions between firms should go untaxed because taxing these transactions would distort (aggregate) production and destroy production efficiency.
- Example: Computer produced by IBM but sold to other firms should be untaxed
  - but the same computer sold to direct consumers should be taxed.
- Government sales of publicly provided good (such as postal services) to firms should be untaxed
  - but government sales to individual consumers should be taxed.
Policy consequences of production efficiency

- **Trade and Tariffs:**
  - In open economy, the production set is extended because it is possible to trade at linear prices (for a small country) with other countries.
  - Diamond-Mirrlees result states that the small open economy should be on the frontier of the extended production set.
  - Implies that no tariffs should be imposed on goods and inputs imported or exported by the production sector.

- **Examples:**
  - If IBM sells computers to other countries, that transaction should be untaxed.
  - If the oil companies buy oil from other countries, that should be untaxed.
  - If US imports cars from Japan, there should be no special tariff but should bear same commodity tax as cars made in US.
Extensions of the theory of optimal commodity taxation: Production Efficiency

- The principle of not taxing intermediate goods is heavily dependent on the following assumptions:
  - No pure private sector profits
  - Perfect competition
  - The possibility to tax all final goods

- What happens if not all final goods can be taxed?
- The production efficiency theorem no longer applies
Extensions of the theory of optimal commodity taxation: Production Efficiency

- Newbery (1986) showed that:
  - If the output of one firm cannot be taxed for some reason (e.g. administrative feasibility), then it may be desirable to tax its inputs.
  - This implies that you introduce an inefficiency in the production process (marginal rates of transformation between pairs of goods will be different across producers).
  - Inefficiency is balanced against the gains from surrogate taxation of the final good.

- In developing countries administrative feasibility often directs taxation towards a few easily taxable targets.
Extensions of the theory of optimal commodity taxation: Production Efficiency

- The production efficiency theorem also implies that we should not impose any tariffs on inputs into production and that all final goods should be taxed the same regardless of whether the source of origin is domestic or foreign.
- EU has abolished tariffs within the unified market.
In summary, the Diamond-Mirrlees lemma provides a persuasive argument for
- the non-taxation of intermediate goods
- the non-differentiation of input taxes between firms

The result is of immediate practical importance
- it provides a basic property that an optimal tax system must possess

Value Added Taxation satisfies this property
- taxes paid on inputs can be reclaimed
- only final consumers pay tax
Applications of optimal commodity taxation

- The fundamental motive of the analysis is to provide practical policy recommendations.
- The results so far derived provide some valuable insights, e.g.
  - The need for production efficiency
  - The non-uniformity of commodity taxes
Applications of optimal commodity taxation

- The first step to application is to introduce equity considerations into the setting of taxes
- Assign consumers different relative importance in the social welfare function and maximise welfare
- Rather than all goods having their compensated demand reduced in the same proportion, equity results in the goods consumed primarily by the poor facing less of a reduction
- This should translate into lower rates of tax on the goods consumed by the poor relative to the rates determined solely by efficiency
- Equity therefore succeeds in moderating the hard-edge of the efficient tax structure
Applications of optimal commodity taxation

- The second step to practical policy is to develop a method for numerically implementing the rules for optimal taxation.

- Two basic pieces of information are needed in order to calculate the tax rates:
  - the demand functions of the consumers to find the levels of demand ($x^h_k$) and the demand derivatives ($\frac{\partial x^h_k}{\partial q_i}$)
  - the social valuations of each consumer ($\beta^h$)

- The demand functions are obtained by estimation.

- The valuations should be calculated from a specified social welfare function and individual utility functions for the consumers.
Applications of optimal commodity taxation

- Ideally, demand functions should be consistent with utility functions. In practice the problems are not solved, but circumvented.
- First we ignore the link between demand and utility and then we impose a procedure to obtain social welfare weights.
- The demand functions are calculated using standard econometric techniques.
Applications of optimal commodity taxation

- One common procedure to find the social welfare weights is to employ the utility function
  \[ U^h = K\left(M^h\right)^{1-\varepsilon} / (1 - \varepsilon) \]

- Assuming a utilitarian social welfare function, the social marginal utility is then given by
  \[ \beta^h = KM^{h-\varepsilon} \]

- \( K \) can then be fixed by setting the value of \( \beta^h \) equal to 1 for the lowest income consumer

- With \( \varepsilon > 0 \) the social marginal utility declines as income rises

- It decreases faster as \( \varepsilon \) rises, so that \( \varepsilon \) is the value of the inequality aversion parameter.
Applications of optimal commodity taxation

- The most developed set of results use data from the Indian National Sample Survey (Ray, 1986)
- Define $\theta$ to be the wage as a proportion of expenditure
- Results are given in the table for $e = 2$
- The tax rates achieve a degree of redistribution since cereals and milk products are both subsidised

<table>
<thead>
<tr>
<th>Item</th>
<th>$\theta = 0.1$</th>
<th>$\theta = 0.05$</th>
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<tbody>
<tr>
<td>Cereal</td>
<td>-.015</td>
<td>-.089</td>
</tr>
<tr>
<td>Milk and milk products</td>
<td>-.042</td>
<td>-.011</td>
</tr>
<tr>
<td>Edible oils</td>
<td>.359</td>
<td>.342</td>
</tr>
<tr>
<td>Meat, fish and eggs</td>
<td>.071</td>
<td>.083</td>
</tr>
<tr>
<td>Sugar and tea</td>
<td>.013</td>
<td>.003</td>
</tr>
<tr>
<td>Other food</td>
<td>.226</td>
<td>.231</td>
</tr>
<tr>
<td>Clothing</td>
<td>.038</td>
<td>.014</td>
</tr>
<tr>
<td>Fuel and light</td>
<td>.038</td>
<td>.014</td>
</tr>
<tr>
<td>Other non-food</td>
<td>.083</td>
<td>.126</td>
</tr>
</tbody>
</table>
Applications of optimal commodity taxation

- This framework has also been used to analyse the impact of Indian commodity taxes.
- $T^h$ is commodity tax payment by consumer $h$.
- Expenditure of consumer $h$ is $m^h$.
- The net gain from the tax system is $-T^h / m^h$.

<table>
<thead>
<tr>
<th>Expenditure level</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rs. 20</td>
<td>.105</td>
<td>.220</td>
</tr>
<tr>
<td>Rs. 50</td>
<td>.004</td>
<td>.037</td>
</tr>
</tbody>
</table>

Existing Taxes
Applications of optimal commodity taxation

- What would the redistributive impact of the optimal tax system be?
- Ray (1986) provides these calculations.
- He considers a consumer with expenditure level $\mu = 0.5\bar{\mu}$, i.e. half of mean expenditure.
- For $\varepsilon = 1$ or more, the potential gains from the tax system are substantial.

<table>
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<td>.037</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$\varepsilon$ = 0.1</th>
<th>$\varepsilon$ = 1.5</th>
<th>$\varepsilon$ = 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-T^h / \mu$</td>
<td>.07</td>
<td>.343</td>
</tr>
</tbody>
</table>

Existing Taxes

Optimal Taxes, $\mu = 0.5\bar{\mu}$
Applications of optimal commodity taxation

- Main conclusion from Ray (1986):
  With sufficient weight given to equity considerations, the optimal set of commodity taxes can effect significant redistribution. The existing Indian tax system does not attain these gains.
Applications of optimal commodity taxation

- Results from two other studies:
  - Atkinson (1972) calculated optimal tax rates for UK and concluded that sole efficiency considerations lead to high taxes on goods like food and rent and low taxes on durables. In any case, the optimal indirect tax system is not uniform.
  - Deaton (1977) concludes that in general optimal tax rates move further from uniformity as equity considerations become more important.
Applications of optimal commodity taxation

- Limitations of applied optimal commodity taxation studies:
  - In order to calculate the welfare weights, you need to know both the private utility functions and the social welfare function.
  - You need to know the complete demand system of the consumer.
  - In general, simpler practically relevant prescriptions can be obtained only at the expense of additional assumptions (e.g. absence of cross-price effects)
Main conclusions

- An efficient tax system places the burden of taxation primarily on necessities.
- Such a system is very damaging to the poor.
- When equity is introduced, it directs taxes towards luxuries.
- Equity-efficiency trade-off in the design of taxes.
Main conclusions

- The production efficiency theorem states implies that there should be no taxes on intermediate goods.
- Actual value-added tax systems satisfy this property.
Main references