Policy Design: Commodity Taxation

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Overview...

An application of standard efficiency analysis
Commodity tax: approach

- **Basic questions:**
  - What criteria should define the optimisation problem?
  - Is there a case for taxing all commodities at the same rate?
  - If not, on which commodities should the tax burden fall more heavily?

- **Model role of the government as intervention in the price system**
  - Price “wedges” are used to raise the required revenue
  - Salanié (2003)

- **Taxes expressed as either**
  - An absolute addition to the producer price (a “specific tax” rate $t$)
  - A percentage increase in the price (an “ad valorem tax” rate $\tau$)

- **Proceed in stages**
  1. Heuristic argument based on applied welfare economics (Coady and Drèze 2002)
  2. Then Ramsey model
  3. Then generalisations
A simple model

- Equilibrium price and quantity
- The tax raises consumer price...
- ...and reduces demand
- Gain to the government
- Loss to consumer
- Waste

- Waste given by size of triangle
- Sum over consumers to get total waste
- Deadweight loss of tax

\[ \Lambda = t_1 x_1^* - \int_{q_1}^{q_1 + t_1} H_1(p, v) \, dp_1 \]
A simple policy rule

• High $\tau_k$ where you have a low $|\varepsilon_k|$  
• So if you impose commodity taxes in order to raise revenue then, to minimise waste:
  • put high taxes on commodities with low (compensated) elasticities
  • and vice versa
• Accords with diagrammatic view earlier
• But this is based on a highly simplified model…
A formal approach

- **Ramsey (1927)** main question “should we have uniform commodity taxes?”
- Objective is utility of representative person
  - can be written in direct form as $U(x)$ or in indirect form as $V(p, I)$
  - where $x := (x_0, x_1, \ldots, x_n)$, good 0 is (nontaxable) leisure, goods 1, \ldots, $n$ are taxable
  - $p := (w, p_1, \ldots, p_n) = (w, q_1 + t_1, \ldots, q_n + t_n)$; $q_i$ are producer prices
  - $w$ is the wage rate and $I$ is non-labour income
- Max $V(p, I)$ subject to government budget constraint using specific taxes $t_i$:

$$
\max_{\{t_1, t_2, \ldots, t_n, \lambda\}} V(p, I) + \lambda \left[ \sum_{i=1}^{n} t_i x_i - R \right]
$$

- Using $V_k(.)$ for $\partial V(.)/\partial p_k$, the FOC are:

$$
V_k(.) + \lambda x_k + \lambda \sum_{i=1}^{n} t_i \frac{\partial x_i}{\partial p_k} = 0, \ k = 1, 2, \ldots, n
$$

- Use Roy’s identity ($V_k = -V_I x_k$) we get:

$$
[\lambda - V_I] x_k + \lambda \sum_{i=1}^{n} t_i \frac{\partial x_i}{\partial p_k} = 0,
$$
Ramsey Rule

- Now use Slutsky equation:
  \[ \frac{\partial x_i}{\partial p_k} = H_{ik} - x_k \frac{\partial x_i}{\partial I} \]
  \( H_i \) is comp demand fn for \( i \)

- Substituting in FOC:
  \[ \sum_{i=1}^{n} t_i \left[ H_{ik} - x_k \frac{\partial x_i}{\partial I} \right] = - \left[ \frac{\lambda - V_I}{\lambda} \right] x_k \]

- This then implies:
  \[ \sum_{i=1}^{n} t_i H_{ki} \frac{x_i}{x_k} = -\theta \quad \theta := \left[ \frac{\lambda - V_I}{\lambda} \right] - \sum_{i=1}^{n} t_i \frac{\partial x_i}{\partial I} \]

- Ramsey rule: “reduce demand for every taxable good in same proportion”
  - Does not prescribe uniform tax rates
  - Does not give us an explicit formula for tax rate
  - Yields interpretable rules

- Simple example (Corlett and Hague 1953)
  - Two taxable consumer goods and (untaxable) labour
  - Tax more heavily the good that is complementary with the untaxed good
Atkinson-Stiglitz (1972) interpretation

- Use the direct utility function to define, for any $k$:

  $$ J^k := - \sum_{i=0}^{n} \frac{U_{ik} x_i}{U_k} $$

- Then Ramsey rule can be written:
  - (where $\tau_k$ is the ad valorem $t_k / q_k$)

  $$ \frac{\tau_k}{1 + \tau_k} = \frac{\lambda - V_I}{\lambda} \left[ \frac{J^k - J^0}{1 - J^0} \right] $$

- If $\infty$ elastic labour supply ($J^0=0$)
  - and if $U_{ik}=0$, $i\neq k$:
    - (“intuitive” result from DWL argument)

  $$ \frac{\tau_k}{1 + \tau_k} = J^k \frac{\lambda - V_I}{\lambda} $$

  $$ \frac{\tau_k}{1 + \tau_k} = \frac{\lambda - V_I}{V_I} \frac{1}{\epsilon^d_k} $$

- If inelastic labour supply ($J^0=\infty$)
  - does this mean uniform taxation?

  $$ \frac{\tau_k}{1 + \tau_k} = \frac{\lambda - V_I}{\lambda} $$
Uniform Taxation?

• The basis for a “common sense” guideline?
• Consider budget constraint in Ramsey-type model if
  • good 0 (labour) is untaxable
  • and the amount of labour is fixed at $K$
• So budget constraint is
  $$\sum_{i=1}^{n} q_i[1+\tau_i]x_i \leq wK$$
  • $q_i$ is producer price of good $i$
  • $\tau_i$ is ad valorem tax on good $i$
• Under uniform commodity taxation this becomes:
  $$\sum_{i=1}^{n} q_i x_i \leq wK / [1+\tau]$$
• But this is equivalent to lump-sum taxation of labour!
Arguments for Uniform Taxation?

1. Invention of new commodities
   • Substitutability may make it difficult to specify robust “boundaries” between commodities.
   • But such boundaries are essential for differential tax rates.
   • “Fine-tuning” of tax rates may be infeasible.

2. Administration cost
   • Formal model of complexity?
   • Degree of disaggregation of the tax-collecting process
   • Minimisation of errors (Dhami and Al-Nowaihi 2006)

3. Perceived equity
   • Special taxes for “special” goods : OK
   • Higher taxes for “luxuries” : OK
   • But, “discriminatory” taxes elsewhere?
Heterogeneous consumers

• Broader social objectives need to be considered.
  • With representative consumer distributional equity is assumed away
  • Concentration on efficiency makes sense.

• Pattern of demand may vary with income
  • distinguish between “luxury items” and conventional goods?
  • a basis for discriminatory taxation?

• Approach by analogy with the Ramsey interpretation
  • Instead of taking the utility of a representative consumer…
  • …use a specific Bergson-Samuelson welfare function \( W \)
  • Can impute inequality-averse values to \( W \)
  • (Atkinson and Stiglitz 1976, Kaplow 2008a)

• Focus on marginal social utility of consumer \( j \):

\[
b_j := \frac{1}{\lambda} \frac{\partial W}{\partial V^j} V^j + \sum_{i=1}^{n} t_i \frac{\partial x^j}{\partial I^j}
\]
Optimal Commodity Taxation: Heterogeneity

• Define averages across consumers:

\[
\bar{x}_k : = \frac{1}{m} \sum_{j=1}^{m} x^j_k
\]

\[
\bar{H}_{ki} : = \frac{1}{m} \sum_{j=1}^{m} H^j_{ki}
\]

\[
\overline{b x_k} = \frac{1}{m} \sum_{j=1}^{m} b_j x^j_k
\]

• The many-person Ramsey rule:
  • Proportion by which demand reduced is less where average social valuation is large
  • depends on correlation between marginal social utility and consumption of particular commodities.
  • could mean higher taxes on goods consumed primarily by high-wage persons.
Indirect tax: summary

- Elementary micro-economics appears to give us a powerful analytical tool
- Using standard results get a neat characterisation of tax structure in terms of elasticities
- The approach can be generalised to many consumers
- But assumes away things that may be crucial in tax design
  - Determinants of commodity boundaries
  - Administrative costs
- Is there a case for simplified taxation?
- Can we use the analysis for guidance on tax reform?
Overview...

- **Policy Design:** Commodity Taxation
  - Optimal tax rules
    - Commodity tax reform
    - Commodity tax and income tax

*Use principle to indicate beneficial changes*
Commodity tax reform: an approach

• In evaluating a proposed tax reform, need to consider:
  • Impact on tax revenues
  • Effect on the welfare of each household
  • Effect on social welfare

• Can fairly easily evaluate first two:
  • Use household expenditure surveys to estimate demand
  • Microsimulation model to determine tax effect

• What about third point?
  • impute social welfare weight to each household…
  • …then aggregate gains and losses of households
  • difficult: embodies normative value judgments
Tax reform problem

• Simple approach to tax reform focuses just on welfare improvement
• This requires full comparability of households
• Reform must be achievable within existing resources
• So a favourable tax reform requires
  • no decrease in tax revenues: \( dR = \sum_i MR_i \, dt_i \geq 0 \)
  • no decrease in social welfare: \( dW \geq 0 \)
• Obvious problem with this approach
  • High informational requirements on individual welfare
  • Specification of social welfare function
Pareto improvement (1)

• To avoid imposing a specific structure on social welfare…
• … just try to find *Pareto-improving* tax reforms
• Pareto improvement requires:
  • achievable within existing resources
  • Pareto superiority of after-reform outcome
• Translated this means
  • non negative impact on tax revenues
  • must harm no one
  • benefit at least one person
Pareto improvement (2)

- To express a Pareto-improving reform
  - $\text{MB}_j^i$: the marginal benefit of household $j$ from a change in tax $i$
  - $dB_j^i$: total change in benefit for household $j$

- Then acceptance of the reform requires:
  - no decrease in tax revenues: $dR = \sum_i \text{MR}_i \ dt_i \geq 0$
  - must harm no one $dB_j^i = \sum_i \text{MB}_j^i \ dt_i \geq 0$ for all $j$

- Then improvement requires the above plus:
  - benefit at least one person: $dB_j^i > 0$ for some $j$

- But these criteria are demanding:
  - in practical applications…
  - …no solution satisfying the conditions
A refined approach

- Because of indecisiveness of Paretian approach, try a modified criterion
  - Base this on the “transfer principle”
- Assume a prior (welfare) ranking of households
- A transfer is approved if
  - it distributes from the low ranking (rich)…
  - …to the high ranking (poor)
  - …without altering the ranking itself
- Logic behind this:
  - Similar to dominance criteria
  - Difficult to find first-order dominance?
  - Therefore worth looking at second-order dominance
Dalton improvement (1)

- Do not try to specify a specific SWF
  - will be arbitrary by definition

- Do not try to find Pareto-improving tax reforms
  - end up with no solution

- Use consumption expenditure per adult-equivalent
  - generate an ordinal social ranking of households
  - “marginal social worth”? 
  - who is more and who is less deserving of a marginal increase in their income

- Arrange households $j = 1, 2, 3, \ldots$
  - …in descending order of marginal social worth
  - can then calculate cumulative benefit
Dalton improvement (2)

- Let $\delta_i$ be the value of the increase in tax revenue due to an increase in tax $i$
- Define Cumulative Marginal Benefit function:
  - $CMB_i(\delta) := dB^1 + dB^2 + \ldots + dB^i$
  - conditioned on the vector of revenue changes $\delta$
- Gives a practical method of checking tax reform
  - use CMB-dominance criterion:
    
    $CMB^1(\delta) = dB^1 \geq 0$?
    $CMB^2(\delta) = dB^1 + dB^2 \geq 0$?
    $\ldots \ldots \ldots$
    $CMB^i(\delta) = dB^1 + dB^2 + \ldots + dB^i \geq 0$?
Improvement criterion

• Gives simple principle for reform of commodity taxation

• Accept the reform if and only if:
  • no decrease in tax revenues: \( dR = \sum_i \delta_i \geq 0 \)
  • dominance result holds: \( \text{CMB}/(\delta) \geq 0 \) for all \( j \)

• Simple relationship between criteria:
  • Pareto-improving criterion implies Dalton-improving
  • but not vice versa

• Dalton-improving is more likely to result in a non-empty solution set
Commodity tax reform

- The Dalton-improving tax reform appears an attractive approach to the problem
- Less demanding because it only requires:
  - Identification of an ordinal social ranking of households
  - The impact on tax revenues and on each household’s welfare
  - Simple computation of effect of each tax instrument
- Usually get a non-empty and a non-trivial solution set
- After all non-trivial solutions have been obtained the alternative tax reforms can be examined for their distributional impact
Overview...

An integrated approach – do we need commodity taxes?
Nonlinear commodity taxation?

• Should consider the issue of proportional versus nonlinear taxation of commodities.
• “Nonlinear” includes affine functions
  • like the so-called linear income tax function
• The argument is whether each commodity should be “repriced”
  • perhaps not in a proportional fashion.
• Similar argument is applied in other areas
  • tariffs for output of state-owned industries
  • price support schemes
Informational considerations

• Main difference direct/indirect taxes is *informational base*
  • Direct tax authority can know details of personal resources.
  • Indirect tax authority can know structure of production and transactions

• Informational requirements may preclude extensive application of nonlinear commodity taxes
  • similar to nonlinear pricing of consumer goods
  • can work for some goods and services

• What if technology enhances informational base
  • use of smart cards? (Cowell 2008 )

• ICC issues can arise with nonlinear pricing:
  • Some groups may choose the “wrong contract”
  • Arises both in private and public sector

• Difficulties disappear if you impose the regularity conditions implied by linearity
Combined direct/indirect tax (1)

- **Atkinson and Stiglitz (1976)**: optimal tax problem combining
  - Ramsey-type proportional commodity taxation
  - Mirrlees-type income taxation
- **Consumer**’s gross income is \( y = w[1-x_0] \)
  - no lump-income sum component: \( I = 0 \)
- So budget constraint is \( \sum_{i=1}^{n} q_i[1+\tau_i]x_i \leq y - T(y) \)
  - \( q_i \) is producer price of good \( i \)
  - \( \tau_i \) is ad valorem tax on good \( i \)
  - \( T \) is income tax schedule
- Chooses \( x_0, x_1, ..., x_n \) to maximise \( U(x_0, x_1, ..., x_n) \)
- **Government**’s budget constraint is \( R \leq \sum_{i=1}^{n} q_i x_i \tau_i + T(y) \)
- Chooses \( \tau_1, ..., \tau_{n-1}, T(.) \) to max SWF (function of individual utility)
- FOCs yield tax rule
  \[
  \tau_i = \frac{\mu(w)U_n}{\lambda f(w)} x_0 \frac{\partial (U_i/U_n)}{\partial x_0}
  \]
Combined direct/indirect tax (2)

- Use FOC rules to give general guidance on tax structure
- Commodity taxes should be zero if
  - tastes are identical and
  - preferences are weakly separable in leisure and other goods
- But this holds also if income tax is *not* optimised
  - *(Kaplow 2006, Laroque 2005)*
- If preferences are not separable
  - $\tau_i$ should be high if the $MRS_{in}$ increases strongly with leisure
  - extended also by *Hellwig (2010)*
- Results robust when tastes are heterogeneous *(Saez 2002)*
  - a small tax on commodity $i$ is desirable if high income earners have a relatively higher taste for $i$ ...
  - …or if consumption of $i$ increases with leisure
Conclusions

• Direct versus indirect
  • distinction between the two is essentially an issue of information.
  • big differences in terms of distributional effect.

• Uniform commodity taxation
  • no compelling case within the context of the model
  • there may be a case if you appeal to other factors

• Do we need commodity taxes?
  • depends on way incentives and information are modelled
  • also depends on structure of preferences
References

- *Salanié, B. (2003), The Economics of Taxation, MIT Press, Chap 3