Econ 551
Government Finance: Revenues
Fall 2019

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Lecture 3: Excess Burden
Agenda:

1. Definition of Excess Burden
2. Harberger’s Approximation
3. Application: Marginal Cost of Public Funds
Defining Excess Burden:

My take here follows Dahlby (2008) most closely, but each of the textbooks goes through this in some way.

When we have a lumpsum tax (and other tough assumptions hold) then we can choose any Pareto efficient allocation on the contract curve, by the 2\textsuperscript{nd} Welfare Theorem.

- But what do we do if we don’t have lumpsum taxes available?
- We enter the ‘2\textsuperscript{nd} best world’.

Does this cost us anything? How much?

- What is the difference in welfare between the case when we have lumpsum taxes and the case that we don’t (but need to raise the same level of tax revenue)?

Dahlby (2008, p. 13): definition of excess burden

*The difference between a money measure of the welfare loss caused by a tax system and the tax revenue collected.*
Notation:

- one person and two goods, \( x_1 \) and \( x_2 \)
- prices \( p_1 \) and \( p_2 \). Normalize \( p_2 \) to 1.
- fixed income \( y \).
- per-unit taxes on the goods are \( t_1 \) and \( t_2 \).

This leads to the following budget constraint.

\[
(p_1 + t_1)x_1 + (p_2 + t_2)x_2 = y
\]

Define an expenditure function as the amount of expenditure necessary to reach some fixed level of utility (here \( U^0 \)), given prices:

\[
e(p_1, p_2, U^0)
\]
E_0: no taxes, t_1=0 and t_2=0. At utility level U^0
E_1: t_1>0 and t_2=0. At utility level U^1
E_2: t_1=0 and t_2=0. At utility level U^1
Equivalent variation:

Start at point $E_0$ without any taxes.

- Impose tax on good one: $t_1$, shifts us down to $E_1$ at utility level $U^1$

Now ask: How much would we pay to avoid the tax and stay at original prices?

Answer: We would pay a flat amount that would take us no lower than $U^1$.

The equivalent variation: At original prices, the difference in income between the original and new utility levels.

- In diagram, going from $E_0$ to $E_2$.

\[ EV = [e(p_1, p_2, U^0) - e(p_1, p_2, U^1)] \]
Going from equivalent variation to excess burden:

The equivalent variation gives us a dollar value of the welfare cost of the price change induced by taxes. Or, it answers the question “how much would you pay to avoid the price change”?

But, what happens to the tax revenue? That’s not a loss.

Let’s impose a lumpsum tax of $t_1x_1^*$, but leave prices at original levels.

\[ p_1x_1 + p_2x_2 = y - t_1x_1^* \]

The extra distance from this line to the lower budget line is the excess burden of the tax.

\[ EB = EV - R \]

\[ EB = [e(p_1, p_2, U^0) - e(p_1, p_2, U^1)] - t_1x_1^* \]
That’s the math, but can we make this tangible?

The excess burden measures the cost to society of imposing distortionary taxes, over and above the revenue that is generated.

This cost comes from changing us away from our preferred consumption bundle.

What does that look like?

Imagine a tax on bicycles that dissuades this purchase....
Some comments on excess burden:

1) Not the only way to do this. We showed this using equivalent variation. Should we use uncompensated consumer surplus? Income-compensated demand? Utility compensated demand? These differences are theoretically important. (See Auerbach and Rosen 1980 for discussion of these issues.)

2) Aggregation issues. We did this for a ‘representative’ consumer. If people are heterogeneous (especially wrt income elasticities of demand/Engle curves) then it is harder to aggregate.

3) Information requirements needed to act on this. Can we estimate precisely someone’s demand functions / utility function? Some are more optimistic than others about this possibility.
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Harberger’s approximation:

“We do not live on the Pareto frontier, and we are not going to do so in the future. Yet policy decisions are constantly being made which can move us either toward or away from that frontier.”

Harberger (1964)

Up to the 1960s, theorists argued about how one might go about in theory measuring the excess burden.

Arnold Harberger, in a landmark article in 1964 argued that the question was too important to worry too much about theoretical niceties. He wanted to make some tangible progress, so he figured out a way to empirically estimate excess burdens. Got his hands dirty….

“The subject of this paper might be called ‘The Economics of the nth Best.’”
Partial equilibrium warmup:

Q: What is the definition of the consumer surplus and where is it found on the diagram?

Q: What is the definition of excess burden of a tax? (Using uncompensated demands.)
Harberger’s Contribution:

Starts by trying to estimate the area of the triangle (like the stripey one above).

\[
Area = \frac{1}{2} \text{base} \times \text{height}
\]

\[
\text{height} = t
\]

\[
\text{base} = Q_t - Q_0 = \Delta Q
\]

Remember the formula for own-price elasticity:

\[
\eta = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}
\]

Solve this for \(\Delta Q\):

\[
\Delta Q = \Delta P \times \frac{Q}{P} \times \eta = t \times \frac{Q}{P} \times \eta = \text{base}
\]
Harberger triangle analysis:

Let’s put it all together:

\[
EB = Area = \frac{1}{2} \left( t \times \frac{Q}{P} \times \eta \right) \times t
\]

Collect terms:

\[
EB = \frac{1}{2} t^2 \times \frac{Q}{P} \times \eta
\]
Implications of the basic excess burden formula:

\[ EB = \frac{1}{2} t^2 \times \frac{Q}{P} \times \eta \]

Two major implications:

1. Tax enters formula quadratically. If tax rate doubles; EB quadruples.

2. Excess burden increases with the elasticity of demand.
Discussion of Harberger’s method:

While Harberger’s technique has been very influential, a number of shortcomings and caveats should be kept in mind:

1) Harberger’s compensation; what Hines (1999) calls ‘Harbergerian’ demand curves. Harberger refunds the tax revenue lumpsum to consumers. This is theoretically a bit messy. Hicks called all of this ‘fiddling.’ Others think it is empirically important.

2) General equilibrium considerations: how does tax in one market affect triangles in other markets? Harberger assumed this away by assuming all other markets were undistorted. Does it matter? Hines cites work that says no; Goulder and Williams (2003) say yes.

3) Distribution: the Harberger measurement doesn’t mention distribution. Should we care who is hurt by high taxes and put different weights on the damage done to different people? Harberger (1971) defends it by saying that (a) it is hard to do and (b) we don’t do it in other economic measurement contexts (GDP for example).
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What does it cost to raise a dollar of revenue?

This is the concept of ‘marginal cost of public funds’.

See Bev Dahlby (2008) for a book on this.

We’ll be drawing on Dahlby and Ferede (2012, 2016).
What does it cost to raise a dollar of revenue?

- If you get one dollar of revenue and there is no net efficiency cost, the MCF is 1.00.

- Calculation accounts for shifting across tax bases, so raising one tax rate could shift revenue to another more efficient tax base, resulting in MCF<1.00.

- Differences across taxes driven by the elasticities of the tax bases, the level of the rates, and cross-base shifting.
Dahlby’s MCF formula

\[
MCF_{\tau_i} = \frac{s_i}{s_i + \tau_i \sum_{j=1}^{3} s_j H_{ji}}
\]

Where:

- Three taxes to talk about: \(i \in l = \{\text{person, corporate, sales}\}\)
- Tax rates: \(\tau_i\)
- Share that tax base \(i\) has of total income: \(s_i\)
- Change in tax base \(j\) when tax rate \(i\) changes: \(H_{ji}\)

They estimate the parameters based on a province-year panel dataset from 1972-2006.

- Note that they don’t account for interprovincial shifting.
- They acknowledge CIT base estimates are quite sensitive.
From Dahlby and Ferede (2012):

<table>
<thead>
<tr>
<th></th>
<th>Marginal cost of funds</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Corporate income tax</td>
<td>Personal income tax</td>
<td>General sales tax</td>
</tr>
<tr>
<td>British Columbia</td>
<td>10.45</td>
<td>1.82</td>
<td>1.26</td>
</tr>
<tr>
<td>Alberta</td>
<td>30.60</td>
<td>1.44</td>
<td>1.00</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>***</td>
<td>1.86</td>
<td>1.26</td>
</tr>
<tr>
<td>Manitoba</td>
<td>2.20</td>
<td>2.15</td>
<td>1.26</td>
</tr>
<tr>
<td>Ontario</td>
<td>***</td>
<td>2.15</td>
<td>1.31</td>
</tr>
<tr>
<td>Quebec</td>
<td>2.51</td>
<td>3.81</td>
<td>1.30</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>4.12</td>
<td>2.21</td>
<td>1.31</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>***</td>
<td>2.45</td>
<td>1.31</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>***</td>
<td>2.30</td>
<td>1.45</td>
</tr>
<tr>
<td>Newfoundland &amp; Labrador</td>
<td>22.52</td>
<td>2.52</td>
<td>1.31</td>
</tr>
<tr>
<td>Federal Government</td>
<td>1.71</td>
<td>1.17</td>
<td>–</td>
</tr>
</tbody>
</table>

Note: A *** indicates that a small CIT rate reduction would increase the current value of the government’s total tax revenues. The MCF is undefined in such cases because there would be a social welfare gain from a reduction in the CIT rate.
Basic lessons from Dahlby’s work on MCFs

- Corporate taxation is very expensive.
- Personal tax MCFs vary a lot; sensitive to how high the rates are.
- Sales tax base most efficient everywhere.
- Federal government has lowest cost for all three bases. Q: Why is this?
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Goulder and Williams (JPE 2003)

**Original title**: “The Usual Excess-Burden Approximation Usually Doesn't Come Close”

**Published title**: “The Substantial Bias from Ignoring General Equilibrium Effects in Estimating Excess Burden, and a Practical Solution.”

- The original Harberger paper had it ‘right’, and included the cross-price effects on other goods.

- But most in practice just use the simple partial equilibrium.
  - Much easier to implement.

- Notes that this wasn’t even mentioned as a big deal in Hines’s 1999 survey of Harberger triangles.

- Key insight: interaction of a new commodity tax and the existing taxation of labour income has nontrivial implications for calculation of excess burdens.
Here’s the logic:

- A uniform tax on commodities is equivalent to a tax on labour income. So, commodity taxation discourages labour supply since the fruits of your labour have less purchasing power.

- A tax on one commodity has a bit of the same impact; it discourages labour supply by making commodities more expensive than leisure, so long as the taxed good is a substitute for leisure.

- So, a commodity tax discourages labour supply.

- Given that labour taxes are already pretty high, the cost of the labour market distortion is non-trivially high.
Key equation from Goulder and Williams

Equation (16)  \[ \frac{1}{\lambda} \frac{dU}{d\tau_{C_k}} = \frac{\tau_{C_k}C_k}{p_{C_k}} \varepsilon_{C_k} + \sum_{i \neq k} \frac{\tau_{C_i}C_i}{p_{C_k}} \varepsilon_{C_iC_k} + \sum_{j=1}^{N} \frac{\tau_{I_jI_j}}{p_{C_k}} \varepsilon_{I_jC_k} - \frac{\tau_{LL}}{p_{C_k}} \varepsilon_{LC_k} \]

First term: own-price effect—the traditional Harberger triangle

Second term: cross-price impact on other consumption goods. Only matters if that good is taxed a lot so that \( \tau_{C_i}C_i \) is big, or strong substitute/complement so big \( \varepsilon \).

Third term: cross-price impact on intermediate goods. Same as for second term.

Fourth term: Labour income tax. Here, \( \tau_{L}L \) is big, so this term matters.
Goulder and Williams calculations:

**IGNORING GENERAL EQUILIBRIUM EFFECTS**

**TABLE 2**

<table>
<thead>
<tr>
<th>ELASTICITY OF DEMAND</th>
<th>TAX RATE</th>
<th>“TRUE” EXCESS BURDEN</th>
<th>ESTIMATED EXCESS BURDEN</th>
<th>ERROR</th>
<th>ESTIMATED EXCESS BURDEN</th>
<th>ERROR</th>
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</thead>
<tbody>
<tr>
<td><strong>A. Cigarette Tax</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.2</td>
<td>14.1%</td>
<td>.613</td>
<td>.074</td>
<td>-88.0%</td>
<td>.640</td>
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<td><strong>B. Energy Tax</strong></td>
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<td>4.3%</td>
</tr>
</tbody>
</table>

Note.—“Simple formula” refers to the second formula on page 899. “New formula” is eq. (24). “True excess burden” is the burden resulting from the general equilibrium model of Sec. IIIA. Cigarette tax rates are equivalent to $0.265, $0.59, and $1.23 per pack.
Goulder and Williams key findings:

Findings:

- The linear approximation of the demand curve doesn’t matter much.
- The assumption of constant MU of Income doesn’t matter much.
- The GE impact on labour supply matters a lot.
- Error is very large with the ‘simple’ formula. Not bad at all with the new formula.
- Error is smaller for high own-price elasticity goods, as the ‘simple’ part of the calculation amounts to much more of the total picture.
- Impact of raising a commodity tax much closer to linear than quadratic.
  - Why? Because excess burden is driven by labour market impact, which grows with commodity tax rate only linearly.