

University of Toronto
Economics 336 – Public Economics

Midterm examination
October 13, 2009

WRITE YOUR NAME in block (capital) letters and your student number on all exam booklets you use. If you use additional booklets, place them inside the first one before handing them in. You may use pocket calculators (but you won't need to). You must not refer to books, computers, or any other aids. You have 110 minutes.

Answer FIVE of the following questions. Explain your reasoning carefully. You may use graphical or mathematical arguments where appropriate, but keep your answers brief. All questions have equal weight.

1. Joseph Harper owns an oil deposit in Canada, and he imports capital from other countries to extract the oil, which he sells in export markets. Studies have shown that Joseph's demand function for capital is

$$K(r) = A - r$$

where A is a parameter and r is the rental price he pays for capital. The government imposes a tax t on interest paid to foreigners. Assuming that *Canada is a small, open economy*, compute the impact of the tax on government revenues and on Joseph's profits. Based on your answer, what is the excess burden of this tax? Draw a graph to illustrate your answer.

Because of the SOE assumption, the tax raises the cost of capital from \bar{r} to $\bar{r} + t$ and reduces the demand from $A - \bar{r}$ to $A - \bar{r} - t$. Therefore

$$\begin{aligned} R(t) &= tK(\bar{r} + t) = t(A - \bar{r} - t) \\ -\Delta\text{Profit} &= \int_{\bar{r}}^{\bar{r}+t} K(r) dr = R(t) + \frac{1}{2}t^2 \\ EB(t) &= \frac{1}{2}t^2 \end{aligned}$$

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2. Recent reforms have increased property taxes on older houses in the City of Toronto, while decreasing taxes on business properties there.
 - (a) Many houses in Toronto are used as rental accommodation. How is the burden of the tax increase shared between owners and tenants *in the short run* (say, two years) after the tax rate is increased? In the longer run?
 - (b) If business tax rates decrease in Toronto, *but not in surrounding cities*, what is the likely economic incidence of the tax reductions?

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- (a) In the short run, rental houses are in largely fixed supply in Toronto, so the tax should be fully shifted backward to owners. (It is not enough to say that the tax is shifted backward because of long term lease contracts: the question talks about 2 years, whereas leases are generally 1 year at most). In the longer run, the supply of rental accommodation is more elastic, so that more of the burden will be shifted forward to renters.
 - (b) Since businesses are mobile and commercial land in Toronto and surrounding areas close substitutes, a tax on business properties in Toronto is mostly borne by immobile factors of production there – i.e. owners of land – and reduction in the tax rate largely reduces the tax burden on this group.
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3. The Harberger triangle measure of the excess burden of an excise tax can be computed from the compensated demand function or from the Marshallian (uncompensated, market) demand function. Which of the two measures gives the correct measure of excess burden? Which of the two measures gives the larger number, or is the comparison ambiguous? Justify your answers.

The compensated measure is the correct one. We can see this by noting either: (a) it corresponds exactly to the measure we get from the equivalent variation, which corresponds to movements along a demand curve, i.e. compensated price changes; or (b) all taxes, including lump-sum taxes, have income effects on demand; therefore, in computing the excess burden of an excess tax we are concerned only with the additional quantity distortions due to the substitution effect, which means using the compensated demand function. For a good that is in positive net demand and taxed at a positive rate, the Marshallian measure of EB is *larger* than the compensated measure, if the good is a normal good.

4. Draw a graph of a *utility possibilities frontier* in a two-consumer economy and label points on the graph that corresponds to allocations that support the following statements:
- (a) Points A and B are *Pareto efficient*, and Point C is Pareto inefficient.
 - (b) Point A is *Pareto superior* to Point C, but Point B is not.
 - (c) If Point C is Pareto inefficient and Pareto superior to Point D, then Point D is also Pareto inefficient.

Below your graph, provide an explicit formal definition in words of the THREE terms in italics.

For full marks on (c), the graph should illustrate the idea that D lies to the SW of C and so cannot be on the UPF. Definitions:

- utility possibilities frontier: in a two person economy, the set of utility pairs for A and B such that, given preferences and resource constraints, it is not possible to increase the utility of one agent without reducing the utility of the other, or the solutions to

$$\max u_A(x_A) \quad \text{s.t.} \quad u_B(x_B) = \bar{u}_B \quad \text{and} \quad (x_A, x_B) \text{ feasible.}$$

- Pareto efficient: an allocation X is Pareto efficient if it is not possible to find another allocation Y that gives higher utility to all agents. (It is also acceptable to say it is not possible to find an allocation Y that increases the utility of one agent without harming another.)
 - Pareto superior: An allocation X is Pareto superior to Y if all agents are better off at X than at Y .
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5. A consumer's utility function is

$$U(X, Y) = 8\sqrt{X} + Y$$

her income is 156, and the pre-tax price of both goods is one. Compute the excess burden of a specific tax of one imposed on good X . (You may use an exact formula or an approximation based on the Harberger triangle.)

For any tax rate t , the optimal demands are

$$X^* = \frac{64}{(1+t)^2}$$
$$Y^* = 156 - \frac{64}{1+t}$$

(The demand for X^* is both compensated and Marshallian - because this utility function is quasi-linear.) Demands before and after tax are

$$(X_0, Y_0) = (16, 140)$$

$$(X_1, Y_1) = (4, 148)$$

so tax revenue is $R = 4$. Excess burden is $EB = EV - R$ where EV solves

$$\frac{16}{2} = 16 - EV$$

or $EV = 8$. This means $EB = 8 - 4 = 4$.

The other approach is the Harberger triangle approximation. Since $-\Delta X = 12$, the Harberger formula is

$$EB \approx \frac{1}{2} \cdot 1 \cdot 12 = 6$$

(Note that the estimate is too high because the demand curve is strictly convex.)

6. The demand for gasoline in a market is

$$G(p) = 200 - 5p$$

where p is the (after-tax) consumer price, and the marginal cost of gasoline production is fixed at one. Compute the economic incidence (on consumers and producers) of a specific tax at rate t on gasoline, assuming that the market is perfectly competitive. Next, compute economic incidence assuming that gasoline is supplied by a monopolist. Based on this, and anything discussed in class, what can you conclude about how market power affects the shifting of excise tax burdens?

Since supply is perfectly elastic the tax is fully shifted forward in a competitive market. But, due to the linear demand curve, the incidence in a monopolistic market is one-half on consumers and one-half on producers. This is not general however: a monopoly might shift more or less of the tax forward to consumers than a competitive industry.

7. A consumer supplies labour, which is untaxed), to purchase two goods with (compensated) demand functions

$$X(p_X, p_Y) = \frac{100}{p_X}$$
$$Y(p_X, p_Y) = \frac{50}{(p_Y)^b}$$

where b is a parameter of the utility function. For what values of b is it optimal to tax X at the same percentage rate as Y ? At twice the percentage rate as Y ? Justify your answers.

The inverse elasticity formula applies, so a uniform tax is optimal if $b = 1$, and the tax rate on X should be double that of Y when $b = 2$.
