AS/ECON 4070 3.0AF Answers to Midterm Exam October 2008

$Q1$. "A monopoly will always shift the entirety of an excise tax forward onto buyers." True, false, or uncertain? Explain your answer.

$A1$. The correct answer is "uncertain". It depends on the shape of the demand curve, and of the monopoly's marginal cost curve.

For example, if the demand curve were a straight line, and if the monopoly's marginal cost curve were horizontal, then a profit–maximizing single–price monopoly would increase its price to consumers by exactly half the tax, so that the entirety of the tax is not shifted (only half of it).

But if the monopoly's demand curve were not linear, but had a constant own–price elasticity $\eta > 1$, and if its marginal cost curve were horizontal, then it would increase its price to consumers by more than the tax : it would find it optimal to increase its price by $\frac{\eta}{\eta-1}t$ in response to an excise tax of t.

Although a monopoly always could increase its price by exactly the amount of the tax, it would not in general find it optimal to do so : it wants to adjust its price so that its marginal revenue equals the marginal cost plus the tax.

$Q2$. What would be the effect on income distribution of a tax change in which employment insurance premia (which are a proportional tax on wage income) were abolished, and the goods and service tax (GST) rate was increased so as to keep federal tax revenue the same? Explain your answer.

$A2$. In the simple world of the Harberger model, the fact that factor supplies are fixed means that a general factor tax is born entirely by the factor on which it is levied. A general wage tax would be born entirely by workers.

If the GST had no exemptions (such as for food bought in grocery stores), then it would correspond to a general sales tax. In the simple world of the Harberger model, a general sales tax is exactly equivalent to a general income tax. A general income tax is born by all sources of income (not just labour), in equal proportion to their income.

Therefore, in the Harberger model, replacing a wage tax (such as employment insurance premia) by a general income tax would replace a tax born by labour with a tax born by all factors of production. Thus the change would benefit workers (who bore all of the burden of the wage tax, but only part of the burden of the GST) and harm owners of other factors (who bore none of the burden of the wage tax, and some of the burden of the GST).

In reality, the GST is not a completely general sales tax. It does have some "excise tax" effects : since food is (mostly) exempt, an increase in the GST would cause some expansion of the food industry and contraction of other industries, changes which would benefit workers if (and only if) food production were more labour–intensive than the rest of the economy.

As well, in reality people's consumption patterns are not all identical, as Harberger assumed. The fact that food is mostly exempt from the GST means that an increase in the GST will benefit lower–income people somewhat, since they spend a higher proportion of their incomes on food than do higher–income people.

$Q3$. Suppose that the supply of bananas to Canada is perfectly elastic, and that the world price of bananas is $4 per kilogramme. Suppose as well that there are no other taxes in the economy. What is the excess burden of a tax on bananas of $5 per kilogramme, for a consumer whose compensated demand curve for bananas has the equation

$$Q = \frac{36}{\sqrt{P}}$$

where Q is the person's quantity of bananas demanded (in kilogrammes per year) and P is the price (including any taxes) which she pays for bananas, per kilogramme?

$A3$. With no tax, the price of bananas would be $4 a kilo, so that demand for bananas would be $\frac{36}{\sqrt{4}} = 18$. With a tax, the price of bananas rises to $9, so that demand for bananas falls (if consumers were compensated so as to stay on the same indifference curve) to $\frac{36}{\sqrt{9}} = 12$.

Therefore, the revenue raised by the tax is $5 per kilo, times 12 kilos :

$$TR = 5(12) = 60$$

The cost to the consumer of the tax is the area inside her compensated demand curve, between the before–tax price of 4 and the after–tax price of 9. Since the area inside a curve is the integral of the function defining the curve

$$CV = \int_4^9 \frac{36}{\sqrt{P}} dP$$

where CV is the total cost of the tax to the consumer. Since the integral is the inverse of the derivative, $\frac{36}{\sqrt{P}}$ is the integral of $72\sqrt{P}$, so that

$$CV = 72\sqrt{9} - 72\sqrt{4} = 72$$

so that the excess burden of the tax is

$$EB = CV - TB = 72 - 60 = 12$$

An approximate answer can be found by pretending that the compensated demand curve were a straight line (which it is not). If the demand curve were a straight line, then the excess burden would be the area of a triangle, with height equal to the tax ($5 per kilo) and width equal to the change in quantity demanded $(18 - 12 = 6)$. So

$$EB \approx \frac{1}{2}(6)(5) = 15$$

A better approximation can be found using the formula

$$EB = \frac{1}{2}\eta^c\tau^2(PQ)$$

where η^c is the compensated elasticity of demand, and τ the tax rate. Since the equation of the demand curve is $Q = \frac{36}{\sqrt{P}}$, here $\eta^c = 0.5$. Expressed as a fraction of the after–tax price P, here $\tau = 5/9$. And, after the tax is imposed, $PQ = (9)(12) = 108$. So the elasticity formula gives an approximation of the excess burden of

$$EB \approx [\frac{1}{2}]^2[\frac{5}{9}]^2(108) = 8.333$$