We have seen that monopolization of a competitive market typically leads to higher prices, lower consumers’ surplus and often a loss in economic efficiency. For decades governments have tried to regulate industry to counteract the harmful effects of monopolies. (Google the Combines Investigation Act for Canada or anti-trust legislation for the US.) Industrial Organization is the field in economics that deals with the regulation of monopolies and related topics. This week we will look at some of the ways monopolies may be regulated.

Assignment 4: please follow the submission rules on the course outline and email me your answers before noon Friday June 5th.

1. A common way for governments to regulate a company with monopoly power is to limit the price the company can charge for its products. To understand how this may work, reconsider Figure (ii) (Monopoly with no price discrimination) in the file labeled Assignment 1 pictures on the web site. Redraw Figure (ii) on the assumption that the government has passed a law that says price cannot be higher than 4 dollars. What happens to producers’ surplus, consumers’ surplus and economic efficiency?

**ANSWER**

If the government legislates an upper bound on price at 4 dollars per unit of output, and the law is obeyed, the monopolist will set price at this ceiling. This will make the Figure (ii) graphs look like the Figure (i) graphs with perfect competition. Price, output, consumers’ surplus and producers’ surplus will be at their levels in perfect competition. See the second to last page in this pdf.

2. Another way a government may try to control monopoly power is by blocking the merger of two existing companies in a market. For example, the Canadian Government would probably block the merger of Bell and Rogers because the merged company would have too much power over the prices charged for electronic communication in Canada. This kind of merger is sometimes described as a *horizontal* merger — two companies that operate at the same level (retail or wholesale or manufacturing etc.) merging. Mergers or acquisitions may also be *vertical* — for example, Costco buying one of the companies that supply products for its stores — that is, a retailer is buying a company that manufactures products it sells. One could think of the exercises we did at the beginning of this course on monopolization of a competitive market as showing that horizontal mergers are likely to reduce consumer welfare. But do vertical mergers reduce consumer welfare? To build some understanding on
this topic read through Workouts problem 26.2 (pages 318-319) and then try the following question.

Assume Loblaw has a monopoly in the sale of bottled water to customers in Kitchener-Waterloo and that Nestle located in Guelph is the sole supplier of bottled water to Loblaw. For simplicity assume Nestle’s costs are zero and the inverse market demand for bottled water in KW is given by

\[ p = a - bQ, \quad a, b > 0. \]

where \( p \) is the price paid by consumers and is measured in dollars per bottle and quantity, \( Q \), is measured in number of bottles.

(i) Suppose Nestle charges Loblaw \( c \) dollars per bottle (\( c < a \)). Write an equation for \( Q \) in terms of \( a, b, c \) that maximizes Loblaw’s profits. Given this equation what value of \( c \) maximizes Nestle’s profits? Now solve for the equilibrium values for \( Q \), Loblaw’s profits, Nestle’s profits, and consumers’ surplus, each in terms of \( a \) and \( b \) (not \( c \)).

(ii) Would a Loblaw-Nestle merger increase their total profits and increase consumers’ surplus? Justify your answer carefully.

**ANSWER**

(i) Loblaw profits can be written as follows:

Loblaw profits\((Q) = \) Revenue minus costs = \( pQ - cQ = (a - bQ)Q - cQ = (a - c)Q - bQ^2. \)

Setting the derivative of profits with respect to \( Q \) equal to zero we obtain

\[ a - c - 2bQ = 0 \text{ or } c = a - 2bQ. \]

So if Nestle charges Loblaw \( c \) per bottle Nestle’s average revenue is \( a - 2bQ \). Since costs for Nestle are zero its profits are

Nestle profits\((Q) = (a - 2bQ)Q = aQ - 2bQ^2. \)

Setting the derivative of Nestle profits with respect to \( Q \) equal to zero we see that \( Q = a/(4b). \) So then Nestle sets its price to Loblaw at

\[ c = a - 2bQ = a - 2b \frac{a}{4b} = \frac{a}{2}. \]

Nestle profits are \( (a/2)(a/(4b)) = a^2/(8b). \) At \( Q = a/(4b), \) \( p = 3a/4 \) and

\[ \text{Loblaw profits} = (p - c)Q = \left( \frac{3a}{4} - \frac{a}{2} \right) \frac{a}{4b} = \frac{a^2}{16b}. \]

Total profits for the two companies are \( 3a^2/(16b). \) And consumers’ surplus is
\[
\frac{1}{2} (a - p)Q = \frac{1}{2} \left( a - \frac{3a}{4} \right) \frac{a}{4b} = \frac{1}{2} \frac{a}{4} \frac{a}{4b} = \frac{a^2}{32b}.
\]

(ii) With a Loblaw-Nestle merger

\[
\text{Joint profits}(Q) = pQ = (a - bQ)Q = aQ - bQ^2.
\]

The optimal \( Q = a/(2b) \) and price \( p = a/2 \). Joint profits are \( a^2/(4b) \) which exceeds total profits without the merger — \( 3a^2/(16b) \). And

\[
\text{Consumers’ surplus} = \frac{1}{2} (a - p)Q = \frac{1}{2} \left( a - \frac{a}{2} \right) \frac{a}{2b} = \frac{a^2}{8b} > \frac{a^2}{32b}.
\]

So, yes, total profits and consumers’ surplus increase with the merger.

3. A third way a government may seek to control a monopoly is through taxation. A government might tax the monopoly’s profits or the dollar value of sales or the number of units of output sold by the company. An \textit{ad valorem tax} is a sales tax that that is expressed as a decimal of the selling price. For example, the HST in Ontario is 0.13 — if you wish to buy something in a store that is priced at 10 dollars, and this item is subject to HST, you will pay \((1.13)(10) = 11.30\). A \textit{specific tax} is a sales tax that is expressed as so many cents or dollars per unit sold. For example, the Federal Tax on gasoline is 10 cents per litre. In a perfectly competitive market, an ad valorem tax and a specific tax, have identical effects if the tax revenue raised is the same. This is \textit{not} true in a monopoly equilibrium.

\textbf{Sales taxes in a competitive market}

Draw market demand as a straight line that intersects the price \((p)\) and quantity \((Q)\) axes. Draw market supply as a straight upward sloping line that runs through the origin. Label the intersection of these lines \( A \) — the initial equilibrium. Think about what an ad valorem tax would do to the net of tax price received by suppliers. At \( p = 0 \) the ad valorem tax is zero. For \( p > 0 \), the tax per unit rises in proportion to price. So we could represent the ad valorem tax by rotating the demand line counterclockwise about its intersection with the \( Q \) axis. Label the intersection of this demand line with the supply line point B. Point B tells us the net of tax price received by retailers and the new equilibrium \( Q \). Moving vertically up from B to the market demand we see the new, higher, price to consumers. Label this point C. BC times the new \( Q \) is tax revenue raised. Now suppose the government switches to a specific tax that raises exactly the same revenue as the ad valorem tax. Use the diagram to argue that none of the following variables changes — price to consumer, net of tax price to suppliers, and equilibrium \( Q \). See the last page of this pdf.

Now work through this problem and its answer to see how things change with monopoly.

Suppose ABC Inc. has a monopoly in the sale of widgets. Assume ABC acts to maximize its profits and is incapable of practising any form of price discrimination. Suppose ABC operates in a jurisdiction in which the government cares about tax revenue and economic
efficiency — given tax revenue, the government will choose that tax system that maximizes
the sum of profits and consumer surplus. Denote revenue before taxes by \( R(Q) \) and total
costs before taxes by \( C(Q) \). Does economic theory offer any advice on how the government
should rank the following taxes: (a) an ad valorem tax, \( t \), with tax revenue \( tR(Q) \); (b) a
specific tax, \( \tau \), with tax revenue \( \tau Q \); (c) a proportional tax rate on profits, \( \theta \), with revenue
\( \theta(R(Q) - C(Q)) \), if \( t = \tau = 0 \)?

**ANSWER**

With all tax rates in place

\[
\text{Profits}(Q) = (1 - \theta) [(1 - t)R(Q) - C(Q) - \tau Q]
\]

Setting the derivative of Profits with respect to \( Q \) equal to zero we see

\[
(1 - \theta) [(1 - t)R'(Q) - C'(Q) - \tau] = 0.
\]

And, assuming \( \theta < 1 \), this means

\[
(1 - t)R'(Q) - C'(Q) - \tau = 0.
\]

The equation tells us \( Q \) does not change with a change in \( \theta \) and a total differential of this
equation implicitly defines \( dQ \) as a function of \( dt \) and \( d\tau \). Taking the total differential and
setting initial tax rates to zero we obtain

\[
(R''(Q) - C''(Q))dQ - R'(Q)dt - d\tau = 0. \tag{1}
\]

Now

\[
\text{Total revenue} = \theta [(1 - t)R(Q) - C(Q) - \tau Q] + tR(Q) + \tau Q
\]

If we hold total revenue constant a total differential of the total revenue equation yields

\[
(R(Q) - C(Q))d\theta + R(Q)dt + Qd\tau = 0, \tag{2}
\]

at \( \theta = t = \tau = 0 \).

In addition, write the value function for the firm’s problem as

\[
\pi(\theta, t, \tau) = \max_Q \ (1 - \theta) [(1 - t)R(Q) - C(Q) - \tau Q]
\]

Applying the envelope theorem at the point where \( \theta = t = \tau = 0 \) we obtain a third equation
that tells us how the firm’s profits change with changes in tax rates.

\[
d\pi + (R(Q) - C(Q))d\theta + R(Q)dt + Qd\tau = 0. \tag{3}
\]
Set \( d\tau \) equal to zero and consider which of \( \theta \) or \( t \) is more efficient. To do this increase \( \theta \) and reduce \( t \) to hold revenue constant. From (2) this means

\[
(R(Q) - C(Q))d\theta + R(Q)dt = 0,
\]

which implies, using (3), that \( d\pi = 0 \). But, since \( R''(Q) - C''(Q) < 0 \) (profits must be strictly concave in output), (1) implies output goes up. Therefore, this experiment gives the government the same revenue and the firm the same profits but consumers’ surplus increases. A profits tax is more efficient than an ad valorem sales tax.

Now set \( d\theta = 0 \) and consider a similar experiment where we increase \( t \) and reduce \( \tau \) to keep government revenue constant. From (2) we can see that the changes in \( t \) and \( \tau \) must satisfy

\[
R(Q)dt + Qd\tau = 0.
\]

But, then in (3), this means that \( d\pi = 0 \) — the experiment leaves firm profits unaffected. What about \( dQ \)? Solve (2) to get

\[
d\tau = -(R(Q)/Q)dt
\]

and then substitute out the \( d\tau \) term in (1). These steps lead to

\[
\frac{dQ}{dt} = \frac{R'(Q) - R(Q)/Q}{R''(Q) - C''(Q)}
\]

The numerator is marginal revenue minus average revenue which must be negative, and the denominator must be negative since Profits are strictly concave in \( Q \). So \( dQ/dt > 0 \) and thus the experiment increases consumers’ surplus.

Summarizing the results, \( (c) \) is better than \( (a) \) which is better than \( (b) \).
Figure (ii) - monopoly, with a price ceiling of 4.
Sales taxes in perfect competition