Exercises : Basic Economics

Génie industriel

Master SIE-M1-BEIE

Iragaël Joly

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1 Exercise 1- Production Function (2 inputs case)

The following table gives the output quantities (Q) produced by farmers given variable surface of land area (S) and variable number of workers (L)

Surfaces	Worker (L)						
(S)	2	4	6	8	10	12	14
10	10	30	40	45	48	50	48
20	35	60	75	85	90	95	98
30	50	80	100	115	125	133	140
40	60	95	115	133	150	165	178
50	65	105	130	150	166	150	192
60	68	110	135	155	173	190	198
70	65	113	136	156	175	195	190

Question 1. Analysing the table :

- Determine non-efficient production process (inefficient inputs combination).
- Draw on figure 1 some isoproduction curve (You will assume that inputs are perfectly divisible).

Answer:

Non-efficient process are process that use more factor (at least one of them) for a given output level, than other process, for the same output level or greater level.

Here $(2, 70)$, $(14, 10)$, $(14, 70)$, and $(12, 60)$ are inefficient factor combinations.

We can reduce the use of one of the factor (the other kept constant) without decreasing the output. Specifically, $(2, 70)$ produces 65, but we can produce 65 with $(2, 50)$

We can draw some isoquant, linking points with the same output level. For example : 50 ; 60 ; 95 ; 115. Horizontal and vertical isoquant depict non efficient production.

Isoquant curve joins all process associated to a given output level.
Increasing or constant (horizontal or vertical) isoquant curves indicate inefficient input mix.

Isoquant curves cannot cross.

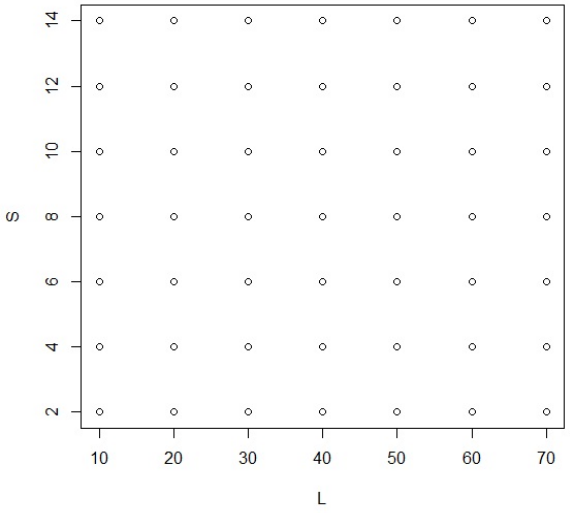

Figure 1 – Isoquant Curves - to be completed

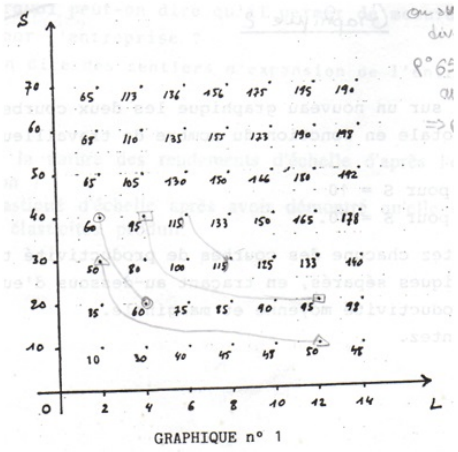

Figure 2 – Efficient combinations and isoproduction combinations

Question 2.

- Represent graphically the production function in the 3D space (OL,OS,OQ)
- Draw the three production functions for $S = 10$,$S = 20$, and $L = 2$.
- Add on the 3D figure, the isoproduction curve for $Q = 60$.

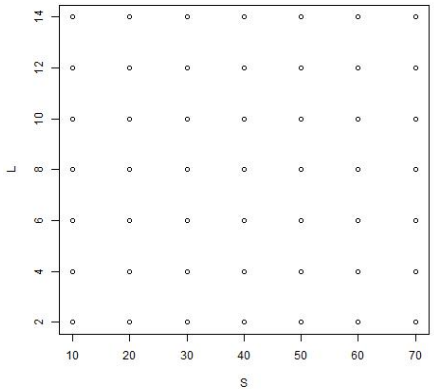

FIGURE 3 – Alternatives Functional Forms - I

Answer:

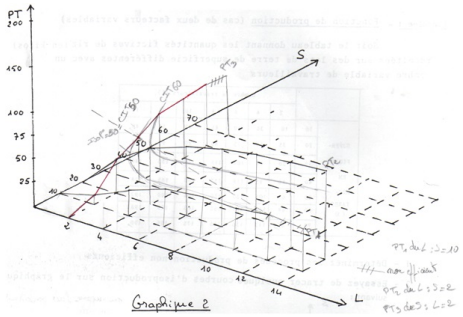

FIGURE 4 – 3D isoproduction combinations

Question 3.

— On two new figures, draw the two production curves for $S = 10$ and $S = 20$.
— Draw average production and marginal production curves.
— Comment

Answer:

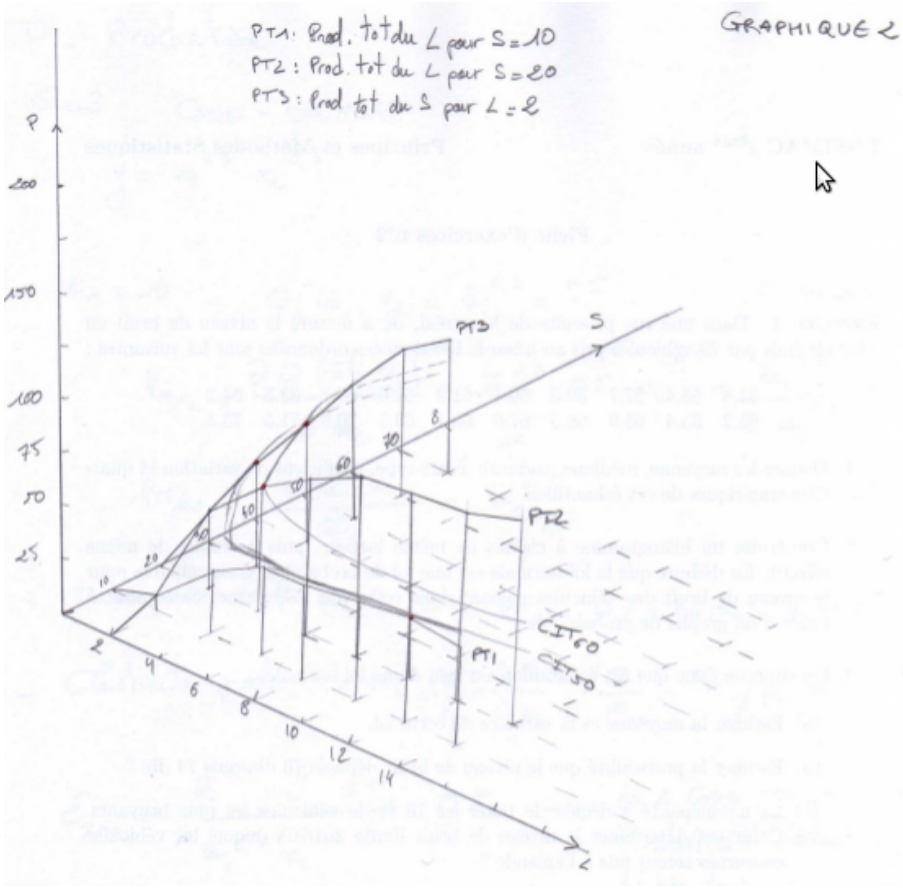

FIGURE 5 – Total product curves

Surfaces	Worker (L)						
	2	4	6	8	10	12	14
S=10							
Tot Prod	10	30	40	45	48	50	48
Avg Prod	5,0	7,5	6,7	5,6	4,8	4,2	3,4
Marg Prod	5,0	10,0	5,0	2,5	1,5	1,0	-1,0
S=20							
Tot Prod	35	60	75	85	90	95	98
Avg Prod	17,5	15,0	12,5	10,6	9,0	7,9	70
Marg Prod	17,5	12,5	7,5	5,0	2,5	2,5	1,5

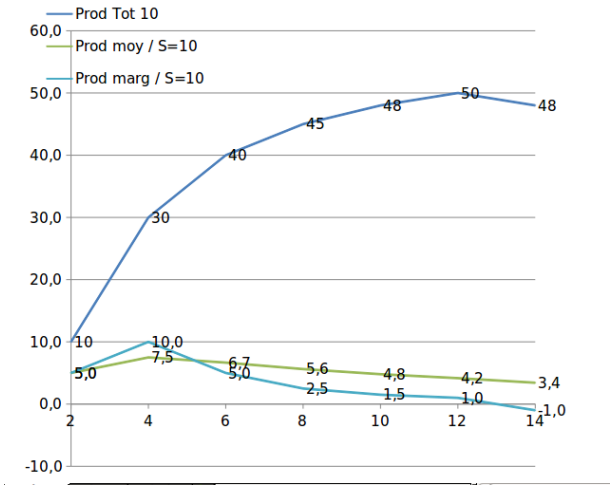

FIGURE 6 – Total, Average and Marginal Product Curves, $S = 10$

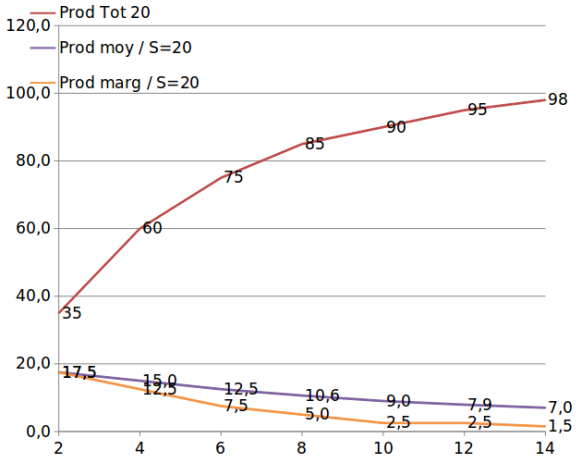

FIGURE 7 – Total, Average and Marginal Product Curves, $S = 10$

2 Exercise 2 : Cobb-Douglas Production Function

Let the production function of a firm using two inputs (x_1 and x_2) to produce y be :

$$y = f(x_1, x_2) = x_1^{0.3} x_2^{0.5}$$

Question 1. Assuming input x_1 is fixed ($x_1 = 10$), how will vary Total Productivity, Average and Marginal Productivity of input x_2 ?

Answer:

With $x_1 = \overline{x}_1 = 10$. Total Product when x_1 is fixed :

$$Q(\overline{x}_1, x_2) = \overline{x}_1^{0.3} x_2^{0.5}$$

Total product is increasing and concave with x_2. Marginal product of input x_2 :

$$mP_{x_2} = \frac{\partial Q(\overline{x}_1, x_2)}{\partial x_2} = \overline{x}_1^{0.3} x_2^{0.5} = \frac{\overline{x}_1^{0.3}}{2x_2^{0.5}}$$

mP_{x_2} is decreasing and convex with x_2 Average product of x_2 :

$$APx_2 = \frac{Q(\overline{x}_1, x_2)}{x_2} = \frac{\overline{x}_1^{0.3}}{x_2^{0.5}}$$

AP_{x_2} is decreasing and convex with x_2

Question 2. Explain the sense of the marginal productivity of x_2.

Answer:

MP indicates change in output quantity for each supplementary unit of input 2. Hence, when x_2 increase by 1 unit, and x_1 constant, total product increases by the amount $mP_{x_2}(x_2)$.

Question 3. Define the output elasticity with respect to x_2.

Answer:

Output elasticity of x_2 :

$$\varepsilon_{y/x_2} = \frac{\frac{\Delta Q}{\Delta x_2}}{\frac{Q}{x_2}} = \frac{mP_{x_2}}{AP_{x_2}}$$

Here :

$$\varepsilon_{y/x_2} = \frac{\overline{x}_1^{0.3} x_2^{-0.5} 0.5}{\overline{x}^{0.3} x_2^{-0.5}} = 0.5$$

Rmk : In Cobb-Douglas function, output elasticity of a factor is its associated exponent.

Question 4. Define the marginal rate of substitution between inputs.
Calculate its value for the following inputs combinations (with $y = 4$) : $A : (x_1 = 101,6; x_2 = 1)$; $B : (x_1 = 10,05; x_2 = 4)$; $C : (x_1 = 1,11; x_2 = 15)$.

Answer:

MRTS is :

$$dQ = dx_1\frac{\partial Q}{\partial x_1} + dx_2\frac{\partial Q}{\partial x_2} = 0$$

$$\iff \frac{dx_1}{dx_2} = \frac{-mP_{x_2}}{mP_{x_1}}$$

It gives the necessary change in x_1 to compensate the loss of output when x_2 is reduced by 1 unit. If x_2 increases by 1 unit, then, x_1 must be reduced by the amount $\frac{mP_{x_2}}{mP_{x_1}}$. In our case :

$$MRTS = \frac{x_1^{0.3}x_2^{-0.5}0.5}{x_1^{-0.7}x_2^{0.5}0.3} = \frac{0.5x_1}{0.3x_2} = \frac{5x_1}{3x_2}$$

We can draw the figure 12 (with x_2 in abscissa)
$A : (x_1 = 101,6; x_2 = 1)$

$$Q = 101.6^{0.3}1^{0.5}x_2 \cong 4$$

$$mP_{x_2} = \frac{101.6^{0.3}1^{-0.5}}{2} \cong 2$$

$$mP_{x_1} = 101.6^{-0.7}1^{0.5}0.3 \cong 0.012$$

$$MRTS = \frac{-2}{0.012} = -169.3$$

If x_2 rises by 1 unit, then, to keep the output level constant ($Q = 4$), x_1 varies of MRTS units : -169.3 units.

$B : (x_1 = 10,05; x_2 = 4)$

$$Q = 3.9965; mP_{x_2} \cong 0.499; mP_{x_1} \cong 0.119; MRTS = \cong -4.19$$

$C : (x_1 = 1,11; x_2 = 15)$

$$Q = 3.9962; mP_{x_2} \cong 0.133; mP_{x_1} \cong 1.08; MRTS = \cong -0.123$$

The three points are presented in figure 12. MRTS is given by the slope of the isoquant, in each point, A, B and C.

Question 5. How does the TMS vary along the isoproduction curve ? Why can we say that the TMS measure the relative value of the inputs for the firm ?

Answer:

MRTS is decreasing along the isoquant. The substitution between the two output is reversed. With few x_2 MRTS is high, indicating that x_2 can easily be substituted to x_1. x_2 increasing, the MRTS decreases too. When $MRTS < 1$ the rate of substitution is reversed : less than few x_1 is needed to compensate 1 unit of x_2. MRTS measures the value of one input in terms of the other input. It is an internal exchange rate. It is a opportunity cost.

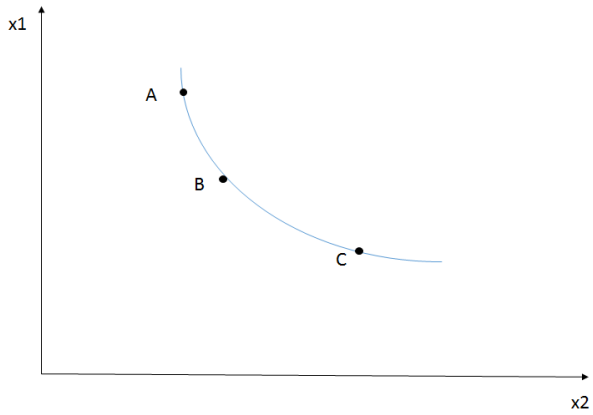

FIGURE 8 – Isoquant curve

Question 6. Qualify the return to scale of the firm. Define the return to scale for a general Cobb-Douglas function (using exponent α and β).

Answer:

Return ot scale are measured by :

$$f(kx_1, kx_2) = (kx_1)^{0.3}(kx_2)^{0.5} = k^{0.8}f(x_1, x_2)$$

$$\forall k > 0, f(kx_1, kx_2) < kf(x_1, x_2)$$

Hence, rts are decreasing. In the Cobb-Douglas case, rts are given by the sum of the inputs exponents. rts are decreasing if the sum is less than 1.

Question 7. Calculate the scale elasticity as the sum of the product elasticities. Comment.

Answer:

Scale elasticity is determined like :

$$\epsilon_{Y/X} = \sum_i \epsilon_{Y/x_i} = \epsilon_{Y/x_1} + \epsilon_{Y/x_2} = 0.3 + 0.5 = 0.8 < 1$$

Scale elasticity is the sum of the Cobb-Douglas exponents. Hence, $\epsilon_{Y/X} = 2$: an increase of all inputs by 1% leads the output to increase by 2%.

Answer:

Exercice 2 - Calculs réalisés sous R

```
(101.6^0.3)*(1^0.5)
(101.6^0.3)*(1.1^0.5)
(101.6^0.3)*(2^0.5)
(102.6^0.3)*(1^0.5)
(102.6^0.3)*(0.5^0.5)

(101.6^0.3)*(1^0.5)
(101.6^0.3)*(2^0.5)
(15^0.3)*(2^0.5)

# qd on fait varié en 1 la mP est une approx


# mP2
pm2<-(101.6^0.3)*(1^-0.5)/2
# pm1
pm1<-(101.6^-0.7)*(1^0.5)*0.3
tmst<-pm2/pm1
(5/3)*(101.6/1)

pm1
pm2
tmst

(10.05^0.3)*(4^0.5)
# pm2
pm2<-(10.05^0.3)*(4^-0.5)/2
# pm1
pm1<-(10.05^-0.7)*(4^0.5)*0.3
tmst<-pm2/pm1
pm1
pm2
tmst
(5/3)*(10.05/4)
((10.05-tmst)^0.3)*((4+1)^0.5)

((10.05-tmst/100)^0.3)*((4+1/100)^0.5)

(1.11^0.3)*(15^0.5)
# pm2
pm2<-(1.11^0.3)*(15^-0.5)/2
# pm1
pm1<-(1.11^-0.7)*(15^0.5)*0.3
tmst<-pm2/pm1
pm1
pm2
tmst
(5/3)*(1.11/15)
((1.11-tmst)^0.3)*((15+1)^0.5)

((1.11-tmst/100)^0.3)*((15+1/100)^0.5)
```

3 Exercise 3 : Constant Coefficient Production Function

Stone quary needs to produce n stones : $8n$ hours of work (x_1) and $2n$ Kwh of energy (x_2).

Question 1. Determine efficient input combinations to produce 1, 2 and 3 stones. Deduce the production coefficient for each input (x_1 and x_2).

Answer:

The 2 factors are complement. The 2 are necessary to produce. Some minimum proportions are needed. Efficient input mixes are all combinations than respect this proportion.

Y	x_1-labor	x_2-energy
1	8	2
2	16	4
3	24	6
4	32	8
5	40	10

Question 2. With 40 hours and 12 Kwh available, what is the maximum number of stones produced. Deduce the expression of the production function.

Answer:

Pursuing the table, we see that 5 stones are reach, and 2Kwh are unused.
In the smae manner, with 40h, we can produce upto 40/8 5 stones and with 12kwh we could produce upto 6 stones (12/2). Stone production is limited by the amount of labor (40h). Inputs are complements. Excess of one input cannot compensate / be substituted to the other input. Finally, the production function describing such technology is :

$$Y = f(x_1, x_2) = \min(ax_1, bx_2)$$

with coefficients a and b fixed : $a = 1/8$ and $b = 1/2$.

Question 3. Draw the isoproduction curves for 5, 10 and 15 stones.

Answer:

Isoquant curves are corner curve. For example, the curve satisfies $5 = \min(x_1/8, x_2/2)$. The line passes by the corner of each curve. It is useless to consumme more inputs than the amount prescribed in the corners.

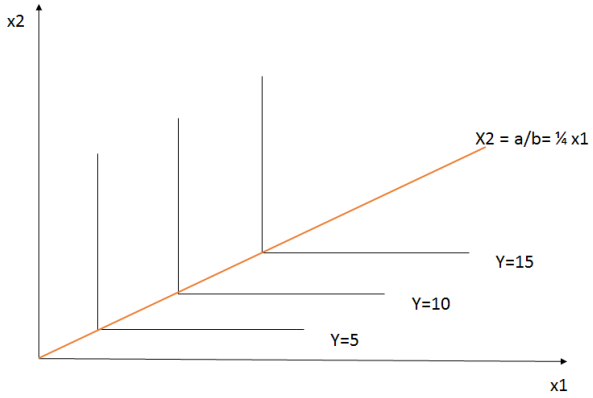

FIGURE 9 – Leontief isoquants

Question 4. Given an energy level available, $x_2 = 20Kwh$, calculate for the labor input the total average and marginal productivity.
Draw graphical representation.
What is the relationship between average productivity and the coefficient of energy ?

Answer:

With 20kwh, upto 10 stones can be produced. Hence, with $0 \leq x_2 \leq 20$, total product is given by the labor level : $Y = x_1/8$ and TP is 10 when $x_1 > 80$. Average product of x_1 is $AP_{x_1} = Y/x_1 = \dfrac{x_1}{8x_1} = 1/8$. Marginal product of x_1 is $mP_{x_1} = 1/8$, when $x_1/8 < 10$ and $mP_{x_1} = 0$when $x_1 > 80$.

Question 5. Precise the returns to scale.

Answer:

RTS are constant. Doubling the inputs will double the output.

4 Cost Minimization in the two inputs case

Assume a small firm relatively to the size of it intputs markets. On these upstream markets, the firm has no market power and is price taker.

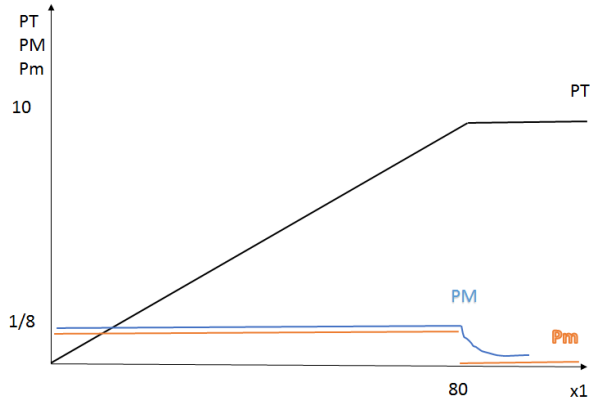

FIGURE 10 – Average and Marginal Product

Assume the firms technology is described by a function of labor x_1 and energy x_2 : $q = f(x_1, x_2) = 2x_1^{0.5}x_2^{0.4}$.
Input prices are w_1 and w_2.

Question 1. Remind how to calculate the total cost of the firm.

Answer:

Here, total cost (TC) implies 2 inputs and no fixed cost. Inputs can be adapted in the considered period. If one factor would have been fixed, it may be considered as fixed cost.

$$TC(q) = w_1x_1 + w_2x_2$$

Question 2. Determine the total cost function of this firm : $TC(q, w_1, w_2)$, which gives the minimal cost to produce efficiently the output level q, and given the input prices (w_1, w_2).

Answer:

The firm will choose input quantity in the best way to produce q output and to minimize the cost.
The firm minimizes $TC(q)$ under the constraint of the production function (efficient use of inputs) : $q = f(x_1, x_2)$.
The total cost function is $TC(w_1, w_2, q) = w_1x_1(w_1, w_2, q) + w_2x_2(w_1, w_2, q)$, with $x_1(w_1, w_2, q)$ and $x_2(w_1, w_2, q)$ the demands of inputs (the optimal mix of inputs to reach q and given the input prices. The firm solves the optimization program : $TC(w, q) = min_{x_1,x_2} w_1x_1 + w_2x_2$ such that $q = f(x_1, x_2)$
In this case it minimizes $TC(w_1, w_2, q) = min_{x_1,x_2} w_1x_1 + w_2x_2$ such that $q = 2x_1^{0.5}x_2^{0.4}$
Efficient production implies to bind the constraint :$q = 2x_1^{0.5}x_2^{0.4}$. From the x_1 and q

levels, x_2 quantities are deduced : $x_2 = \left(\frac{q}{2x_1^{0.5}}\right)^{1/0.4}$
Substituting x_2 we minimize $TC(w_1, w_2, q) = min_{x_1} w_1 x_1 + 0.177 w_2 x 1^{-1.25} q^{2.5}$
Minimizing with respect to x_1 implies to cancel the first derivative of the objective function. First order condition is : $w_1 - 0.221 w_2 x_1^{-2.25} q^{2.5} = 0$
Positive second derivative (second order condition) insure that a minimum is reached. for positive w_1, w_2 and q.
Conditional demand of input x_1, depending on q is : $x_1(w1, w_2, q) = 0.511 w_1^{-0.444} w_2 0.444 q^{1.111}$ Substituting in the production function, we obtain the conditional demand of input x_2 : $x_2(w_1, w_2, q) = 0.409 w_1^{0.556} w_2^{-0.556} q^{1.111}$
Finally, the TC function is : $TC*(w_1, w_2, q) = w_1 x_1(w_1, w_2, q) + w_2 x_2(w_1, w_2, q) = 0.92 w_1^{0.556} w_2^{0.444} q^{1.111}$
A property of the Cobb-Douglas production function is that it implies a Cobb-Douglas total cost function.
Economies of scale can be identified : exponent of q is greater than 1 doubling the scale of production will more than double the total cost.

Question 3. Calculate total cost and inputs quantities when $(w_1, w_2, q) = (150, 1, 10)$. What happens if prices double ?

Answer:

at point A $(x_1, x_2, c) = (0.71, 85.63, 192.62)$
To produce efficiently 10 units, minimum cost is 192.62 and inputs quantities are 0.71 and 85.63.
Doubling prices, will double the total cost ($c = 385.23$), with inputs demand being the same.
Indeed, the price ratio is unchanged, firm has no incentive to substitute its inputs.
Total cost function is homogeneous of degree 1 in w_1 and w_2 (sum of the exponent is 1)

With same prices, and $q = 15$: point B $(x_1, x_2, c) = (1.12, 134.36, 302.23)$.
Total cost function is non-decreasing and homogeneous with the input prices ; non decreasing with output

Question 4. Draw optimal choices for $q = 10$ and $q = 15$.

Answer:

isocost line slope : $\frac{-w_1}{w_2} = -150$, intercept : $c/w_1 = 192.62$ for $q = 10$

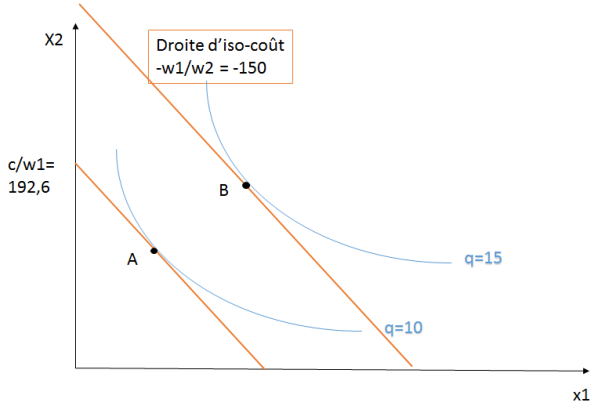

FIGURE 11 –

5 Profit Maximisation of the firm (two factors case)

Suppose the simple mono-input case : $q = x^{0.5}$. Maximisation program of the firm's profit under technologie constraint is : $\pi(p, w) = max_{q,x} pq - wx$ such that $q - x^{0.5} = 0$

Question 1. Determine the input demand function, the optimal supply function and the profit function (functions of the prices (p, w)).

Answer:

$\pi(p, w) = max_x px^{0.5} - wx$.
First order condition : $0.5px^{-0.5} - w = 0$ leads to the input demand (non conditional for the mono-input case) : $x(p, w) = 0.25 w^{-2} p^2$

This condition of first order has a specific meaning :it shows that at optimum $p\frac{\delta q(x)}{\delta x} = w$.

Hence, at optimum, value of the marginal production equals its corresponding cost of input factor ! At the optimum, marginal revenue equals the marginal cost : $mR = mC$.
Using it in the production function , we obtain the optimal supply function : $q(p, w) = 0.5 w^{-1} p$ and the profit function : $\pi(p, w) = pq(p, w) - wx(p, w) = 0.25 w^{-1} p^2$

Question 2. Give graphical representation of the situation (isoprofit line and isoproduct curve).

Answer:

Isoprofit line $\pi = pq - wx$: $q = (\pi/p) + (w/p)x$ is decreasing line.
Production function $q = x^{0.5}$ is increasing and concave curve.

Question 3. Same questions with the two-inputs production function : $q = 2x_1^{0.5} x_2^{0.4}$.

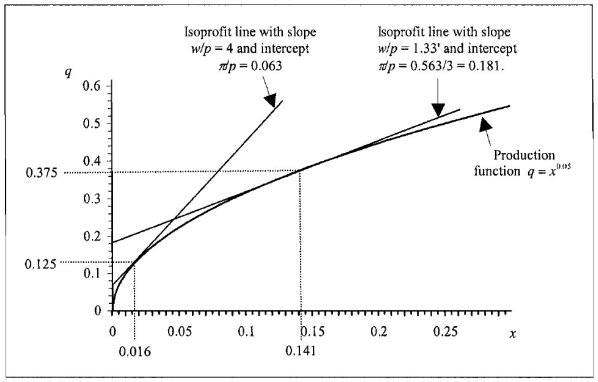

Figure 2.8 Profit Maximisation

FIGURE 12 – Profit Maximisation

Answer:

We maximise : $\pi(p, w_1, w_2) = max_{q,x_1,x_2} pq - (w_1x_1 + w_2x_2)$ such that $q - 2x_1^{0.5}x_2^{0.4} = 0$
$\pi(p, w_1, w_2) = max_{x_1,x_2} 2px_1^{0.5}x_2^{0.4} - (w_1x_1 + w_2x_2)$
1rst order conditions are : $px_1^{-0.5}x_2^{0.4} - w_1 = 0$ and $0.8px_1^{0.5}x_2^{-0.6} - w_2 = 0$.
It follows the input demand functions : $x_1(p, w_1, w_2) = 0.4096w_1^{-6}w_2^{-4}p^{10}$ $x_2(p, w_1, w_2) = 0.3277w_1^{-5}w_2^{-5}p^{10}$
And the optimal production function : $q(p, w_1, w_2) = 0.8192w_1^{-5}w_2^{-4}p^9$
The profit function : $\pi(p, w_1, w_2) = pq(p, w_1, w_2) - w_1x_1(p, w_1, w_2) - w_2x_2(p, w_1, w_2) = 0.0819w_1^{-5}w_2^{-4}p^{10}$

Question 4. Determine the firm's strategy for $(w_1, w_2, p) = (150, 1, 20)$.

Answer:

Quantities : $(x_1, x_2, q) = (0.368, 44.187, 5.523)$, profit $\pi = 11.05$, cost $c = 99.42$.

6 Study of the 3 inputs production function

Several air companies propose back and forth flights between Paris and Lyon using three inputs : capital (K : the planes), labor(L : pilots, stewards, etc), and fuel (F).

Assume the following Cobb-Douglas production function describes the full industry :

$$T = aK^bL^cF^d = 0,02K^{0,25}L^{0,2}F^{0,55}$$

With T is the number of seats-km produced each year, K is the capital level, L the labor level, and F the fuel level.

Question 1. Assume the input consumption levels : $K = 100$, $L = 500$ and $F = 20000$. Calculate the production level and the marginal products of each of the 3 inputs K, L, and F, for these level of inputs.

Answer:

$Pm_K = 0.2 * 0.25 * K^{-0.75} * L^{.2} * F^{.55}$ $Pm_L = 0.2 * 0.2 * K^{0.25} * L^{-.8} * F^{.55}$ $Pm_F = 0.2 * 0.55 * K^{0.25} * L^{.2} * F^{-.45}$ We get : $Pm_K = .127$, $Pm_L = .020$ and $Pm_F = .001$.

Question 2. For these input levels, what is the MRST, marginal rate of technical substitution between K and L ? and between K and F ? Should the companies insure that all MRTS are equal ? Explain.

Answer:

$TMST_{K/L} = \frac{Pm_K}{Pm_L} = \frac{0.25L}{0.20K} = 1.25 * \frac{L}{K}$ $TMST_{K/F} = \frac{Pm_K}{Pm_F} = \frac{0.25F}{0.55K} = 5/11 * \frac{F}{K}$ And then $TMST_{L/K} = 0.8 * \frac{K}{L}$ $TMST_{F/K} = 11/5 * \frac{K}{F}$

Yes, companies should consume inputs levels that equalize MRST. MRST represents internal rate of exchange between inputs. If one MRST is greater than another, it means that for one of the inputs, the marginal product is greater than the one of the other inputs. Then their is opportunity to exchange inputs : to reduce the low marginal product input (relatively) and increase the high marginal product input.

Here $TMST_{L/K} = 0.44$ and $TMST_{F/K} = 0.004$, Hence marginal product of K appears to be much higher than the one of L. The firm should decrease its use of F and increase K.

Question 3. Does the law of diminishing returns of inputs apply to K ? and to L or F ? Does the law of diminishing returns of inputs apply if $c = -0,2$ or $c = 0,2$? or $c = 1,2$?

Answer:

Returns of inputs are studied with marginal product of the inputs. With such production function, the 3 marginal products are decreasing, hence the inputs returns are all decreasing.
For other values of c :
If $c = -0.2$, $mP_L < 0$, production is decreasing with L, return of L is decreasing. This is an extreme case.
If $c = 1.2$, mP_L is increasing with L return of L is increasing.

Question 4. Given that the exponent associated with input F is greater than the one associated to L, is it well-advised for the firms to concentrate their expenses solely on the F or K input and none on the L ? Explain.

Answer:

Here, $d = 0.55 > c = 0.2$, yet mP_F is not strictly greater than the mP_L for all values of

F. An inputs mix is to be found, because inputs productivity is decreasing. Intensive use of one of the input reduces its mP, the use of another factor may be more productive. Expense on a unique input could be justified only in presence of increasing mP

Question 5. Does the production function of this sector show constant, increasing or decreasing return to scale ? Explain.
Is it always the case if $c = -0,2$ or $c = 0,2$? or $c = 1,2$?

Answer:

Let study the function : $F(\lambda K, \lambda L, \lambda F) = 0.02\lambda^{0.25+0.2+0.55}K^{0.25}L^{0.2}F^{0.55} = \lambda F(K, L, F)$
Hence, with $\lambda = 2$, to double all inputs will exactly double production level : returns are constant.
Remark : homogeneity degree of the function equals 1
With $c = -0.2$, return to scale are decreasing ($F(\lambda K, \lambda L, \lambda F) = \lambda^{0.6}F(K, L, F)$)
With $c = 1.2$, rts are increasing ($F(\lambda K, \lambda L, \lambda F) = \lambda^{1.65}F(K, L, F)$)

Question 6. Does the law of decreasing return of inputs imply decreasing return to scale ? Explain.
Do decreasing returns to scale imply the law of diminishing returns of inputs ?

Answer:

In the Cobb-Douglas production function case, Rts are defined by the sum of the exponents associated with the inputs. Note that this sum define the homogeneity degree of the function. Hence, input returns defined by the exponents enter into consideration in the rts evaluation, but there is no identity. With at least 2 inputs in the production function, the mP (exponents and input returns) may be weak for each input, but the rts (the sum of exponents) may be stronger.

Question 7. In the real world, do you think that production of seat-km between Paris and Lyon is characterized by a multiplicative function like Cobb-Douglas one ? Explain and propose properties that another functional form should present to be more realistic.
Answer:

In real case, we can identify that a theoretical function should be such that :
- If one of the factor is null, then the production is null ($F(O, L, F) = 0$)
- Some factors may lead to increasing input returns. For example, capital correspond to planes, whose capacity rises exponentially with size. Labor could lead to a better organization, flexibility and coordination of tasks. Some inputs may be linked together : higher capital invested in planes can lead to less fuel consuming planes.

7 Functions of production costs

Assume a Cobb-Douglas production function Note respectively Y, N and K : production level, labor and capital :

$$Y = f(N, K) = N^{3/4}K^{1/4}$$

Inputs prices are on their upstream markets : $p_N = 100$ per labor unit(N) and $p_K = 300$ per capital unit (K).
We assume the firm's market is competitive and the upstream market of inputs are competitive too.

Part I : Short term analysis

Question 1. Given a fixed level of capital : $K = 5$ and a variable level of labor N, give the equation of the short term total cost function : $C_{CT}(Y, pN, pK)$
Reminder : This function gives the minimum cost for a given production level, i.e. when the firm is producing efficiently the level Y, taking into account the inputs prices.

Answer:

In short term, with $K = 5$, we get $y = N^{3/4} \times 5^{1/4}$
Total cost function is : $CT = p_N N + p_K 5$ such that $y = N^{3/4} \times 5^{1/4}$
Constraint may be written : $N = (y/5^{1/4})^{4/3} = \dfrac{y^{4/3}}{5^{1/3}}$

Hence, $CT(y, p_N, p_K) = p_N \dfrac{y^{4/3}}{5^{1/3}} + p_K 5 \cong 58y^{4/3} + 1500$

Question 2. Give the Average Cost and the marginal cost functions ($AC_{ST}(Y)$ and $mC_{ST}(Y)$).

Answer:

On a : $AC(y) = p_N y^{1/3} + \dfrac{5p_K}{y} \cong 58y^{1/3} + 1500/y$ and $mC(y) = \dfrac{4p_N}{3 \times 5^{1/3}} y^{1/3} \cong 77.98y^{1/3}$

Question 3. Explain why we can consider that, in the short term, the total cost function include a fixed cost.

Answer:

Short term total cost is built considering fixed capital. In the equation we have the term $p_K(5^{2/3}$ independent from the production level y. This term is a fixed cost in the short term.

Question 4. Represent graphically the total cost, the fixed cost, the average and the marginal costs in the short term.

Answer:

mC is decreasing and concave, CT is increasing convex, AC is first decreasing and increasing.

Part II : Long term analysis

Question 5. Give the long term total cost function ?

Answer:

We minimize : $minCT = w_1x_1 + w_2x_2$ under constraint $y = Ax_1^{\alpha}x_2^{\beta}$

We deduce : $x_1 = \left(\frac{y}{Ax_2^{\beta}}\right)^{1/\alpha} = \frac{y}{A}^{1/\alpha} x_2^{-\beta/\alpha}$ or $x_2 = \left(\frac{y}{Ax_1^{\alpha}}\right)^{1/\beta} = \frac{y}{A}^{1/\beta} x_1^{-\alpha/\beta}$

Setting the first derivative to zero : $\frac{\delta CT}{\delta x_1} = w_1x_1 + w_2\frac{y}{A}^{1/\beta} x_1^{-\alpha/\beta} = 0$ we get : $x_1 = \left(\frac{w_2\alpha}{w_1\beta}\left(\frac{y}{A}\right)^{1/\beta}\right)^{\frac{1}{\alpha/\beta+1}}$ Hence : $x_1^* = \left(\frac{w_2\alpha}{w_1\beta}\right)^{\frac{\beta}{\alpha+\beta}}\left(\frac{y}{A}\right)^{\frac{1}{\alpha+\beta}}$

$x_2^* = \left(\frac{w_1\beta}{w_2\alpha}\right)^{\frac{\alpha}{\alpha+\beta}}\left(\frac{y}{A}\right)^{\frac{1}{\alpha+\beta}}$

These two inputs demand function are re-introduced to obtain the total cost : $CT = w_1x_1^* + w_2x_2^* : CT(y, w_1, w_2) = y\left(3p_K^{1/4}p_N^{3/4} + (\frac{p_N}{3})^{3/4}p_K^{1/4}\right)$

In our case :

$$N* = \left(\frac{p_K 3/4}{p_N 1/4}\right)^{1/4} y \cong= 1.73y$$

$$K* = \left(\frac{p_N 1/4}{p_K 3/4}\right)^{3/4} y \cong= 1.73^{-3}y = 0.19y$$

and

$$CT* = p_N n* + p_K K* = y\left[p_K^{1/4}p_N^{3/4}3^{1/4} + p_N^{3/4}p_K^{1/4}\frac{1}{3}^{3/4}\right]$$

$$CT* = 1.75yp_K^{1/4}p_N^{3/4} \cong 231y$$

Question 6. Calculate Average cost, marginal cost in the long term. Why are they equal and constant ?

Answer:

$AC = mC \cong 231$
AC and mC are equal, because TC is increasing at constant rate, it is linear. Average cost is constant for all production level y and equal mC.

Question 7. Give graphical representation

Answer:

Question 8. Assuming that the firm's production level objective is $y = 5$. What is the labor quantity to be used ? What are the associated costs ?

Answer:

For $y = 5$, TC is approx. : $CT = Y \times 231 = 1151.6$.

Optimal input demands are : $x_1^* = \left(\frac{w_2\alpha}{w_1\beta}\right)^{\frac{\beta}{\alpha+\beta}}\left(\frac{y}{A}\right)^{\frac{1}{\alpha+\beta}}$ and $x_2^* = \left(\frac{w_1\beta}{w_2\alpha}\right)^{\frac{\alpha}{\alpha+\beta}}\left(\frac{y}{A}\right)^{\frac{1}{\alpha+\beta}}$

Hence, $N* = 8.66$ and $K* = 0.95$

8 Case studies - Economics of production

In order to support discussion in the classroom, you will propose three slides about the case study you are assigned with. You will produce 3 slides,

— 1 for the survey of the case,
— 1 for the definitions of the economic notions at stake,
— 1 slide for your proposition of analysis of the case (graph or/and model).

NOTE : We here assume that you have carefully read the Krugman's textbook chapter on production theory. You may use the herein technical tools in the aforementioned case studies. Part I are cases to be discussed in class. Part II are supplementary material.

8.1 Part I : Firm's Production

8.2 Food Intake and Productivity : An Example of Diminishing Returns

Economist John Strauss analyzed data from a survey of farmers from Sierra Leone in West Africa. Through this analysis, he was able to estimate the relation between an individual's agricultural output and daily calorie intake. Between 0 and 5,200 calories per day, he found a positive association between output and calorie intake. The relation, however, was subject to diminishing marginal returns. For instance, for workers consuming about 1,500 calories per day, a 1 percent increase in calorie consumption increased agricultural output by about 0.5 percent. This impact of calorie consumption on output declined steadily with increases in calorie consumption. For workers consuming 4,500 calories per day, a 1 percent increase in calories increased output by only 0.12 percent. Beyond 5,200 calories per day, the estimated relation was negative ?additional calorie intake reduced output. Apparently, beyond that point the marginal product of food intake was negative.
Source : J. Strauss (1986), "Does Better Nutrition Raise Productivity ?" Journal of Political Economy 94, 297-320.

8.3 Increasing Returns to Scale at Volkswagen

In order to compete globally, VW and Volvo have long had a cooperative relationship whereby VW modifies or installs VW engines in certain Volvo cars. This allows VW to produce proportionally more engines with a proportionally smaller increase in inputs, thereby increasing VWs productivity. Some of these productivity gains can be passed through to Volvo in terms of lower engine costs. This is an example of increasing returns to scale. (Note, in 1999 Ford purchased Volvo's car division.)
Source : B. Mitchener, A. Latour, and S. Moore (1998), "VW-Volvo Talks Suggest Success Isn't Enough to Ensure Independence in Automotive Industry," The Wall Street Journal (July 2), A17.

8.4 Baseball Averages

Marginal product is above average product when average product is rising and below average product when average product is falling. This relation is a general property of marginals and averages. A useful illustration is a baseball player's batting average. The batting average is defined as the number of hits divided by the number of times at bat. Suppose a player starts a game with an average of .300. If the player gets two hits out of four at bats, the marginal batting average for the day is .500 and the player's batting average must rise. If the player gets one hit out of four at bats, the marginal is .250 and the overall average must drop.

8.5 Substitution of Inputs in Home Building

Builders in the Pacific Northwest use large quantities of wood in the construction of residential houses. For instance, wood is used for framing, siding, floors, roofs, and so on. Homebuilders in the Southwest (for example, Arizona) use much more stucco and tile in home construction. An important reason for this difference is that, in contrast to the Pacific Northwest, the Southwest does not have large nearby forests. This example suggests that homebuilders are able to substitute among inputs in building a home. Homebuilders in the Southwest, however, still use wood to frame the house : The substitution of other inputs for wood is not complete.

8.6 Economies of scale and hospitals in Scotland

The Scottish Office was asked by the Secretary of State for Scotland to recommend how resources in the National Health Service could be best allocated in Scotland. In 1999 the executive reported its findings. One of its chief concerns was to assess the costs of delivering health services to very different geographic areas, so as to ensure an equitable distribution of resources. One aspect of this analysis was to analyze the implications of remoteness and rurality for the costs of providing hospital services and other medical services. The costs of running hospitals in rural areas were considered to be higher than those in urban areas because rural hospitals usually operated on a small scale. The report noted that large scale hospitals had the following advantages :

— They could spread their fixed assets, such as operating theatres and diagnostic equipment, over a greater volume of patients, thereby reducing average costs.
— Specialist staff in larger hospitals could be used more efficiently.
— Large hospitals required a smaller margin for reserve capacity to cope with variability of demand. Small hospitals would require proportionately more reserve capacity to deal with unexpected variations in demand, such as a sudden increase in births.
— The report also noted that large hospitals provided more staff development, leading to efficiency gains.

The evidence showed that the average cost of providing health services was greater in small hospitals than in large ones. In the case of the large mental illness hospitals, the average cost of patient care was around £700 a week ; in the smaller hospitals, the equivalent figure

was £900 a week. Similar cost differences were found in acute hospitals, maternity units and institutions caring for the elderly.
Source : Pair Shares for Ail Technical Report. National review of resource allocation for the NHS in Scotland, Scottish Executive, July 1999. www.scotland.gov.uk/library2/doc02/fsat-00.htm

8.7 Economies of Scale and Learning Effects in the Chemical Processing Industry

Marvin Lieberman studied economies of scale and learning effects in the chemical processing industry. He found that for each doubling in plant size, average production costs fell by about 11 percent. For each doubling of cumulative volume, the average cost of production fell by about 27 percent. Thus, there is evidence of both economies of scale and learning effects in the chemical processing industry. The size of the estimates suggests that learning effects are more important than economies of scale in explaining the observed decline in costs within the industry from the 1950s to the 1970s.
Source : M. Lieberman (1984), "The Learning Curve and Pricing in the Chemical Processing Industries," Rand Journal 15, 213-288.

8.8 Economies of Scale and Scope in Apartment Management

Home Properties of New York is a real estate investment trust specializing in apartment communities in select Northeast, Midwest, and Mid-Atlantic markets. Board Chairman Norman Leenhouts noted : "Since the beginning of last year, we have more than doubled the size of our owned portfolio. By concentrating our growth in our core markets, we are realizing material scale economies ?especially in advertising and personnel costs. Moreover, we exploit scope economies by identifying best practices in our different markets and exporting those practices to properties throughout our portfolio."
Source : "Home Properties Reports Record Second Quarter 1999 Results" (August 5, 1999), PR Newswire.

8.9 Economies of Scale and Scope in DSP Production

In 1999, Texas Instruments was the leading producer of DSPs (digital signal processors). Its DSPs powered roughly two of every three digital phones, most high-performance disk drives, and a third of all modems. They also are used in a myriad of other products including digital cameras, Internet audio, digital speakers, hand-held information appliances, printers, electric-motor controls, and wireless networking equipment. DSPs are programmable. They are especially good at performing superfast real-time calculations, which come in handy when you want to compress, decompress, encrypt, or filter signals and images. Programmability helps keep DSPs inexpensive to produce. The major difference between a DSP in a cell phone and a DSP in a digital camera is the software that tells it what to do. Thus TI gains substantial economies of scale in DSP production even though the chips are used in a variety of products. It also enjoys economies of scope. For instance, it is able to leverage technological developments across its various products. While TI was notably slow in technology development a few years ago, it is now a world leader. For example, it makes a cell-phone chip whose circuits are just 0.18 micron (millionth of a meter) apart. This distance is similar to Intel's and IBM's most advanced chips.
Source : E. Schonefeld (1999), "Hotter than Intel" Fortune (October 11), 179-184.

8.10 General Motors Is Shanghaied

In the late 1990s, General Motors participated in a $1.5 billion joint venture with a state-owned enterprise in China. The Buicks produced at the resulting state-of-the-art Shanghai plant were considered to be the highest-quality cars of that model being produced anywhere in the world. Production costs, however, were extremely high. One important reason for the high costs was government regulation. The Chinese government dictated what products could be built, as well as how many, and at what price. The government also restricted the input mix. For instance, in 1999 GM was required to use locally made components equaling 40 percent in terms of value and 60 percent in 2000. Thus although GM has shared important technology with its Chinese partner, government constraints have precluded efficient production. High costs have limited the joint venture's ability to export cars to other countries.
Source : L Kraar (1999), "Chinas Car Guy," Fortune (October 11), 238-246

8.11 DeLorean Automobiles

The difficulties of competing with plant sizes significantly below the minimum efficient scale are highlighted by the experience of the DeLorean Motor Company. John Z. DeLorean had been a high-ranking executive at General Motors. He left GM in 1979 to form his own automobile company, the DeLorean Motor Company. The strategy of the new company was to specialize in high-priced luxury sports cars. The company's first (and only) car was the stainless-steel DMC12 with a list price of $29,000 - quite a high car price in the early 1980s. Although the minimum efficient scale is relatively large in auto production, DeLorean felt he could compete by designing higher-quality sports cars than the large auto companies. Planned production for 1980 was 3,000 cars. The company soon ran into financial difficulties. In 1982, DeLorean was accused of conspiring to buy and distribute 220 pounds of cocaine valued at $24 million. Federal officials asserted that DeLorean was entering the drug business to help save his ailing automobile company. Although DeLorean was later acquitted on these charges, the company still faced insurmountable financial difficulties and soon went out of business.

8.12 Attention consumers : creativity never comes cheap

See Economic Viewpoint by R.J. Barro (last page of pdf)

8.13 Job Seekers Use Internet

Posting résumés on the Internet is growing in popularity. In 1999, there were almost five million résumés on the Internet-200 times as many as 1994, according to Computer Economies. The number of job-related Web sites is expected to grow from about 200 in 1998 to 1,200 in 2002. This explosive growth is a response to the advantages of online job searches. Candidates can reach a larger audience with greater ease. And recruiters can reduce paperwork and travel. But this flood in job candidates sending online résumés has created unexpected headaches for employers. Some companies are getting thousands of résumés dumped into their e-mail boxes each day. Others, fed up with mass e-mailed résumés, yearn for a more personal touch. "You get tons of stuff from people who aren't qualified," says Michael Erbschloe of Computer Economies, a Carlsbad, ÇA, research firm. "The content of the e-mail is horrible. It bogs down your mailbox and your server." Thus in the production of job offers, the reduced cost of distributing information about themselves using the Internet has resulted in huge volume of e-mail as job seekers substitute away from more expensive alternatives. *Source : S. Armour (1999), "Online Resumes Bogging Down Employers," Democrat and Chronicle (July 19), 1F.*

8.14 Public Utilities

The production of electric power typically is associated with large economies of scale : The average cost of producing electricity decreases with the quantity produced. This production characteristic implies that it is generally more efficient to have one large plant that produces power for an area than several smaller plants. A problem with having one producer of electric power in an area, however, is that the firm has the potential to overcharge consumers for electricity since there are limited alternative sources of supply. Concerns about this problem provide one motivation for the formation of public utility commissions that regulate the prices that utility companies can charge consumers.

8.15 Minimum Wage Laws

The minimum wage in the United States was increased to $5.15 on September 1, 1997. President Clinton and other proponents of this action argued that the poor would be substantially better off as a result of this increase. The analysis in this chapter indicates why many economists and politicians are skeptical about this claim. Although it is true that the increase in minimum wage makes some workers better off by increasing their wages, other individuals would be made worse off. In particular, the increase in the wage rate is likely to motivate firms to substitute away from low-skilled workers toward more automation and additional high-skilled workers. Thus, the number of employees hired at the minimum wage is likely to decline with an increase in the wage. Estimates suggest that when the minimum wage was increased from $3.35 to 4.25$, employment among teenage men fell by 7.29 percent, and employment among teenage women fell by 11.34 percent ; employment among teenage blacks fell by 10 percent. Minimum wage workers who retain their jobs are better off ; but individuals who want a job, yet cannot find one, are worse off. *Source : D. Deere, K. Murphy, and F. Welch (1995), "Employment and the 1990-1991 Minimum-Wage Hike," American Economic Review 85 :2, 232-237.*

8.16 Television and newspaper publicity

In most countries, professional sports such as football probably could not survive without the free publicity they receive through newspaper, television and radio coverage. Equally, sports coverage is essential for the ability of the print and broadcasting media to attract readers, viewers, listeners and, thereby, advertising revenue.

For a long time, it has been assumed by sports administrators and academies that if a sports fixture is the subject of live television coverage, spectator attendance may be adversely affected. However, the statistical evidence for a negative impact of television coverage on attendance is rather mixed : some studies find such an effect, while others find no effect. Other relevant factors include the following :

- Even if attendance is affected, the loss of gate revenue might be compensated by direct income from the broadcaster, or indirect income from advertising or sponsorship within the stadium.
- The broadcasting rights might be more valuable if the stadium is full, due to the improved atmosphere created by a capacity crowd. Consequently, there might be a case for offering cheaper ticket prices to spectators attending televised matches.

8.17 City population and per capita income

There is a natural tendency for the strongest teams to be located in the cities with the largest population and/or largest per capita incomes. Teams with the largest potential or actual markets tend to generate the most income. In the long term this usually translates into playing success.

In the North American major league sports (baseball, American football, basketball and hockey), membership of the major leagues is closed : there is a fixed number of franchise-holding teams. In the longer term, franchises tend to gravitate towards the largest cities that can afford to pay the highest subsidies. In Europe, membership of the top divisions is regulated through the promotion and relegation System :

- If a small market team is promoted to the top division, its lack of spending power often ensures speedy relegation.
- If a big market team is relegated to a lower division, its high spending power will usually guarantee promotion back to the top division sooner or later.

8.18 Stadium facilities and hooliganism

In England, anecdotal evidence suggests that hooliganism and the antiquated, dilapidated physical condition of many football stadium made a major contribution to the long-term

decline in football attendances between the late 1940s and mid-1980s. Aggregate attendances for English league football fell from 41.0m in the 1948-9 season to 16.5m in the 1985-6 season, before recovering to reach 29.9m in the 2007-8 season.

Since the mid-1980s, incidents of hooliganism affecting English football at club level have become much less frequent. Over the same period, the stadia of most leading clubs have been significantly upgraded or completely rebuilt. Since the mid-1990s, Premiership clubs have been required to provide seated viewing accommodation only ; many lower-division clubs have done so as well.

8.19 Uncertainty of outcome and competitive balance

It is widely assumed by sports economists that spectator interest in sport depends on uncertainty of outcome. There are three (related) types of uncertainty of outcome :

- Degree of uncertainty concerning the result of an individual match.
- Degree of uncertainty concerning the end-of-season outcome of a championship race or a battle to avoid relegation.
- Degree to which championship success is concentrated in the hands of a few teams, or spread among many teams, over a number of years.

In today's English Premiership, there is less of all three types of uncertainty of outcome than in the equivalent competition (the Football League) 20, 30 or 50 years ago. There has been extensive debate concerning the usefulness of policy measures designed to promote competitive balance and increase uncertainty of outcome :

- Capping of teams' total expenditure on players' wages or salaries.
- Sharing or pooling of gate or television revenues.
- The US draft pick System, whereby the weakest teams from the previous season get first choice of new players turning professional for the first time.

8.20 Part II : Production and markets

8.21 Gains from Trade : The Story of McDonald's

McDonald's Corporation, with over 24 000 restaurants in 114 countries, is the largest fast-food company in the world. Its worldwide sales in 1998 were over $36 billion. Although Ray Kroc often is given credit for founding this company, the history of the restaurant goes back to 1937 when two brothers, Dick and Mac McDonald, opened a drive-in restaurant. These brothers conceived of the idea of a clean, efficient, quick-service restaurant with a limited menu featuring hamburgers and French fries. However, Kroc had the vision and the ability to take this idea and expand it nationwide. Taking advantage of potential gains from trade, the McDonald brothers sold Kroc the exclusive rights to franchise copies of their operation. This transaction resulted in one of the most successful business operations of all time.

Source : C. Shook and R. Shook (1993), Franchising : The Business Strategy That Changed the World (Prentice Hall : Englewood Cliffs, NJ).

8.22 Shifts in Demand, Quantity, and Price at the Ryder Cup

The Ryder Cup features competition between top American and European golfers. It has become one of the more prominent golfing events in the world. In 1995, the Ryder Cup was held at Oak Hill Country Club in Rochester, New York. The event attracted over 30,000 spectators a day. Many of these spectators (for example, Prince Andrew of Great Britain) were from outside the Rochester area. A significant number of these visitors were avid golfers who wanted to play while they were in Rochester. Rochester has several courses that are open to the public. However, many courses in the area are private (only members and their guests can play). Facing this dramatic temporary increase in the demand for public golf courses, several of the private courses decided to become public during the week of the Ryder Cup. These courses charged high fees ranging from $100 to $250 per round (their normal guest fees were approximately $50). This example highlights that shifts in demand motivate increases in the quantity supplied and the price of a product (in this case, golf times). 2.3 High Prices and Criminal Activity : Computer Chips Become a Big Black-Market Item The strong incentives that high prices provide to suppliers to bring products to marker unfortunately can be seen in die activities of criminals. Intel 486 chips sold for about $450 to $500 in 1993. These prices motivated increased theft of computer chips. For example, in September 1993, six masked men overwhelmed employees at one of Intel's right distributors, making off with $739,000 of microprocessors. Many similar robberies have been reported. According to The Wall Street Journal, "Forget drugs. Forget arms. If you want to make a black-market killing these days, steal computer chips. Chips are the dope of the 90's." Fortunately, the high prices of computer chips also have motivated legal activity to increase chip supply-other computer companies have developed producers to compare with Intel.

Source : E. Gonzales (1993), "Chips Become Big Black-Market Item," The Wall Street Journal (September 16), B1.

8.23 Supply of Online Résumés Bogs Down Employers

The Internet has reduced significantly the cost of submitting résumés to would-be employers. Job seekers no longer must print their résumés on high-quality paper, address, stamp, and mail an envelope. A click of the mouse and the résumé is gone. Some companies have thousands of résumés dumped into their e-mail boxes each day. During 1999 there were almost 5 million résumés on the Internet ?200 times more than in 1994. When the cost of a good (like submitting a résumé) falls, the quantity supplied increases.

Source : S. Armour (1999), "Online Résumés Bogging Down Employers," Democrat and Chronicle (July 19), 1F.

8.24 Learning the law of Demand the Hard Way

Mercury One-2-One is a British mobile-phone company. In a promotion to attract new customers, the company offered free telephone calls on Christmas to customers who signed

on between November 8th and Christmas Eve. The company "never dreamed its customers would be so generous in spreading the holiday cheer." The promotion generated more than 33 000 hours of calls, jamming the network and prompting hundreds of complaints from people who couldn't get through to place their calls. The volume on Christmas was about 10 times the daily average. Many people placed overseas calls and simply left the phone line open, logging free international calls of up to 12 hours. The average call was about 1.5 hours long ; the typical caller rang up about $60 worth of calls-equal to the average monthly bill of a cellular company in the United States. The promotion ended up costing the firm millions of dollars. One member of Parliament vowed to file a complaint with Britain's Board of Trade. To quote one executive of the company, "There's certainly been insatiable demand." *Source : K. Pope (1994), "Phone Company's Gift of Gab Jams Its Line", The Wall Street Journal (December 28), B1.*

8.25 Increased Foreign Competition and Demand Elasticities

Price elasticities for products usually increase with available substitutes. In recent years, there has been a dramatic increase in the amount of foreign competition facing many American companies. One result has been an increase in the demand elasticities for many American products. A specific example is film produced by Eastman Kodak. For years, Kodak had a virtual worldwide monopoly in the production of film. Correspondingly, consumers were relatively insensitive to the price of Kodak film-they had no alternative sources. Kodak now faces intense pressure from Japan's Fuji Corporation. Competition also comes from producers of store-brand film, such as the 3-M Corporation in the United States (store-brand film is sold under the store name at large discount drug, retail, and grocery stores). As a result, the demand for Kodak film is much more price-elastic. This change in price elasticities has motivated Kodak to change its pricing and product development strategies : It can no longer focus exclusively on selling high-quality film at high prices.

8.26 Short-Run versus Long-Run Effects of Increases in Gasoline Prices

In the 1960s, gasoline sold for about 25 cents per gallon in the United States. At this price, Americans tended to purchase large, powerful automobiles with poor gas mileage. In the early 1970s, Americans experienced an extraordinarily disruptive gasoline crisis. Not only did the price rise but for a time there were shortages of gasoline ; people had to wait in line sometimes for hours to fill their tanks. The increase in gasoline prices and waiting times resulted in a near-term decline in the quantity demanded of gasoline (people carpooled, drove less frequently, etc.). The longer-term effect was much greater ; in response to changes in consumer demand, car companies began designing smaller, more fuel-efficient automobiles. Currently, many cars travel at least 20 miles per gallon (and often much more). In the 1960s, many cars traveled fewer than 10 miles per gallon. 2.8 First-Mover Advantages and Financial Innovation US investment banks have introduced an impressive list of innovative financial products. Bankers estimate that developing a new financial product requires an investment of $50,000 to 5$ million. Yet the securities they create cannot be patented and SEC regulations compel innovators to disclose quite detailed information about product design. Thus rivals can copy the product at low cost and exploit the innovating bank's investment in educating investors, issuers, and regulators. Bankers estimate that imitators incur costs that are only 25 to 50 percent of the costs incurred by innovators. If financial innovation is profitable, these cost disadvantages of innovation must be offset by other benefits-first-mover advantages. These advantages might include higher prices, lower costs, or larger volume. In a study of 58 financial innovations that raised almost $280 billion over the period 1974 ?1987, there is no evidence that innovative banks charged higher prices during the brief "monopoly" period prior to the introduction of imitative products. In the longer run, they actually charged prices that were lower than those of their imitative rivals. This result should not be extraordinarily surprising. Investment banks typically choose one of their best customers as the issuer of an innovative product. These issuers will have special burdens placed on them in explaining the innovative product to investors, regulators, and rating agencies. If immediately following the offering, a rival firm were to issue an imitative product at a lower cost using a competing investment bank, the firm's managers might be understandably annoyed. Thus, investment banks profit from product innovation in ways other than charging higher prices. They underwrite more offers of the products they innovate than do imitating rivals. Innovation also appears to lower costs by allowing banks to exploit economies of scope and learning effects.

Source : P. Tufano (1989), "Financial Innovation and First-Mover Advantages," Journal of Financial Economies 25,213 ?240.

8.27 Using Technology to Assess Demand

The ACNielsen Corporation has been using handheld computers known as la maquinita-the little machine-to collect information on the buying habits of Hispanics. As part of a pilot program in Los Angeles, 500 Latino households are taking all their household purchases and scanning their bar codes into the device. This is the first time that comprehensive information has been collected on the buying habits of the Latino community, which now represents 12 percent of the US population. Eventually ACNielsen will sell the database to consumer product firms. The likely upshot will be more spending on ads targeting the Latino community. In 1998, an estimated $1.71 billion was spent on advertising to Latinos, representing about 2 percent of total advertising dollars in the United States. This example highlights how new technologies are being employed to assess product demand.

Source : R. Wartzman (1999), "A Push to Probe Buying Habits in Latino Homes," The Wall Street Journal (August 5), B1.

8.28 On Estimating Demand Curves for Common Stocks

There has been a long-running debate over the demand elasticities of common stocks of individual firms. Many economists argue that these demand curves are perfectly elastic, since there are numerous stocks with similar risk-return characteristics available in the

BY ROBERT J. BARRO

ATTENTION CONSUMERS: CREATIVITY NEVER COMES CHEAP

FOREVER: Whether you are buying a music CD or prescription drugs, the cost of development has to be part of the price

What do Napster Inc. and proposals to limit prescription-drug prices have in common? Both seek to reduce prices of goods that cost little to produce but were expensive to create initially. Cutting prices today looks great for users and, arguably, for society as a whole. If it costs virtually nothing to copy a CD over the Internet, why should people not be able to copy and listen to the music, rather than having to pay $15 down at the local store? If it costs only a few dollars to produce and distribute a standard quantity of Prozac, why should people not be able to buy the drug at $10, rather than at $100?

The problem is that the "high" price is the reward for the costly, long-term effort that went into the creation of the product. Music companies and artists expend time and money to create hits, and the bulk of the expenses goes into failed projects. To compensate for these efforts and to provide incentives for future hits, the industry has to reap large profits on its few successes.

IT'S ONLY FAIR. Piracy has long been a problem for producers of music and similar items, such as books, movies, and computer software. The incentive to abridge intellectual-property rights reflects the big gap between the prices charged by the copyright owners and the actual costs of copying and distribution. Innovations in the Internet and computer technology have dramatically lowered these costs. These advances are desirable because they allow products to reach a vastly expanded audience.

But there is a downside as well—the threat to intellectual-property rights. These rights are partly a matter of fairness, in the philosophical sense that inventors ought to be able to control the use of their discoveries. But more concretely, if intellectual-property rights disappear and no other effective method of compensating creativity is adopted, we will see much less brilliance in future music, books, movies, and software.

It may be that the Internet makes impossible the effective enforcement of intellectual-property rights in certain areas. If so, we are likely to be in trouble with respect to future creations. However, the best policy for now would be to maintain the highest feasible degree of property rights, and the pursuit of the legal case against Napster is a helpful part of this policy.

Prescription drugs are similar in many respects, although the Internet has not yet figured out how to physically copy drugs. However, the costs of sale and distribution will likely be reduced significantly because of the Net, once effective ways are developed to ensure the identity of the buyer.

One way to see that prices of patented drugs exceed current costs of production is to compare U.S. prices with the lower ones in some other countries. For example, Prozac sells in Canada for less than half of its U.S. price. Some people deduce that the U.S. ought to adopt Canada's single-payer policy for prescription drugs or, alternatively, allow reimportation of the cheaper pharmaceutical drugs back into the U.S. A more reasonable view is that the incentives for drug research and innovation created by high U.S. prices give Canada, Mexico, and other countries a free ride. If the U.S. were to follow Canadian policies, then fewer new drugs would be available in the U.S. and the rest of the world.

Complaints about high drug prices are on the rise, and the irony is that pharmaceutical companies would be facing fewer attacks if they had been less successful at developing new drugs. The winners of recent years include antidepressants, ulcer medications, agents to lower cholesterol levels, new types of antibiotics, and protease inhibitors to fight HIV. One would have thought that people would prefer the current environment, with many effective new drugs at high prices, to one with few or no new drugs at low prices. This choice is the relevant one for society, but many people pretend that they can have both low prices and many new drugs. It isn't so.

WHO PAYS? Particularly depressing are current suggestions for "solving the problem" by subsidizing purchases of prescription drugs through Medicare. If we have decided (I would say wisely) not to reduce the rewards to pharmaceutical companies for effective drugs, then the question becomes: Who shall pay for them? Adding drug purchases to Medicare means that payment will come from the general taxpayer rather than elderly users.

This shift might be defensible, despite the budgetary costs, if seniors were poorer than average. However, the opposite is now true, particularly because of the past expansions of Social Security and Medicare. The elderly are among the more well-off groups in America today.

Proposals for additional public spending on new health-care entitlements makes one yearn for the bad old days of budget deficits. At least at that time, attention was focussed on effective ways to curb Medicare, rather than on ways to expand it.

Robert J. Barro is a professor of economics at Harvard University and a senior fellow of the Hoover Institution (rjbweek@harvard.edu).

LAURIE BLACK PHOTOGRAPHY

9 Case studies - Economics of Consumption

In order to support discussion in the classroom, you will propose three slides about the case study you are assigned with.

You will produce 3 slides
— 1 for the survey of the case,
— 1 for the definitions of the economic notions at stake,
— 1 slide for your proposition of analysis of the case (graph or/and model).
NOTE : We here assume that you have carefully read the chapters of the Krugman's textbook. You may use the herein technical tools in the aforementioned case studies.

Part I are cases to be discussed in class. Part II are supplementary material. [1]

9.1 Part I - Consumer Theory

9.2 CASE 1 : A Blogger Who Understands the Importance of Ignoring Sunk Costs

In recent years, many people have started blogs -or, "Web logs"- where they record their thoughts on politics, sports, their favorite hobbies, or anything else that interests them. Some bloggers can spend hours a day writing up their latest ideas and providing links to relevant material on the Web. A few blogs become so successful that they attract paid advertising and earn their owners a good income. Arnold Kim began blogging about Apple products in 2000, during his fourth year of medical school. He continued blogging on his site, MacRumors.com, over the next eight years while pursuing a medical career as a nephrologist -a doctor who treats kidney problems.

By 2008, Kim's site had become very successful, attracting 4.4 million people and more than 40 million page views each month. Kim was earning more than $100,000 per year from paid advertising by companies such as Verizon, Audible.com, and CDW. But compiling rumors about new Apple products, keeping an Apple buying guide up to date, and monitoring multiple discussion boards on the site became more than he could handle as a part-time job. Kim enjoyed working on the Web site and believed that ultimately it could earn him more than he was earning as a doctor. Still, he hesitated to abandon his medical career because he had invested nearly $200,000 in his education. But the $200,000, as well as the years he had spent in medical school, completing a residency in internal medicine, and completing a fellowship in nephrology, were sunk costs. Kim realized he needed to ignore these sunk costs in order to make a rational decision about whether to continue in medicine or to become a full-time blogger. After calculating that he would make more from his Web site than from his medical career-and taking into account that by working from home he could spend more time with his young daughter- he decided to blog full time. He was quoted as saying, "on paper it was an easy decision." Knowing that it is rational to ignore sunk costs can be important in making key decisions in life. Source : Brian Stelter, "My Son, the Blogger : An M.D. Trades Medicine for Apple Rumors," New York Times, July 21, 2008 ; and Dan Frommer, "Nephrologist to Mac Blogger : The Unlikely Career Path of MacRumors' Arnold Kim," businessinsider.com, July 13,2008.

Would you give up being a surgeon to start your own blog ?

Source : Hubbard & O'Brien, 2010, Microeconomics, Prentice Hall ?

9.3 CASE 2 : Why Don't Students Study More ?

Government statistics show that students who do well in college earn at least $10,000 more per year than students who fail to graduate or who graduate with low grades. So, over the course of a career of 40 years or more, students who do well in college will have earned upwards of $400,000 more than students who failed to graduate or who received low grades. Most colleges advise that students study at least two hours outside class for every hour they spend in class. Surveys show that students often ignore this advice.

If the opportunity cost of not studying is so high, why do many students choose to study relatively little ? Some students have work or family commitments that limit the amount of time they can study. But many other students study less than they would if they were more realistic about their future behavior. On any given night, a student has to choose between studying and other activities-such as watching television, going to a movie, or going to a party-that may seem to provide higher utility in the short run. Many students choose one of these activities over studying because they expect to study tomorrow or the next day, but tomorrow they face the same choices and make similar decisions. As a result, they do not study enough to meet their long-run goal of graduating with high grades. If they were more realistic about their future behavior, they would not make the mistake of overvaluing the utility from activities such as watching television or partying because they would realize that those activities can endanger their long-run goal of graduating with honors.

If the payoff to studying is so high, why don't students study more ?

?

9.4 CASE 3 : The New Philanthropy

Charitable giving by U.S. citizen totals over $200 billion annually-roughly 2 percent of national income [2]. Such altruism has been highlighted by some notable gifts (in real as well as nominal terms) from prominent business leaders. For example, as of 2004, Microsoft cofounder Bill Gates and his wife Melinda had given over $25 billion to their philanthropic foundation. In real terms Bill and Melinda Gates have given money away faster and in greater amounts than any-one else in history. By comparison, the charitable contributions

1. Sources : Brickley, Smith, Zimmerman, Managerial Economics and Organizational Architecture (2001), McGaw-Hill. And others ?

2. This application is based on "The New Philanthropy," Time (iuly 24, 2000), pp. 49-59.

of early-twentieth-century oil tycoon and noted benefactor John D. Rockefeller total $6 billion in 2005 dollars. Steel magnate and philanthropist Andrew Carnegie's giving amounts to $5 billion in 2005 dollars.

Although significant in real terms, modern-day altruism is similar in three ways to the philanthropy of previous generations. First, U.S. citizens have consistently distinguished themselves by their willingness to give of their time and money. This was a cultural trait noted by Frenchman Alexis de Tocqueville in his classic Democracy in America after visiting the United States in the early 1800s. A recent Johns Hopkins survey indicates that 49 percent of U.S. respondents volunteered their time for civic activities in the previous year, versus 13 percent of Germans and 19 percent of French. The survey also indicated that 73 percent gave money to charity over the last year versus 44 percent of Germans and 43 percent of French.

Second, much like the federal food stamp program described in the preceding section, philanthropic gifts typically come with restrictions about who the intended beneficiaries will be, and in what particular dimensions those beneficiaries are meant, by the donor, to be better off : For example, one of the first big commitments made by Bill Gates was in 1997 and involved paying billions to help children specifically through wiring every library in the country to the internet. Many of the libraries wired through the Gates gift had been started earlier in the century through the munificence of Andrew Carnegie, who similarly wanted to provide opportunity to U.S. youth through a subsidy of a particular good (libraries) rather than an equivalent cash subsidy.

Finally, the intensity of preferences for giving to others differs, as it always has, across individuals. Unlike Gates, for instance, Larry Ellison, the founder of Oracle, is skeptical about the extent to which philanthropy can solve the world's problems. Worth about $19 billion of 2004, Ellison does not give as much-about $100 million per year-because he believes that the profit motive is the best tool for solving the world's problems.

Ellison asks, "Which did more for the world ? The Ford Motor Company or the Ford Foundation ?"

9.5 Case 4 : Using Price to Deter Youth Alcohol Abuse, Traffic Fatalities, and Campus Violence

Although economists ascribe an important role to price in determining the quantity demanded of a product, policymakers often do not. A case in point is the campaign waged by policymakers since the mid-1970s to discourage alcohol abuse and thereby decrease the number of traffic-related deaths. One of the main campaign objectives has been to raise the legal age of alcohol consumption to 21 years. The reason behind this is that while people under the age of 25 represent 20 percent of all licensed drivers, they account for 35 percent of all drivers involved in fatal accidents. Alcohol is involved in more than half the driving fatalities accounted .for by young drivers.

By raising the legal age for alcohol consumption to 21, policymakers hope to shift the demand curve for alcohol to the left (diminishing the portion of the population with access to alcohol) and thereby reduce both alcohol abuse and driving fatalities. Shifting the demand curve for alcohol to the left is one way to reduce alcohol abuse and traffic fatalities. However, economic research suggests that a more effective method, even among teenagers, would be to raise the price of alcohol through higher taxes, thereby producing a movement along the demand curve for alcohol.

The federal tax on alcohol was constant in nominal dollar terms between 1951 and 1.991 ($9 per barrel of beer, $10.50 per proof gallon of distilled spirits such as vodka, and so on) and has only been increased modestly since then. In real terms, consequently, the federal tax on alcohol has decreased since 1951. For examples, the real federal tax on beer has declined by 70 percent since 1951 while the real tax on distilled spirits has decreased by 81 percent. The decline, in real terms, of the federal tax on alcohol is a major factor behind the substantial decrease in the real price of alcohol since 1951- 40 percent in the case of beer and 70 percent for hard liquor.

A national survey of teenagers finds that, holding constant other factors such as a state's minimum drinking age, religious affiliation, and proximity to bordering states with lower minimum drinking ages, the amount of alcohol consumed by the average teenager in a state is significantly influenced by the price of alcohol there [3] .

The survey findings suggest that raising taxes on alcohol offers a potent mechanism for deterring alcohol abuse and traffic fatalities among teenagers. Specifically, based on the survey's results, had federal taxes on alcohol remained constant since 1951 in real purchasing power terms rather than in dollar terms, teenage drinking would have fallen more than if the minimum drinking age had been raised to 21 in all states. Raising the price of drinking and moving along the demand curve for alcohol thus promises to be more effective in reducing teenage drinking than the policy pursued by most policymakers-shifting the demand curve for alcohol to the left by imposing age restrictions.

According to another study, the decline in the real price of alcohol also appears to have resulted in an increase in campus violence over the last decade [4]. Currently, a third of the college student population of 14.5 million in the United States is expected to be involved, in any given year, in some kind of campus violence (arguments, fights, run-ins with police or college authorities, sexual misconduct, and so on). Because alcoholic consumption is positively correlated with violence, the study examined the relationship between prices of six-packs of beer and levels of violence at colleges around the country. The study found that a 10 percent increase in the price of beer would be sufficient to decrease campus violence by 4 percent, other factors held constant. However, since the real price of beer has actually fallen by 10 percent since 1991-largely due to the decline, in real items, of the federal tax on alcohol-the converse result has occurred. Namely, the study concludes that campus violence has increased by 4 percent (200,000 incidents) since 1991 on account of the decline in the real price of beer.

3. According to Douglas Coate and Michael Crossman, "Effects of Alcoholic Beverage Prices and Legal Drinking Ages on Youth Alcohol Use," Journal of Law and Economies, 31 No. 1 (April 1988), pp. 145-172, the estimated price elasticity of demand for teenage drinking ranges from 0.5 to 1.2.

4. How to Calm the Campus," Business Week, November 1, 1999, p. 32

9.6 Case 5 : Do Rats Have Downward-Sloping Demand Curves ?

Logical reasoning and empirical evidence support the proposition that humans have downward- sloping demand curves. The inquiring reader may wonder whether the law of demand also applies to the behavior of animals. Experimental evidence suggests that it does. Consider the results of a study on rats done by researchers at Texas A&M University [5]. The rats were found to have downward-sloping demand curves for root beer and Tom Collins mix. Researchers confronted each rat with a budget line relating root beer and Collins-mix. They charged a "price" by requiring the rats to press a lever to receive 0.05 milliliter of each beverage. The "incomes" of the rats were determined by allocating each rat a certain number of lever presses per day. With an income of 300 lever presses and equal prices for root beer and Collins mix, rats expressed a decided preference for root beer and spent most of their incomes on it. Then, the price of Collins mix was cut in half (half as many lever presses required per unit of Collins mix) and the price of root beer doubled, with income set so that each rat could still consume its previously chosen market basket if it wished. Economic theory predicts that consumption of Collins mix will rise and root beer fall given the new "prices". The theory proved correct : the rats chose to consume more than four times as much Collins mix as before and less root beer.

In a more recent study, researchers attempted to create a situation in which the rats would consume less at a lower price (and, conversely, more at a higher price) ? the Giffen good case [6]. Economic theory suggests that this can occur only when the good is strongly inferior and occupies a large portion of the budget (so .the income effect is large). When consumption of fluids was restricted to root beer and quinine water, the researchers found that quinine water was an inferior good for the rats. They then lowered the rats' "incomes" to the point where most of their budget was devoted to quinine water ; a change in the price of quinine water would then have a large income effect. Next came the crucial experiment : the price of quinine water was reduced. The rats consumed less quinine at the lower price and used their increased real income to increase their root beer consumption. A Giffen good case finally had been found. What is particularly interesting about the experimental results is that the Giffen good case was demonstrated in exactly the circumstances that theory emphasizes are necessary - a strongly inferior good, with most of the budget devoted to purchases of that good.

9.7 Case 6 : The Consumer Surplus Associated with Free TV

Until the advent of cable, television was not sold directly to viewers. The price of viewing broadcast -programming was zero (apart from the opportunity cost of the viewer's time and the electricity necessary to power the set) for a household with a television and clear reception of the signal. Most of the costs of operating over-the-air networks and stations were, and still are, covered by sales of broadcast time to advertisers.

ln the heyday of free television, viewing options were limited but the consumer surplus accruing to viewers was not. In 1968, for example, the average U.S. household had access to three network stations and one independent station. The estimated annual consumer surplus garnered by viewers was $32 billion (176 billion in 2005 dollars) due to a price of zero for broadcast television [7]. The estimated consumer surplus vastly exceeded the $3.5 billion in advertising revenues earned by all television stations in 1968.

A prominent economic study published in 1973 indicated that an expansion in viewing options, in terms of the consumer surplus generated through such an expansion, would be highly valued. According to the study, a fourth network would add $4.2 billion in consumer surplus as of 1968 ($23 billion in 2005 dollars). Expansion, however, was precluded by regulations as well as by the fact that it was not technologically feasible to charge viewers for the additional programming.

The study's results suggest why cable television has grown so rapidly over the past 40 years. Namely, by figuring out a way to exclude nonpayers and charge subscribers for their service, cable operators have been able to capture some of the television consumer surplus from either existing or newly developed programming and convert it into cable company profits. Television owners have found subscribing to cable attractive because it allows them to expand their viewing options (experiments involving cable Systems with up to 500 channels of programming have recently been undertaken), enhanced options that generate consumer surplus. Currently, 67 percent of U.S. households subscribe to cable, and the average subscribing household spends approximately $40 per month on cable. In comparison, the amount of advertising revenues earned by broadcast stations averages roughly $35 per month per household.

9.8 Case 7 : Network Effects and the Diffusion of Communications Technologies and Computer Hardware and Software

Communications technologies are prime examples of products characterized by positive network effects [8] . As the established user base of telephones, fax machines, the Internet, and e-mail grows, increasingly more individuals find adoption worthwhile. Consequently, such products tend to be characterized by relatively long developmental periods followed by rapid diffusion. Take the case of fax machines, a product that AT&T first introduced in 1925. The technology, however, was little used until the mid-1980s, when demand for and supply of fax machines exploded. While ownership of fax machines was negligible prior to 1982, over half of American businesses had at least one fax machine by 1987.

Internet usage has followed a similar pattern. While the first e-mail message was sent in 1969, Internet traffic did not begin to grow substantially until the late 1980s. Once it

5. John Kagel et al., "Experimental Studies of Consumer Demand Behavior Using Laboratory Animals," Economic Inquiry, 13 No. 1 (March 1975), pp. 22-38.

6. Raymond C. Battalio, John H. Kagel, and Cari Kogut, "Experimental Confirmation of the Existence of a Giffen Good," American Economic Review, 81 No. 3 (September 1991), pp. 961-970

7. Roger G. Noll, Merton j. Peck, and John J. McGowan, Economic Aspects of Television Regulation (Washington, D.C. : Brookings Institution, 1973).

8. This application is based on Cari Shapiro and Haï R. Varian, Information Rules (Boston : Harvard Business School Press, 1999) ; :and Austan Goolsbee and Peter J. Klenow, "Evidence on Learning and Network Externalities in the Diffusion of Home Computers," Journal of Law and Economies, 45 No. 2 Pt 1 (October 2002), pp. 317-343.

began to grow, however, it doubled annually in virtually every year after 1989.

Positive network effects are not limited to communications technologies. They are also at the heart of explaining the diffusion of computer software and hardware, where popular systems enjoy a significant competitive advantage over less popular systems. Personal computers provide a telling example. A study of 110,000 American households in 1997 suggests that the rate of adoption of personal computers may have been almost doubled on account of network effects. Moreover, the observed network effects are strongly related to usage of the Internet and e-mail.

Positive network effects also likely have played an important role in the rapid spread of popular computer software programs such as Microsoft Windows operating system and Office (a combination of word processing, spreadsheet, data base, and presentation programs). Both products quickly acquired shares of over 90 percent of their relevant markets.

Of course, the same positive network effects propelling a product's rapid diffusion can also have adverse legal consequences. For example, the Justice Department's antitrust case against Microsoft hinged critically on the positive network effects fueling Window's success. The Justice Department alleged that a positive network effect allowed Microsoft to capture a dominant share of the personal computer operating system market. In turn, the built-in customer base gave Microsoft a significant edge in the browser market for its Internet Explorer product over rival Netscape Navigator, said the Justice Department, because, at no extra charge to consumers, Microsoft packaged Internet Explorer with its Windows operating system.

But one point that deserves mention here is that positive network effects can be a two-edged sword for suppliers. Although a bandwagon effect enhances the possibility that a supplier will capture a dominant market share, it simultaneously limits the supplier's ability to exploit that position through a price increase. The market demand curve is more price elastic when there are positive network effects present. In the case of Windows, this implies that Microsoft's ability to exploit, through a price increase, the dominant customer base that a bandwagon effect helped to build is limited by the same bandwagon effect. Should Microsoft attempt to raise Windows' price, customers would run toward alternative operating Systems more quickly than they would without the bandwagon effect being present.

9.9 Case 8 : Income and substitution effects and home ownership

The likelihood of home ownership in the United States increases with income [9]. For example, 35 percent of families with an annual income of less than $10,000 own a home versus 68 percent of families with an annual income of between $25,000 and $49,999 and 93 percent of families with an annual income of $100,000 or more. This phenomenon is due partly to an income effect : home ownership is a normal good, and as income increases, so does the likelihood of home ownership. A substitution effect, however, is also at work. This is because mortgage interest payments on a home can be deducted from the personal income subject to federal taxation, and the tax rate increases with income. Since higher-income individuals can disproportionately reduce the amount they owe in taxes through the mortgage interest deduction, the relative price of home ownership is lower for them. The lower relative price, a substitution effect, thus also encourages a positive correlation between income and home ownership.

9. Jeffrey M. Perloff, Microeconomics, 2nd ed. (Boston ; Addison-Wesley Longman, 2001) and U.S. Census Bureau, Statistical Abstract of the United States : 2001 (Washington, DC : U.S. Government Print-ing Office, 2001)

9.10 Case 9 : Trash Pricing and Recycling

There have been numerous news stories in recent years concerning the problem of garbage disposal in the United States. Despite the many admonitions to moderate their trashy habits, Americans generate nearly 4 pounds of garbage per day, up from 2.6 pounds per day in 1960. In part, this behavior results from the fact that most communities use systems like the fixed annual fee to finance trash collections, so residents don't have to pay more when they discard more trash. The Perkasie experience shows that some pricing policies can give people an incentive to generate less trash. Starting from close to the national average in terms of the trash produced on a per-citizen basis. Perkasie was able to cut its trash collections in half by switching to a per-bag pricing scheme.

Charging by the bag not only can reduce a municipality's garbage collection costs and more fairly allocate expanses across households based on the amount of garbage generated, but it also encourages recycling, a substitute for trash generation. For example, the largest and oldest per-container billing system in the United States is in Seattle. Since the billing program's inception in 1981, the percentage of trash recycled in Seattle has risen from 5 to 42 percent.

The principal complaint regarding per-bag billing is that it provides an incentive for illegal dumping. Some Seattle homeowners, for example, routinely leave their garbage in apartment house dumpsters. In response, the owners of such dumpsters have begun padlocking them.

9.11 Case 10 : Risk Aversion While Standing in Line

Many airline ticket counters, department of motor vehicles offices, federal customs checkpoints, banks, postal branches, college financial aid departments, and fast-food restaurants have a single line feeding to multiple clerks as opposed to separate lines for each clerk. This is the case even though a single-line system is unlikely to alter the average time a customer must spend waiting to see a clerk. After all, the line is not likely to affect either the total number of clerks or the number of customers waiting to see them.

A single line, however, does reduce the variance of a customer's waiting time since a customer is less likely to get into a "slow" or "fast" line. Holding constant the expected waiting time, the reduction in the variance of the waiting time will be appealing to customers if they are risk averse to spending time in lines. If a sure wait of 5 minutes is preferred to

the prospect of a 0.5 probability each of a 2-minute and an 8-minute wait, customers will be happier under the single-line system. According to operations researchers, at least part of the reason customers prefer less variance when waiting in line is their sense of social justice. Specifically, relative to an expected wait of 5 minutes, experiencing only a 2-minute wait because one is fortunate enough to get into a "fast" line appears to add less to total utility than experiencing an 8-minute wait in a "slow" line subtracts from total utility, since the longer wait brings with it the added aggravation of seeing more recent arrivals who get into a fast line receive service first [10].

9.12 Case 11 : Geographic market segmentation

Fifty years ago, the markets served by each English football club were local : most spectators lived within walking distance or a short bus or train journey from the stadium. Today, the most successful clubs attract a national audience. Factors that have contributed to reduced geographic market segmentation have included :

— growth in private car ownership ;
— improvements in the road transport System ;
— demographic change (population is more mobile geographically) ;
— Increased media coverage of star players and leading teams.

9.13 Case 12 : The Benefits and Costs of Rationing by Waiting

An equal allocation of ration coupons or a lottery is not the only non-price ways of rationing a good that is in short supply at the existing price. Sometimes, a price-controlled good is allocated to buyers on a first-come, first-served basis. This rationing-by-waiting approach has the advantage that, if there are no costs to waiting, consumers placing the highest marginal value on a good have the greatest incentive to get in line to purchase the good. To the extent that consumers placing the highest marginal value on a good are at the head of the line, efficiency in the distribution of the good among consumers is promoted.

Rationing by waiting, however, has its costs if consumers have something else that they could be doing besides waiting in line. For example, a study examined the effects of a price ceiling applied to a Chevron station in Ventura, California, in 1980 versus two competing stations not subject to the same price ceiling [11] . (Stations owned and operated by integrated oil companies were subject to the price ceiling while those operated by independent or franchised dealers were not) The study found that the price at the Chevron station was $0.19 per gallon lower than at the competing stations. Because of the lower price, long lines formed at the Chevron station, and the average time a consumer spent waiting in line was 15 minutes. By contrast, there was no waiting at the competing stations.

10. Richard C. Larson, "Perspectives on Queues : Social Justice and the Psychology of Queuing," Operations Research, 35 No. 6 (November-December 1987), pp. 895-905

11. Robert T. Deacon and Jon Sonstelie, "Rationing by Waiting and the Value of Time : Results from a Natural Experiment," Journal of Political Economy, 93 No. 4 (October 1985), pp. 627-647

The study surveyed customers at the various stations and estimated the customers' opportunity cost of time based on their employment and income characteristics. The study found that a significant percentage of the increase in consumer' surplus generated by the price ceiling was dissipated through the costs of having to wait in line to buy the low-priced Chevron gasoline. Specifically, once the costs of waiting were accounted for, consumers received only 49 percent of the increase in consumer surplus generated by the price ceiling at the Chevron station. Moreover, the study pointed out that there is no guarantee that if costs are associated with waiting, the consumers placing the highest marginal value on a good will also be the ones with the lowest opportunity cost of time. To the extent that high-marginal-value customers also have a high opportunity cost of time, they will be discouraged from waiting in line and a rationing-by-waiting scheme will not allocate the good across consumers in an efficient manner. ?

9.14 Part II - Market Demand

9.15 Case 13 : Price Elasticities

Economists have estimated the price elasticities of various products, such as

Sugar	=0.31
Potatoes	=0.31
Tires	=1.20
Electricity	=1.20
Haddock	=2.20
Movies	=3.70

These estimates indicate that sugar and potatoes have relatively low price elasticities. This might be expected given that these products represent a small portion of most people ?s budgets. Also, sugar has few close substitutes. Haddock and movies have high elasticities. Haddock is a narrowly defined product (as opposed to fish) and has many close substitutes. Movies are a luxury item for many people ; higher prices cause individuals to consume other forms of entertainment.

Source : E. Mansfield (1988), Microeconomics (W.W. Norton : New York), 142.

9.16 Case 14 :Demand Elasticities and Airline Pricing

Round-trip airfares are substantially lower if the traveler stays over a Saturday night. Airline companies offer this discount to increase revenues (and profits). The typical traveler who stays over a Saturday night is a tourist. Tourists have relatively high price elasticities for air travel. Lowering the price from the standard fare correspondingly increases revenue : The price decrease is more than offset by the increase in tickets sold. Airline companies do not offer comparable discounts to travelers who complete the round-trip midweek. These customers are primarily business travelers who have relatively inelastic demands. Lowering price would decrease revenue because the decrease in price would not be offset by an

increase in tickets sold. Airline companies also offer fewer discounts during peak periods, such as the period around the Thanksgiving holiday. During these periods, demand is relatively inelastic and they can fill the planes without offering substantial discounts.

9.17 Case 15 :Complementarity between Computer Hardware and Software

Over the past decade, there has been a dramatic decrease in the price of personal computers. Not only has the price of PCs decreased, but their quality and computing power have improved significantly as well. This decrease in the price of personal computers has increased the quantity of PCs demanded enormously. In addition, it also has increased the demand for software products. Today, some of the largest companies in the world (for example, the Microsoft Corporation) specialize in the production of software for PCs. Computer hardware and software are complements and thus have negative cross elasticities.

9.18 Case 16 :Derived Demand

Some products are demanded, not because individuals receive pleasure from consuming them, but rather because they are useful in the consumption of other products. Demands for these products are derived from the demands from other products. Take motor oil, for example. Few people derive satisfaction from purchasing oil for their automobiles. Rather, this oil is a derived demand from consuming transportation services provided by your car. Procter & Gamble (P&G) discovered that spraying a bit of their Clean Shower bathroom cleaning product on a razor each day can extend the razor's life three or four times. They are formulating a product targeted to this use. Thus, this new products demand is derived from the demand for razor blades.

9.19 Case 17 :Estimates of Cross Elasticities

All the pairs of commodities listed above are substitutes. Complements such as DVD players and DVD movies have negative cross elasticities. Natural gas apparently is not a very strong substitute for electricity. Although people can use either gas or electricity for heating, natural gas is not generally used for lighting. On the other hand, natural gas and fuel oil are closer substitutes (both tend to be used for heating). Margarine and butter are strong substitutes. *Source : E. Mansfield (1988), Microeconomics (W.W. Norton : New York), 143.*

9.20 Case 18 : Russian Cola Wars

In 1999, Crazy Cola had a 48 percent market share in Krasnoyarsk, Russia. Crazy Cola, produced locally by OAO Pikra, is headed by a 60-year-old former communist factory worker named Yevgeniya Kuznetsova. Ms. Kuznetsova formerly bottled Pepsi at a state-run plant. A 1.5-liter bottle of Crazy Cola sold for about 39 cents, compared to 77 cents for a two-liter bottle of Coke or Pepsi. Krasnoyarsk is a poor community, and many residents are unwilling to pay a premium for brand-name colas. To quote one 25-year-old graduate student, Viktoria Pimenova, "Crazy Cola is fun, and it's our local product. But it is a drink for people who don't have money. Coke and Pepsi taste better." This statement suggests that Crazy Cola is an inferior good, while Coke and Pepsi are normal goods. This implies that if the incomes of local residents increase, demand for Coke and Pepsi will increase, while the demand for Crazy Cola will decrease. *Source : B. McKay (1999), "Siberian Soft-Drink Queen Outmarkets Coke and Pepsi," The Wall Street Journal (August 23), Bl.*

9.21 Case 19 : Estimates of Income Elasticities

Economists have estimated the income elasticities for various products. Below are a few of these estimates :

Flour	=-0.36
Natural gas and fuel oil	=0.44
Margarine	=-0.20
Milk and cream	=0.07
Dentist services	=1.41
Restaurant consumption	=1.48

According to these estimates, flour and margarine are inferior goods. People spend less on these goods as their incomes rise. The other goods are normal goods (expenditures on the products rise with income). Dentist services and restaurant consumption are particularly sensitive to income changes.

Source : E. Mansfield (1988), Microeconomics (W. W. Norton : New York), 143.

9.22 Case 20 : Store Layout Affects Demand

Paco Underhill calls himself a "retail anthropologist." His consulting firm video tapes consumers as they shop at his clients' stores such as Sears, The Gap, and McDonald's. He then offers recommendations for store layout. For example, most North Americans turn right after entering a store while most British and Australian customers turn left. Consumers tend to avoid narrow aisles ; they apparently dislike being jostled from behind (what he calls the "butt-brush factor"). Junk food should be placed on low or middle shelves so kids can reach them. After finding that women spend only half the time in the store when accompanied by a man, he recommends placing numerous chairs around stores so men can sit comfortably while the women shop. *Source : K. Labich (1999), "Attention Shoppers : This Man Is Watching You," Fortune (July 19), 131-133*

9.23 Case 21 : Demand Elasticity for Gasoline

The industry-level demand for gasoline is relatively inelastic : The price of gasoline can change substantially and have little effect on the overall quantity demanded. The demand elasticities facing individual gas stations are much larger. If several gas stations are located at the same intersection, an individual station can suffer a remarkable loss of business to its local competitors by raising its price.

9.24 Case 22 :Understanding Consumer Demands at The GAP

Companies spend considerable resources trying to determine the specific preferences of their customers. One industry where knowledge of consumer preferences is particularly important is the apparel industry. Popular fashions change frequently, and successful firms must be "close to the customer." The importance of knowing customer demands is highlighted by the following statement made by The GAP president, Millard Drexler : "We just keep trying to figure out what people wear on a regular basis. Our business is reading signals from the customer day in and day out." The GAP's success in apparel retailing suggests that this activity can pay off. *Source : S. Caminti (1991), "The GAP Reading the Customer Right," Fortune (December 2), 106*