

**Ministry of Education and Science of Ukraine**

**NATIONAL UNIVERSITY OF WATER  
AND ENVIRONMENTAL ENGINEERING**

*Department of Enterprise Economics and International Business*

**06-01-257M**

**METHODICAL MANUAL  
FOR SELF-DEPENDENT EDUCATIONAL AND  
RESEARCH WORK**

**in**

***MICROECONOMICS***

*(English as a Medium of Instruction for Foreign Students)*

*for full-time Bachelor students majoring in*

*076 «Entrepreneurship, Trade and Exchange activities»*

Approved by the Scientific and  
Methodological Council on Quality  
of the Institute of Economics and  
Management

*November 20 2020,*

*Minutes No. 12*

Rivne – 2020

**Methodical manual for self-dependent educational and research work in *Microeconomics* (English as a medium of instruction for foreign students) for full-time Bachelor students majoring in 076 “Entrepreneurship, Trade and Exchange Activities” /**  
D. Nikytenko, A. Ventsuryk, L. Kupchyk. – Rivne : NUWEE, 2020.  
– 26 p.

Authors: *Dmytro Nikytenko, Doctor of Economic Science,  
Associate Professor*  
*Alisa Ventsuryk, Candidate of Economic Science*  
*Larysa Kupchyk, Candidate of Pedagogical Science,  
Associate Professor*

***Head of curriculum:***

*«Entrepreneurship, trade and exchange activity» –  
Stakhiv O. A., Candidate of Economic Sciences, Associate Professor*

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## INTRODUCTION

**Educational and research task** (ERT) is an important component of students' self-dependent work within the course of «Microeconomics».

ERT is an analytical and calculation work which allows students to better understand the theoretical content, acquire skills of economic calculation, experience of the application of microeconomic analysis principles and purposes to justify the optimal solutions founded by microeconomic subjects – consumers and companies, whose behaviour is studied by “Microeconomics” in different market structures.

Modelling of the behaviour of consumers and companies is carried out by the general rules of microeconomic modelling and includes three main items: *goals*, *constraints* and *choice of solutions*.

ERT consists of three parts:

1. Modelling the consumer's behaviour.
2. Modelling the behaviour of a perfectly competitive firm.
3. Modelling the monopolistic behaviour.

Each ERT part involves performing calculations, graphs construction and provides a brief explanatory note describing the economic content of consumer's or company's reactions.

*Every student is assigned with individual data tasks.*

**The ERT** is assessed at **15 points** (5 points for each of the three parts) on the completed, timely work, successfully done and defended. It is part of the overall 100-point assessment of student achievements in the course.

### **References:**

1. Hrontkovska G. E., Kosik A. F. Microeconomics. Workshop : Textbook. Issue 3<sup>rd</sup>. Kyiv : TSUL, 2010. 418 p. (*in Ukrainian*)
2. Kosik A.F., Hrontkovskaya G.E. Microeconomics : Textbook. Issue 2<sup>nd</sup> supplemented. Kyiv : TSUL, 2008. 438 p. (*in Ukrainian*)

## **TASK TO PART 1**

### **MODELLING THE CONSUMER'S BEHAVIOUR**

The consumer, whose utility function is described by the equation, must choose the optimal consumer basket that would allow him to achieve the goal (maximize the total utility of the set of goods) under existing constraints (its income and existing commodity prices).

#### **Task 1. Optimization of consumer choice. Consumer's equilibrium (Figure 1.1):**

- 1.1. Calculate the numerical value of the total utility according to the variant.
- 1.2. Construct a utility function (indifference curve).
- 1.3. Build a budget line.
- 1.4. Determine the consumer's equilibrium position graphically and check its compliance with the structure of the optimal consumer basket analytically.

#### **Task 2. Determinate how price changes affect consumer choices (Figure 1.2):**

- 2.1. Transfer the indifference curve and the budget line from Figure 1.1 to Figure 1.2.
- 2.2. Calculate the numerical value of total utility associated with the change in the price of commodity  $X$ .
- 2.3. Construct a new utility function (indifference curve).
- 2.4. Build a new budget line.
- 2.5. Graphically and analytically, determine the consumer's equilibrium position and the structure of the optimal consumer basket.
- 2.6. According to Hicks model build compensating budget line, determine the point of compensating (conditional) balance and structure of the consumer basket *graphically*.
- 2.7. Determine the substitute effect, income effects and the total effect *graphically*.
- 2.8. Construct the "price–consumption" curve.
- 2.9. Build an individual demand curve for commodity  $X$ , which is correlated below with the graph of changes in the consumer equilibrium state.

**2.10.** What is the price elasticity of commodity X demand?

**Task 3: Determinate how a change in income affects consumption choices (Figure 1.3):**

**3.1.** Transfer the indifference curve and the budget line from Figure 1.1 to Figure 1.3.

**3.2.** Calculate the numerical value of the total utility associated with the change in consumer income.

**3.3.** Construct a new utility function (indifference curve).

**3.4.** Build a new budget line.

**3.5.** Graphically and analytically, determine the new position of consumer equilibrium and the structure of the optimal consumer basket.

**3.6.** Construct the “income-consumption” curve.

**3.7.** Build a graph of changes in individual demand for commodity X below correlated with the graph of changes in consumer’s equilibrium state (Figure 1.3).

**3.8.** What is the income elasticity of commodities X and Y consumption?

### *Set of Values for Part 1*

#### *Modelling of consumer’s behaviour*

Variant №	Consumer Income (I) UAH	The price for commodity X ( $P_X$ ), UAH	The price for commodity Y ( $P_Y$ ), UAH	Price changes for commodity X ( $\Delta P_X$ ), UAH	Changes in consumer income ( $\Delta I$ ), UAH
1	2	3	4	5	6
1	10	1	2	+1	+2
2	20	1	2	+2	-4
3	10	2	1	-1	-2
4	20	2	1	+3	+4
5	16	1	4	+3	-4
6	32	2	4	+6	-8
7	32	4	2	+4	-16
8	18	1	3	+2	-3
9	18	3	1	+3	-6
10	36	2	3	+4	-6
11	36	3	2	+3	+6
12	12	2	3	-1	-6
13	24	2	3	+1	-6
14	24	3	2	-1	+6
15	12	3	2	-1	+6

## GUIDELINES ON PART 1

### *Modelling the consumer's behaviour*

Utility function of the consumer is:  $= \sqrt{X} * \bar{Y}$ .

Consumer budget constraint is described by equation:

$$I = P_X * X + P_Y * Y.$$

*Assume that the initial data of the option are as follows:*

Variant №	Consumer Income (I) UAH	The price for commodity X (P <sub>X</sub> ), UAH	The price for commodity Y (P <sub>Y</sub> ), UAH	Price changes for commodity X (ΔP <sub>X</sub> ), UAH	Changes in consumer income (ΔI), UAH
<b>16</b>	20	2	4	+3	- 4

**Task 1.1. Optimization of consumer choice. Consumer equilibrium (Figure 1.1):**

**1.1.** Calculate the value of total utility by equations:  $U = \frac{I}{2\sqrt{P_X * P_Y}}$

$$U = \frac{20}{2\sqrt{2 * 4}} = \frac{5}{\sqrt{2}}$$

**1.2.** Calculate the structure of the set of consumer basket, which corresponds to the obtained value of the level of total utility from 1.1:

$$U = \sqrt{X * Y} \Rightarrow U^2 = X * Y$$

$$U_1^2 = \left(\frac{5}{\sqrt{2}}\right)^2 = \frac{25}{2} = 12,5 = X * Y \Rightarrow Y = \frac{U^2}{X} = \frac{12,5}{X}$$

Find value Y for any given value X:

<b>X</b>	1	1,5	2	3	4	5	6	7	8	9	10
<b>Y</b>	12,5	8,3	6,25	4,2	3,1	2,5	2,1	1,8	1,6	1,4	1,25

According to calculations presented in the table, build the indifference

curve  $U_1$  in Figure 1.1.

**1.3.** Build the budget line  $B_1$  on the basis of the equation of the budget constraint  $I = P_X * X + P_Y * Y$  on extreme points:

when  $Y = 0$ , then  $X = \frac{I}{P_X} = \frac{20}{2} = 10$

when  $X = 0$ , then  $Y = \frac{I}{P_Y} = \frac{20}{4} = 5$

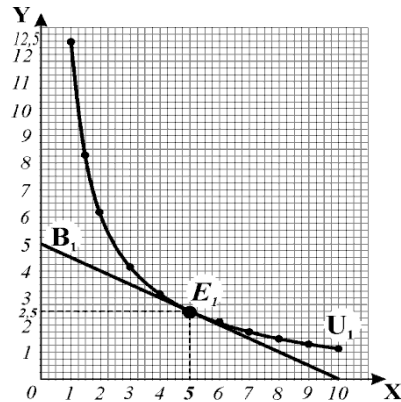
*Similar calculation as in 1.1, 1.2, and 1.3 must be carried out in Tasks 2 and 3.*

**1.4.** Graphically, the consumer's equilibrium is established at the point of contact of the indifference curve and the budget line – point  $E_1$  in Figure 1.1. According to the figure, the initial equilibrium (optimal) consumer basket has the structure:  $5X + 2.5Y$ .

**Task 2. Determinate how price changes affect consumer choices (Figure 1.2)**

Calculations of data for tasks 2.2, 2.3, 2.4, 2.5 are carried out similarly to those described in paragraphs 1.1., 1.2, 1.3, 1.4 according to the changes in the price of commodity X (according to the example, the price of commodity X increases to 5 UAH.).

In Figure 1.2, the indifference curve  $U_2$  and the budget line  $B_2$  are added to the curves of Figure 1.1; a new equilibrium point  $E_2$  and the structure of a new optimal consumer basket ( $2X + 2.5Y$ ) are determined.



**Figure 1.1. Consumer's equilibrium**

2.6. According to the Hicks model, the compensating budget

line  $B_k$  reflects the change in the relative prices of goods ( $P_x/P_y$ ) under constant real consumer income. It is parallel to the new budget line  $B_2$ , which reflects the change in relative prices, and is tangent to the initial indifference curve  $U_1$ . By the point of contact, we graphically determine the point of compensating equilibrium  $E_k$  and the structure of the conditional consumer basket ( $3X + 4.2Y$ ).

2.7. Determine the values graphically:

- the substitution effect (ES) – as a change in the volume of commodity X consumption when the equilibrium changes from  $E_1$  to  $E_k$ ;
- the effect of income (EI) – as a change in commodity X consumption when the equilibrium changes from  $E_k$  to  $E_2$ ;
- the total effect (TE) – for unidirectional/one-way substitution and income effects - as their sum.

2.8. To construct the “price–consumption” curve, we connect the consumer’s equilibrium points associated with the change in the price of commodity X ( $E_1, E_2$ ).

2.9. According to the values of prices and the corresponding quantities of commodity X in the equilibrium consumer baskets ( $E_1, E_2$ ), we complete the curve of individual demand  $D_1$  for commodity X below.

The completed graph shows that there is an inverse relationship between the price of goods and the quantity demanded: at a lower price  $P_x = 2$ , the



consumer bought 5 units of commodity X; when the price rose to  $P_X = 5$  and under the influence of substitution and income effects, their reduced purchases to 2 units.

2.10. The price elasticity of commodity X demand determines as:

$$E_p^D = \frac{\Delta Q}{\Delta P} * \frac{P_1}{Q_1}$$

$$E_p^D = \frac{-3}{3} * \frac{2}{5} = -0,4$$

So, the demand on commodity X is relatively inelastic.

In general, Figure 1.2 shows that:

- the demand curve reflects the change in the level of utility: the lower the price, the higher level of well-being it provides to the consumer;
- each point of the demand curve is the point of the consumer's equilibrium, at which they maximize the total utility under existing constraints.

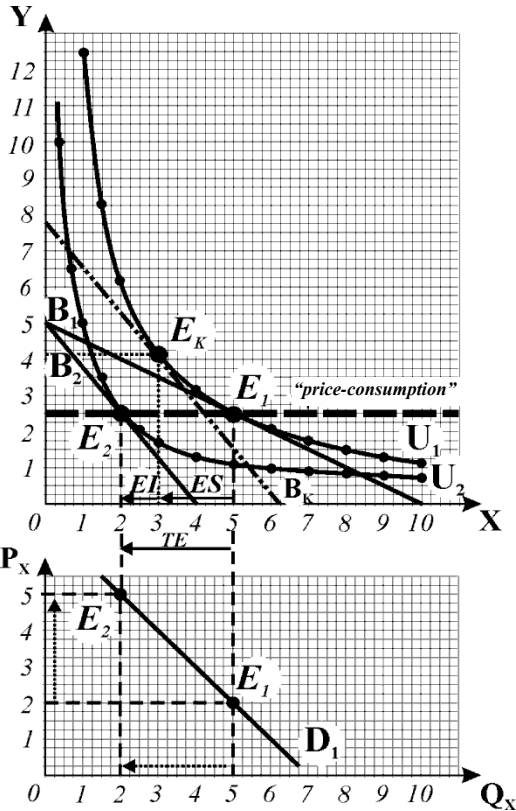


Figure 1.2. Changing of the consumer's equilibrium with a price changes of commodity X.  
Individual demand curve

**Task 3: Determinate how a change in income affects consumption choices (Figure 1.3)**

Calculations of data for tasks 3.2, 3.3, 3.4, 3.5 are carried out similarly to those described in paragraphs 1.1, 1.2, 1.3, 1.4 according to the changes in consumer income and initial prices of goods (according to the example, consumer income decreases from 20 UAH to 16 UAH).

In Figure 1.3, the indifference curve  $U_3$  and the budget line  $B_3$  are added to the curves of Figure 1.1; a new equilibrium point  $E_3$  and the structure of the new optimal consumer basket ( $4X + 2Y$ ) are determined.

3.5. To construct the “income–consumption” curve, we connect the consumer’s equilibrium points ( $E_1, E_3$ ) connected with the change of their income under the constant prices for commodities.

3.6. According to the values of the quantities of commodity  $X$  in the equilibrium consumer baskets ( $E_1, E_3$ ), we complete the graph of changes in the individual consumer demand for commodity  $X$ .

The completed graph shows that as income decreases, the consumer demand for the commodity decreases at any price value, so its individual demand curve shifts to the left.

3.7. The income elasticity of commodities  $X$  and  $Y$  consumption determines as:

$$E_I^D = \frac{\Delta Q_X}{\Delta I} * \frac{\bar{I}}{\bar{Q}_X}$$

$$E_I^D = \frac{\Delta Q_Y}{\Delta I} * \frac{\bar{I}}{\bar{Q}_Y}$$

So, income elasticity of commodity  $X$  consumption is  $E_I^D = \frac{-1}{-4} * \frac{18}{4.5} = 1$ ; income elasticity of commodity  $Y$  consumption is  $E_I^D = \frac{-0.5}{-4} * \frac{18}{2.25} = 1$ . According to calculations, commodities  $X$  and  $Y$  are normal commodities as  $E_I^D > 0$ .

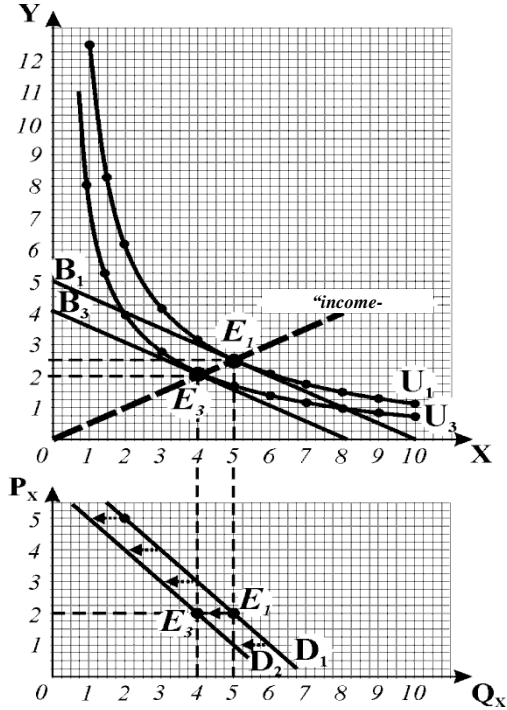


Figure 1.3. Changing of the consumer's equilibrium with a changing income.  
Changes in individual demand

## TASK TO PART 2

### *Modelling the behaviour of a perfectly competitive firm*

A competitive firm that increases production from 0 to 10 units in the short run chooses the optimal output that would allow it to achieve its goal (maximize economic profits) under existing constraints (a certain level of costs and market prices).

#### **Task 1. Calculation of indicators of economic activity of a perfectly competitive firm**

1.1. Calculate the total, average and marginal costs of the firm (in UAH), fill in columns 4-8 of Table 2.1.

1.2. Calculate the values of total revenue and economic profit (loss) at given market prices (UAH), fill in columns 12-17 of Table 2.1.

*Table 2.1*

#### **COSTS AND ECONOMIC PROFITS OF A PERFECTLY COMPETITIVE FIRM**

Volume of output	Total costs			Average costs			Marginal costs	Price (marginal revenue)			Total revenue			Economic profit (+) / loss (-)		
	Q	FC	VC	TC	AFC	AVC		ATC	MC	MR <sub>1</sub>	MR <sub>2</sub>	MR <sub>3</sub>	TR <sub>1</sub>	TR <sub>2</sub>	TR <sub>3</sub>	EP <sub>1</sub>
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

#### **Task 2. Optimization of the choice of a perfectly competitive firm**

2.1. According to Table 2.1, build a *TRTC* model, graphically determine the optimal production volumes and results of the firm at each of the three given prices:

- Figure 2.1 – curves TC, VC, FC, TR<sub>1</sub>;
- Figure 2.2 – curves TC, VC, FC, TR<sub>2</sub>;
- Figure 2.3 – curves TC, VC, FC, TR<sub>3</sub>.

2.2. According to Table 2.1, build a *MRMC* model, graphically determine the optimal production volumes and results of the firm at each of the three given prices:

- Figure 2.4 – curves ATC, AVC, MC, MR<sub>1</sub>;
- Figure 2.5 – curves ATC, AVC, MC, MR<sub>2</sub>;
- Figure 2.6 – curves ATC, AVC, MC, MR<sub>3</sub>.

2.3. According to Figure 2.6 of the *MRMC* model:

- determine the critical prices: break-even price and the price of suspension (closure) of production; in the graph, mark the break-even point (b) and closure (z) of the firm;
- determine and plot the short-run supply curve of the firm.

### **Task 3. Determination of short-term equilibrium industry market and long-term industry dynamics**

Assume that the studied competitive firm is a typical firm in an industry in which 1000 firms operate with identical costs, so all firms have the same short-run supply curves.

3.1. According to the function of market (sectoral) demand, given by the initial data of the option, plot in Figure 2.7 a) the curve of market demand. From Figure 2.6, transfer to Figure 2.7 a) the short-run supply curve  $S_c$ , which is the sum of the supply volumes of 1,000 firms in a competitive industry. In the figure, determine and plot the point of market equilibrium  $E_c$ , the corresponding equilibrium price (UAH) and the equilibrium volume of production (thous. units).

3.2. Along with Figure of market equilibrium 2.7 a) construct the correlated graph 2.7 b), on which you transfer the curves of average and marginal costs of a typical industry firm. Determine the optimal volume of output and the result of the firm under the equilibrium market price and predict the dynamics of the industry in the long run (expansion or contraction).

#### *Set of Values*

#### *for Part 2 Modelling the behaviour of a perfectly competitive firm and Part 3 Modelling the monopolistic behaviour*

##### **VARIANT 1.**

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	50	90	125	158	195	235	280	335	400	475

Fixed costs = 65.

Price: 58, 40, 35.

Market (sectoral) demand function:  $P=110-8Q$ .

##### **VARIANT 2.**

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	31	54	71	91	114	149	200	265	345	440

Fixed costs= 50.

Price: 41, 30, 22.

Market (sectoral) demand function:  $P=130-10Q$ .

**VARIANT 3.**

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	63	103	138	170	208	254	307	368	436	514

Fixed costs= 80.

Price: 68, 52, 48.

Market (sectoral) demand function:  $P=160-10Q$ .

**VARIANT 4.**

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	51	80	101	116	135	160	191	229	275	331

Fixed costs= 50.

Price: 48, 31, 24.

Market (sectoral) demand function:  $P=100-6Q$ .

**VARIANT 5.**

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	39	66	86	107	132	165	208	264	334	424

Fixed costs= 70.

Price: 50, 35, 21.

Market (sectoral) demand function:  $P=130-10Q$ .

**VARIANT 6.**

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	38	64	84	105	130	162	203	253	309	375

Fixed costs= 65.

Price: 50, 35, 25.

Market (sectoral) demand function:  $P=120-10Q$ .

**VARIANT 7.**

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	82	152	217	277	347	437	547	677	827	997

Fixed costs= 100.

Price: 105, 82, 66.

Market (sectoral) demand function:  $P=155-10Q$ .

**VARIANT 8.**

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	32	56	74	94	118	148	188	237	296	365

Fixed costs= 60.

Price: 55, 29, 20.

Market (sectoral) demand function:  $P=120-9Q$ .

**VARIANT 9.**

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	36	64	86	111	140	176	220	273	338	417

Fixed costs= 70.

Price: 50, 35, 28.

Market (sectoral) demand function:  $P=130-10Q$ .

**VARIANT 10.**

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	75	105	125	140	153	173	204	254	324	426

Fixed costs= 70.

Price: 60, 32, 28

Market (sectoral) demand function:  $P=140-10Q$ .

**VARIANT 11.**

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	66	90	107	114	127	146	177	226	299	402

Fixed costs= 70.

Price: 60, 30, 24

Market (sectoral) demand function:  $P=130-12Q$ .

**VARIANT 12.**

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	32	56	74	94	118	148	188	237	296	365

Fixed costs= 60.

Price: 55, 29, 20

Market (sectoral) demand function:  $P=120-10Q$ .

**VARIANT 13.**

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	86	130	161	188	217	250	286	336	399	476

Fixed costs= 85.

Price: 62, 46, 38.

Market (sectoral) demand function:  $P=140-12Q$ .

### VARIANT 14.

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	45	85	120	153	188	228	273	328	393	468

Fixed costs= 65.

Price: 58, 47, 36.

Market (sectoral) demand function:  $P=130-9Q$ .

### VARIANT 15.

Volume of output, units	0	1	2	3	4	5	6	7	8	9	10
Variable costs, UAH	0	68	108	143	173	208	248	293	348	413	488

Fixed costs= 65.

Price: 68, 45, 38.

Market (sectoral) demand function:  $P=115-5Q$ .

## GUIDELINES ON PART 2

### *Modelling the behaviour of perfectly competitive firm*

Assume that the initial data of the option are as follows:

Fixed costs = 60.

Market prices:  $P_1 = 60$ ,  $P_2 = 40$ ,  $P_3 = 30$ .

Market (sectoral) demand function:  $P = 120 - 10 * Q$ .

### **Task 1. Calculation of economic activity indicators of a perfectly competitive firm**

We calculate the costs and economic profits (losses) of the firm (UAH), the results of the calculations are entered in table 2.1.

1.1. To calculate the costs of the firm (columns 4-8) we use the basic formulas:

$$\begin{aligned} AFC &= \frac{FC}{Q}; & AVC &= \frac{VC}{Q}; \\ ATC &= \frac{TC}{Q} & \text{or} & \quad ATC = AFC + AVC \\ MC &= \frac{\Delta TC}{\Delta Q} & \text{or} & \quad MC = \frac{\Delta VC}{\Delta Q} \end{aligned}$$

1.2. To calculate the total revenue and economic profit (loss) of the firm (columns 12-17) we use the basic formulas:

$$\begin{aligned} EP &= TR - TC & \text{or} & \quad EP = (P - ATC) * Q \end{aligned}$$

Table 2.1

**COSTS AND ECONOMIC PROFITS  
OF A PERFECTLY COMPETITIVE FIRM**

Volume of output  Q	Total costs			Average costs			marginal costs  MC	Price (marginal revenue)			Total revenue			Economic profit (+) / loss (-)		
	FC	VC	TC	AFC	AVC	ATC		MR <sub>1</sub>	MR <sub>2</sub>	MR <sub>3</sub>	TR <sub>1</sub>	TR <sub>2</sub>	TR <sub>3</sub>	EP <sub>1</sub>	EP <sub>2</sub>	EP <sub>3</sub>
0	60	0	60	-	-	-	45	60	40	30	0	0	0	-60	-60	-60
1	60	45	105	60	45	105	40	60	40	30	60	40	30	-45	-65	-75
2	60	85	145	30	42,5	72,5	35	60	40	30	120	80	60	-25	-65	-85
3	60	120	180	20	40	60	30	60	40	30	180	120	30	0	-60	-90
4	60	150	210	15	37,5	52,5	35	60	40	30	240	160	120	30	-50	-90
5	60	185	245	12	37	49	40	60	40	30	300	200	150	55	-45	-95
6	60	225	285	10	37,5	47,5	45	60	40	30	360	240	180	75	-45	-105
7	60	270	330	8,6	38,5	47,1	55	60	40	30	420	280	210	80	-50	-120
8	60	325	385	7,5	40,6	48,1	65	60	40	30	480	320	240	95	-65	-145
9	60	390	450	6,7	43,3	50	75	60	40	30	540	360	270	90	-90	-180
10	60	465	525	6,0	46,5	52,5		60	40	30	600	400	300	75	-125	-225

**Task 2. Optimization of the choice of a perfectly competitive firm**

Optimizing the choice of any company for the production and supply of goods involves a two-stage procedure:

1) *determination of the optimal volume of output* – the amount that allows maximizing economic profits or minimizing losses – is carried out as a **general rule for choosing the optimal volume of output:**

**Optimal is the volume of output, for which the marginal revenue is equal to the marginal costs:**

$$MR = MC$$

2) *calculation of the result of economic activities* is the amount of economic profit or loss under the optimal volume.



**2.1.** According to Table 2.1, build the **TRTC** model.

At each of the set prices in accordance with the two-stage selection optimization procedure, graphically determine:

1) **optimal volume of output** – in the model for a competing firm, it is determined by tangent to  $TC$ , parallel to  $TR$ . The parallelism achieved for a certain volume means that the angles of inclination of the corresponding curves are equal to:  $\frac{\Delta TR}{\Delta Q} = \frac{\Delta TC}{\Delta Q}$ ; because  $\frac{\Delta TR}{\Delta Q} = MR$ , and  $\frac{\Delta TC}{\Delta Q} = MC$ , then the rule  $MR = MC$  is fulfilled consequently, and a certain amount is optimal;

2) **result of economic activities** – in the  $TRTC$  model, the amount of profit or loss is determined on the basis of formula  $EP = TR - TC$  and graphically corresponds to the segment between  $TR$  and  $TC$  vertically.

To consider as an example:

**Graph 2.1.**

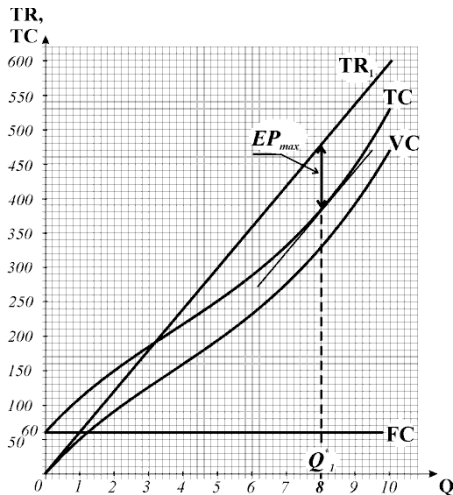
At a market price  $P_1 = 60$  ( $TR_1$ ):

- the **optimal output** is  $Q_1^* = 8$  units of production;
- the **result of economic activities**: the firm maximizes its economic profit, because for  $Q_1^* TR > TC$ ; the value (sum) of profit is  $EP = TR - TC = 480 - 385 = 95$ ;
- graphically, the amount of profit corresponds to the vertical segment  $EP_{max}$  between the curves  $TR$  and  $TC$ .

**Graph 2.2.**

At a market price  $P_2 = 40$  ( $TR_2$ ):

- the **optimal output** is  $Q_2^* = 6$  units of production;
- the **result of economic activities**: the firm minimizes losses by means of production, because for  $Q_2^* VC < TR < TC$ , the sum of losses is  $EP = TR - TC = 240 - 285 = -45$ ;
- graphically the amount of losses corresponds to the vertical segment  $-EP_{min}$  between the curves  $TC$  and  $TR$ .



**Graph 2.1. TRTC model of perfectly competitive firm: the case of profit maximization**

**Graph 2.3.**

At a market price  $P_3 = 30$  ( $TR_3$ ):

- the **optimal output** is  $Q_3^* = 0$  units of production;
- the **result of economic activities:** the

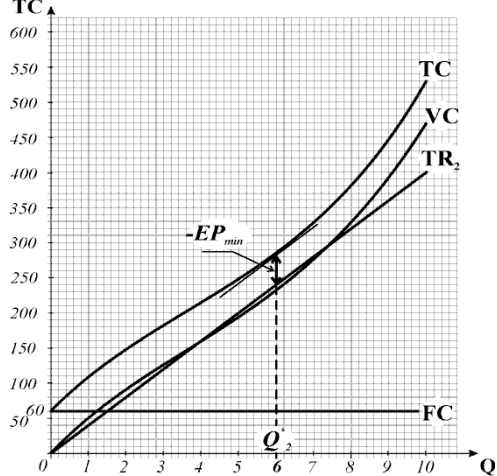
firm minimizes losses by closing, because for all volumes of output  $TR < VC$ ; the sum of losses is  $EP = TR - TC = 0 - 60 = -60$  and is equal to the amount of fixed costs of the firm; graphically the amount of losses corresponds to the vertical segment  $-EP_{min}$  between the curves  $TC$  and  $TR$  at zero output.

2.2. According to Table 2.1, build the *MRMC* model.

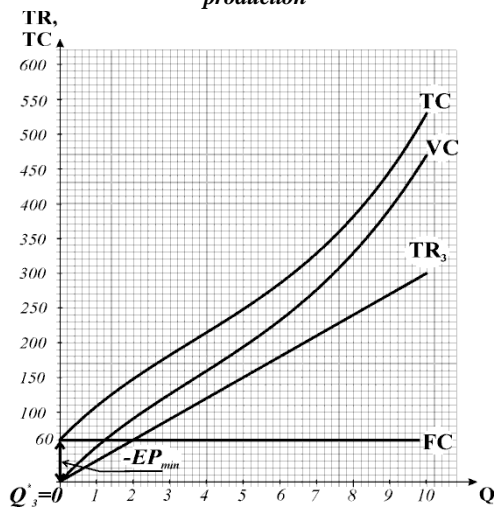
At each of the set prices in accordance with the two-stage selection optimization procedure, graphically determine:

1) **optimal volume of output** – in the *MRMC* model, it is directly determined by the rule  $MR = MC$  and corresponds to the point of intersection of the curves  $MR$  and  $MC$ ;

2) **the result of economic activities** – in the *MRMC* model, the amount of profit or loss is determined by the basic formula



**Graph 2.2.** *TRTC* model of perfectly competitive firm: the case of minimizing losses by production



**Graph 2.3.** *TRTC* model of perfectly competitive firm: the case of minimizing losses by closing

$$EP = (P - ATC) * Q$$

and graphically corresponds to the area of the rectangle.

**Graph 2.4.**

At a market price  $P_1 = 60$  ( $MR_1$ ):

- the **optimal output** is  $Q_1^* = 8$  units of production;
- the **result of economic activities**: the firm maximizes economic profit because

$Q_1^* P > ATC$ ; the value of profit is  $EP = (P - ATC) * Q = (60 - 48.1) * 8 = 95.2$ ;

- graphically, the amount of profit corresponds to the area of the shaded rectangle  $EP_{max}$ .

**Graph 2.5.**

At a market price  $P_2 = 40$  ( $MR_2$ ):

- the **optimal output** is  $Q_2^* = 5.4$  units of production;
- the **result of economic activities**: the firm minimizes losses by production because  $Q_2^* AVC < MR < ATC$ ,

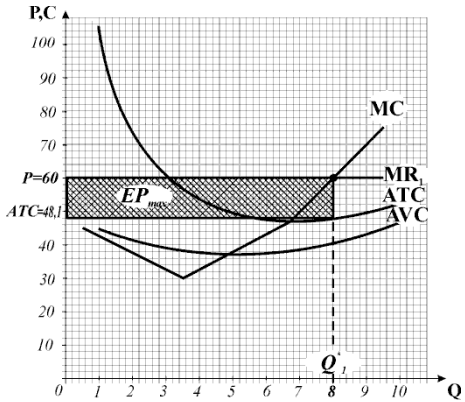
the amount of losses is  $EP = (P - ATC) * Q = (40 - 48.3) * 5.4 = -44.8$ ;

- graphically, the amount of losses corresponds to the area of the shaded rectangle  $-EP_{min}$ .

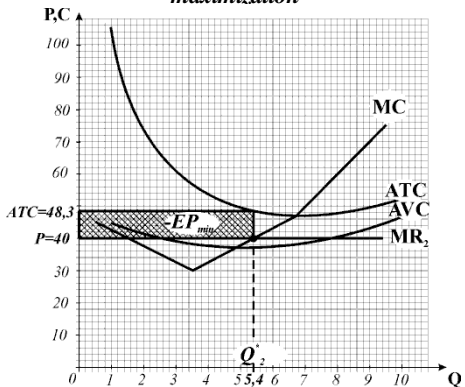
**Graph 2.6.**

At a market price  $P_3 = 30$  ( $MR_3$ ):

- the **optimal output** is  $Q_3^* = 0$  units of production;



**Graph 2.4. MRMC model of perfectly competitive firm: the case of profit maximization**



**Graph 2.5. MRMC model of perfectly competitive firm: the case of minimizing losses by production**

▪ the **result of economic activities**: the firm minimizes losses by closing, because all volumes of output  $P < AVC$ ; the amount of losses is equal to the sum of fixed costs of the firm.

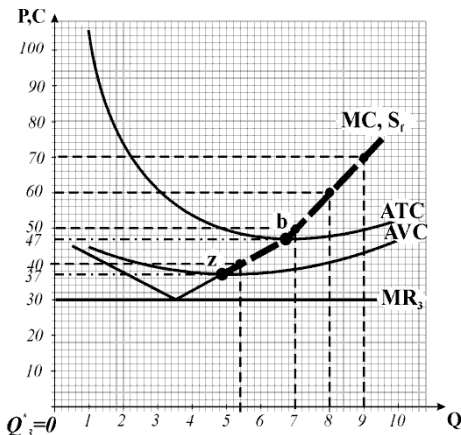
2.3. According to Figure 2.6 of the  $MRMC$  model:

▪ determine **critical prices**:

- break-even price (break-even point **b**) corresponds to the minimum average total costs

$$(P = ATC_{min} = 47);$$

- price of production closing (closing point **z**) corresponds to the minimum average variable costs ( $P = AVC_{min} = 37$ );
- determine the curve of short-term supply of the firm  $MC = S_f$  - being an ascending segment of the marginal costs curve above the closing point ( $z = AVC_{min}$ ) and marked with a bold dotted line in Figure 2.6.



Graph 2.6.  $MRMC$  model of perfectly competitive firm: the case of minimizing losses by closing

### Task 3. Determining the short-term equilibrium of the industry market and long-term dynamics of the industry

3.1. In Figure 2.7 a) according to the function of quantity demanded set by initial data  $P = 120 - 10 * Q$ , construct a curve of market demand ( $D$ ). Since the demand function is linear, it can be constructed at extremes or at any two points: the point of intersection of the demand curve with the vertical and horizontal axis.

From Figure 2.6 to Figure 2.7 a) we transfer the curve of a short-term supply (thickened dotted line  $MC = S_f$ ) as the curve of the total market supply ( $S_c$ ) of 1000 firms (in thous. of units).

The intersection of the demand curves for the industry's products and their supply determines the point of market equilibrium ( $E_c$ ), which

corresponds to the equilibrium price  $P_c^* = 50$  and the equilibrium output of the industry  $Q_c^* = 7$  in thous. of units.

3.2. Into graph 2.7 b), transfer curves of average and marginal costs of a typical firm, define optimum volume of release and result of activity at the equilibrium market price  $P_c^* = 50$ :

- the **optimal output** is  $Q_c^* = 7$  units of production;
- the **result of economic activity**: the firm maximizes economic profit, because  $Q^* P > ATC$ ; the amount of profit is  $EP = (P - ATC) * Q = (50 - 47.1) * 7 = 20.3$ ; graphically corresponds to the area of the shaded rectangle  $EP_{max}$ .

As the typical firm of the industry is profitable, in the long run, new firms will begin entering the profitable industry, the industry will therefore expand.

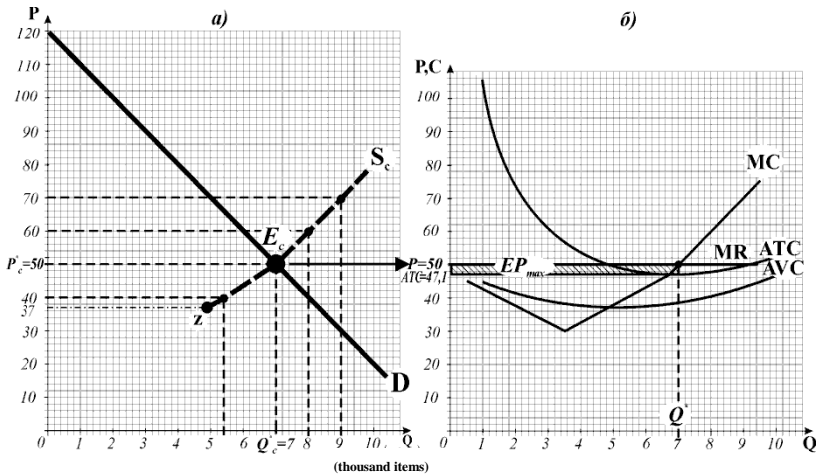


Figure 2.7. Short-term equilibrium of a competitive industry and a typical firm

### TASK TO PART 3

#### *Modelling the monopolistic behaviour*

The competitive industry, in which 1,000 firms operated, is monopolized. The monopolist as the sole seller faces a curve of market (industry) demand, which shows that it can increase the output from 0 to 10 thousand units only if the price decreases. The total (thous. UAH), average and marginal costs of the monopoly are identical to the costs of firms of the former competitive industry.

#### **Task 1. Calculation of economic activity indicators of a simple monopoly**

**1.1.** According to the function of market demand, determine the prices at which the monopoly will be able to sell from 0 to 10 thousand units, fill in columns 1-2 of Table 3.1.

**1.2.** Transfer the data on marginal, average aggregate and aggregate costs from Table 2.1 to columns 5, 6, 7 of Table 3.1.

**1.3.** Determine the values of aggregate and marginal revenues and economic profits of the monopolist; fill in columns 3, 4, 8 of Table 3.1.

Table 3.1.

#### **COSTS AND ECONOMIC PROFITS OF THE MONOPOLY**

Quantity demanded	Price, UAH.	Total revenue	Marginal revenue	Marginal costs	Average costs	Total costs	Economic profit
Q	P	TR <sub>m</sub>	MR <sub>m</sub>	MC	ATC	TC	EP <sub>m</sub>
1	2	3	4	5	6	7	8

#### **Task 2. Optimization of the choice of a simple monopoly**

**2.1.** According to Table 3.1, build a **TRTC** model; graphically determine the optimal volume of production and the result of the monopoly:

- Figure 3.1 – curves TC, TR<sub>m</sub>.

**2.2.** According to Table 3.1, build the **MRMC** model; graphically determine the optimal volume of production and the price set by the monopolist; mark the equilibrium point of the monopoly ( $E_m$ ); determine the result of the monopoly:

- Figure 3.2 – curves D, MR<sub>m</sub>, ATC, MC.

### Task 3. Determination of social losses from the monopolization of the industry

**3.1.** Into Figure 3.3 of the *MRMC* model for a simple monopoly from Figure 2.7.a), transfer the supply curve of a competitive industry ( $S_c$ ), mark the equilibrium point of the competitive market ( $E_c$ ), the corresponding equilibrium output ( $Q_c^*$ ) and equilibrium price ( $P_c^*$ ); compare the parameters of the equilibrium of a competitive market with the volume of output and price under conditions of monopolization of the industry.

**3.2.** In Figure 3.3, identify and graphically illustrate the components of social losses from the monopolization of the industry.

## GUIDELINES ON PART 3 *Modelling the monopolistic behaviour*

### Task 1. Calculation of economic activity indicators of a monopoly

**1.1.** Into the market demand function we add the values of output volumes from 0 to 10 (thous. units) from column 1 Table 3.1 and define the prices at which the items can be bought/sold; the calculation results should be entered in column 2.

Table 3.1

#### COSTS AND ECONOMIC PROFITS OF THE MONOPOLY

Quantity demanded	Price, UAH.	Total revenue	Marginal revenue	Marginal costs	Average costs	Total costs	Economic profit
Q	P	TR <sub>m</sub>	MR <sub>m</sub>	MC	ATC	TC	EP <sub>m</sub>
1	2	3	4	5	6	7	8
0	120	0			-	60	-60
1	110	110	110	45	105	105	5
2	100	200	90	40	72,5	145	55
3	90	270	70	35	60	180	90
4	80	320	50	30	52,5	210	110
5	70	350	30	35	49	245	105
6	60	360	10	40	47,5	285	75
7	50	350	-10	45	47,1	330	20
8	40	320	-30	55	48,1	385	-65
9	30	270	-50	65	50	450	-180
10	20	200	-70	75	52,5	525	-325

**1.2.** Transfer the values of marginal ( $MC$ ), average total ( $ATC$ ) and total costs ( $TC$ ) from Table 2.1 (columns 8, 7, 4, respectively) to Table 3.1 (columns 5, 6, 7).

**1.3.** We calculate the values of total and marginal revenues and economic profits of the monopoly, the results of the calculations to be put in columns 3, 4, 8 of Table 3.1.

**Task 2.**

**Optimization of the choice of a simple monopoly**

Optimization of the choice of a simple monopoly (monopoly with a single price for all units of production), as well as for a competing firm, involves a two-stage procedure:

- 1) determination of the optimal volume of production according to the rule  $MR = MC$ ;
- 2) calculation of the economic activity result according to the optimal volume of output.

To consider as an example:

**2.1.** According to columns 3 and 7 of table 3.1, build Figure 3.1, a  $TRTC$  model for

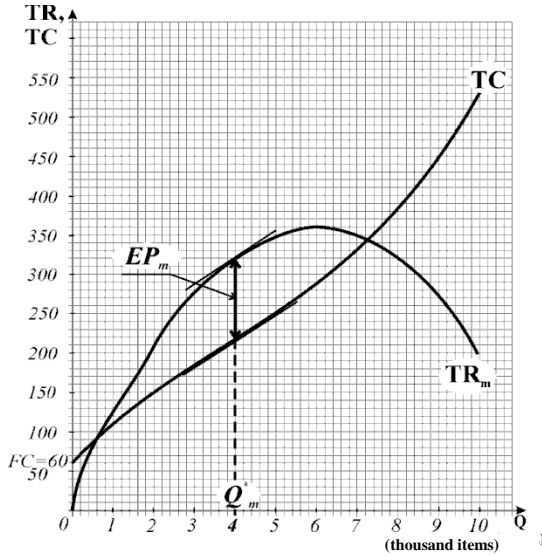


Figure 3.1.  $TRTC$  model for a simple monopoly: the case of profit

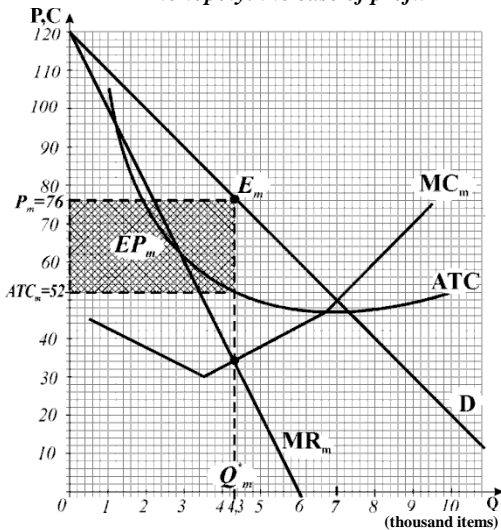


Figure 3.2.  $MRMC$  model for a simple monopoly: the case of profit maximization



monopoly.

**Graphically**, by tangents drawn to  $TR$  and  $TC$ , parallel to the optimal output, i.e. according to the  $MR = MC$  rule, we determine the optimal output being  $Q_m^* = 4$  thous. of units.

The **result of the activity**: the monopoly maximizes economic profit, because of  $Q_m^* TR > TC$ ; the value (sum) of profit is:  $EP = TR - TC = 320 - 210 = 110$  ; graphically it corresponds to the vertical segment between the curves  $TR$  and  $TC$ .

**2.2.** According to columns 1, 2, 4, 5, 6 of Table 3.1, we build Figure 3.2 – the **MRMC** model for monopoly.

Monopoly as the only seller in the market that has an impact on the market price, determines the combination of optimal output and price:

- According to the rule  $MR = MC$ , we determine the optimal volume of production - it is  $Q_m^* = 4.3$  thous. of units;
- for the optimal volume of output according to the market demand curve, we find the corresponding price:  $P_m^* = 76$ UAH.

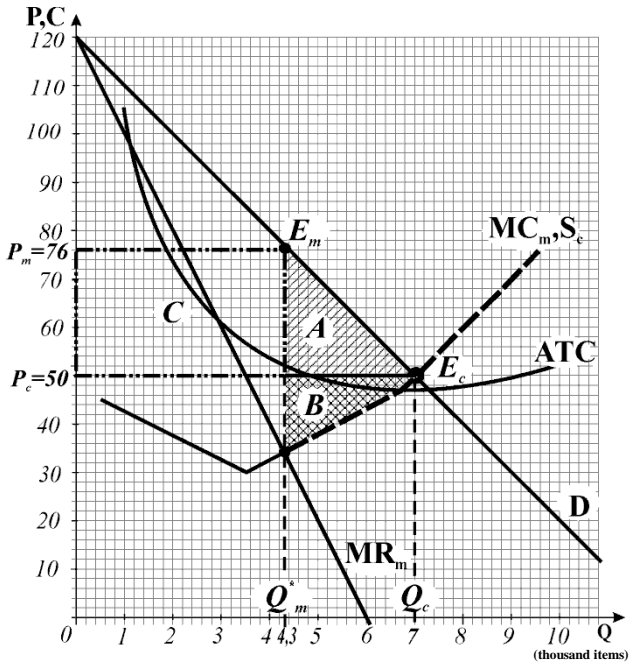
The result of the activity: the monopoly maximizes economic profit, because of the optimal volume of output ( $Q_m^* P > ATC$ ), the amount of profit is:  $EP = (P - ATC) * Q = (76 - 52) * 4.3 = 103.2$ , it graphically corresponds to the area of the shaded rectangle  $EP_m$ .

### **Task 3. Determination of social losses from the industry monopolization**

**3.1.** In Figure 3.3 of the **MRMC** model for a simple monopoly from Figure 2.7.a), we transfer the supply curve of a competitive industry ( $S_c$ ), mark the equilibrium point of the competitive market ( $(E_c)$ ) and the corresponding equilibrium output and price. Compared with the competitive industry, which would produce  $Q_c^* = 7$  thous. of units at the price of  $P_c^* = 50$  UAH, the monopoly (other things being equal) produces a smaller volume of products  $Q_m^* = 4.3$  (thous. of units) and sells it at a higher price  $P_m^* = 76$  (UAH).

**3.2.** Social losses from the monopolization of the industry are analysed by changes in indicators of economic prosperity – the surplus of consumers and producers. Under the conditions of a competitive equilibrium, the surplus of the consumer and the producer is maximum. Under the conditions of a monopoly (Figure 3.3), due to a smaller volume of output, consumers lose a part of the consumer surplus that corresponds to the area  $A$ , due to the higher price of products, they lose the part of the consumer surplus that corresponds to the area  $C$ . The total loss of surplus consumers is equal to the sum of the areas  $A + C$ . Due to the smaller volume of output,

the monopolist itself loses part of the producer's surplus (area  $B$ ), but turns part of the consumer surplus into a producer's surplus  $C$ , thereby increasing its economic profit. The net loss of consumer and production surpluses for



**Figure 3.3. Model of social losses from the monopolization of a competitive industry**

society from the unproduced industry under monopolization (irreversible social losses) corresponds to the sum of the areas of triangles  $A$  and  $B$ .