Massachusetts Institute of Technology

Department of Economics

14.01 Principles of Microeconomics

Exam 3

Wednesday, December 15th, 2010

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Instructions. Please read carefully.

The exam has a total of 173 points. Answers should be as concise as possible. This is a closed book exam. You are not allowed to use notes, equation sheets, books or any other aids. You are not allowed to use calculators. You must write your answers in the space provided between questions. Fractional answers are permissible in any part of this exam. DO NOT attach additional sheets of paper. This exam has 22 pages (17 pages + 5 blank pages for scratch work)

Circle Your Section/Recitation:

Please circle the section or recitation, which you are attending below. The marked exam will be returned to you in the section or recitation that you indicate. *Really?*

MWF 9AM   F 10AM

MWF 11AM   F 11 AM

MWF 1PM   F 1PM

MWF 2PM   F 3PM

DO NOT WRITE IN THE AREA BELOW:

Question 1 21/48   Question 2 4_/20

Question 3 36/45   Question 4 15/40

Question 5 17/20
Total 93/173

1

1. True/False/Uncertain and Short Questions (48 points)

In this section, write whether each statement is true, false or uncertain or answer the question that is posed. You should fully explain your answer, including diagrams where appropriate. Points will be given based on your explanation.

2/4

(a) (4 points) A uniform pricing monopolist has an upward sloping MC curve. Claim: a price ceiling set below the monopoly price will increase welfare relative to the monopoly outcome (assume the monopolist does not shut down).

P mon

Pcieling

DWL ↑ here
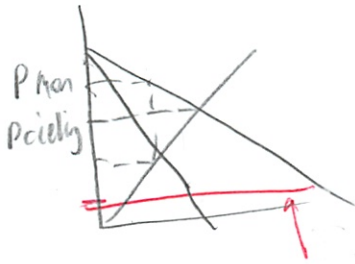
True, as long as it is set at or below the competitive outcome, if higher, monopolist will charge lower price so not effective

This removes the "poisoning" effect for the monopolist, so increasing Q will no longer poison profit, leading to more people happy in society

0/4

(b) (4 points) A large box of paper towels which will last you 2 years is on deep discount at Wal-Mart, saving you $1 per roll. Claim: a rational consumer who has perfectly inelastic demand for paper towels should always purchase this large box instead of paying a higher price for individual paper towel rolls.

will buy whatever the price

elastic -∞
inelastic 0
↳ if price ↑ profits

True The consumer will buy the towels, no matter the price, but if they are cheaper -and the same good (or perfect substitutes) no consumer will buy the more expensive one

(c) (4 points) In an oligopolistic market with identical firms, the market price is higher when there are two firms in the market than when there are 100 firms in the market.

True, 100 firms in the market is a ~pretty much a perfectly competive market. An oligopolistic market has a higher price than a perfectly competive market, so price is higher w/ 2 firms

$$P_n \geq P_0 \geq P_{nc}$$

Bertrand ?

(d) (4 points) The government of a developing country is worried about the adverse effect that the high interest rate in the economy has on investment. Claim: Since a low interest rate makes more projects have positive NPV, investment in this economy will increase if the government imposes an interest rate cap.

False - No one would lend $ if there was an interest rate cap, further hurting investments and thus projects, since investment would not be available for projects that have a high enough NPV (above the interest rate) - So nothing would get funded.

not necessarily nothing but there will be a shortage

See soln

3

4/8

(e) (8 points) There are three individuals in society: Bob, Milton and Paul. There are three possible social states which result in different utility levels for the three individuals:

	Bob	Milton	Paul
A	12	50	10
B	20	20	20
C	15	15	15

Are the following True/False/Uncertain? Explain.

4/4 (i) No government would choose social state C.

True - by every quantifer of utility we had C would not be a good option. B is a more equitable society where everyone is better off

Ⓞ/4 (ii) There is a government election in this society and there are two candidates: a Rawlsian and an Utilitarian government candidates. Claim: In a democratic election (majority win election) a Utilitarian candidate will be elected since more individuals in this society prefer the Utilitarian candidate.

Utilitarian = B+M+P
Rawlsian = min(B,M,P)

See soln

Only the people at the bottom would like a Rawlsian candidate, where as people in top + middle like Utilitarian, so Utilitarian will win.

Anyone whose income was above the redistribution level would not be happy.

Ⓞ/8 (f) (8 points) Jon spends his entire budget on espresso and gasoline. You have the following data on his choices:

Table 1: Jon's budget

	Price/ gallon gasoline	Price/ shot espresso	Gallons purchased	Shots purchased	Total income
February	2	1	9	4	22
March	5/2 2.5	3/4	10	8	31
April	3	1/2	8	14	31

Assume Jon's preferences are monotone, the same over the three months, and that he has no way to save or borrow across periods. Are Jon's choices consistent with ~~utility~~ maximization?

Yes - he is spreading his income between the 2 goods to keep consumption fairly steady and to take advantage of lower prices. We don't know what his utility function is, so we can't tell if he is maximizing - but it looks like it

See soln

(g) (4 points) Marco's monthly income is $1000. He spends 40% of his income on food and the rest on buying designer clothes. The City Council thinks it is unfair that people spend more than 35% of their income for food. In order to lower the proportion of income going to food, the City Council gives Marco $200. Claim: given that Marco's income elasticity of food is 2, the City Council accomplishes its goal.

$\frac{35}{17.5}$

$\frac{35 \cdot 1.5}{100 \cdot 1.5} \frac{52.5}{150}$

Calculations off

2/4

$\frac{\Delta Q/Q}{\Delta I/I} = \epsilon_I$

$2 = \frac{\Delta Q/400}{.2/1000}$

$2 = \frac{\Delta Q}{400} \cdot \frac{1000}{.2}$

$2 = \frac{10\Delta Q}{.8}$

$1.6 = 10\Delta Q$

$.16 = \Delta Q$

→elastic   unit elastic = double the income, double food spending
            inelastic = double the income more than double spending

No, he would not spend the $200 on food,
                                    ∧entire
instead he would only spend 16% of her income on food, leading to $80 additional food spending, or $\frac{432}{1200} = \frac{216}{600} = \frac{108}{300} = \frac{54}{150}$

which is slightly more than 35% $\left(\frac{52.5}{150}\right)$ so the policy does not work. The policy is quite stupid as well.

5

(h) (4 points) Venus Williams likes both tennis rackets and tennis shoes. She has many of both. Her marginal rate of substitution (MRS) of rackets for shoes is 3, meaning that given the opportunity, she is willing to trade 3 tennis rackets for 1 pair of shoes, or vice versa. Unused rackets and shoes may be returned to the local sporting goods store for a refund. The current price for a racket is $200 and the price for a pair of shoes is $100. Claim: Venus can make herself better off by trading in some tennis rackets in return for some shoes at the market rate.

$$MRS \frac{Rackets}{shoes} \quad \frac{3}{1} = \frac{x}{100} = \frac{price\ shoes}{price\ rackets}$$

$1x = 300$

She would be happy to make the trade if the price of a racket was 300, but rackets are on sale, so she should make the trade. True.

4/4

(i) (4 points) Suppose that there are two types of drivers - speeders and slowpokes. Speeders are more likely to have accidents, and have expected costs of $5,000 a year in car repair bills. Slowpokes on the other hand have expected costs of only $100 a year. Suppose further that speeders are risk-loving and that slowpokes are risk-averse. Claim: a (risk-neutral) private car insurance company will insure only slowpokes even if there are no asymmetric information or moral hazard problems in this market.

Risk adverse people - buy insurance and pay risk premium
Risk-loving people would not buy insurance.

4/4

True - The risk loving people will not buy insurance because they like taking the financial risk themselves

6

(j) (4 points) Please outline the pros and cons of the U.S. adopting a tax system with a heavier reliance on a consumption tax.

2/4

Pros – it would remove the payroll tax – incentivizing Work

it would ↑ savings, allowing more capital to be built/purchased – increasing Consumption tomorrow

– It may be easier to collect (people withhold income from IRS)

Cons – it would reduce consumer purchases hurting manufactures + retailers

– it would reduce consumption today

– people may purchase goods in other countries

– foreigners would not spend the same amt of $ here hurting tourism.

Regressive

2. Uncertainty (20 points)

An economy has two agents, Bill and Bob. Bill has $110, and Bob has $200. Utility of agents in this economy is characterized by the following function of income: *or current wealth*

$$U = u(y) = \begin{cases} \log(y - 60) & \text{if } y < 160 \\ \frac{1}{80}y & \text{if } y \geq 160 \end{cases}$$

The minimum level of income possible in this economy is 60.

Each agent is about to choose a new business venture, and has a choice between project A and project B. Neither project requires any investment up front. Project A yields revenues of 20 with probability $\frac{1}{2}$ and revenues of -10 with probability $\frac{1}{2}$. Project B yields revenues of 4 with probability one-half and revenues of 5 with probability one-half. Throughout this problem, assume that fractional income is possible.

(a) (5 points) Which project would each agent choose? Provide intuition for your answer.

$E[A] = 0 + \frac{1}{2} \cdot 20 + (-10) \cdot \frac{1}{2}$

$= 5$

$E[B] = \frac{1}{2} \cdot 4 + \frac{1}{2} \cdot 5$

$= 4.5$

$U_A(Bill) = \log(115 - 60)$
$= \log(55)$

$U_B(Bill) = \log(114.5 - 60)$
$= \log(54.5)$

$U_A(Bob) = \frac{1}{80} \cdot 205$

$\frac{205}{80} = \frac{41}{16}$

$U_B(Bob) = \frac{204.5}{80}$

Both would choose where their utility was greatest – here Bill → A, Bob → A

7

↓ see next pg

Should actually calculate w/ utility

A Bill $\frac{1}{2}\log(130-60) + \frac{1}{2}\log(100-60)$
$= E[\text{utility}, A, \text{Bob}]$

A Bob $\frac{1}{2}\frac{220}{80} + \frac{1}{2}\frac{190}{80}$

$\frac{11}{8} + \frac{11}{16}$

B Bill $\frac{1}{2}\log(115-60) + \frac{1}{2}\log(114-60)$
$=$

A Bbb $\frac{1}{2}\frac{205}{80} + \frac{1}{2}\frac{204}{80}$

will choose which ever has larger utility

2/5

(b) (5 points) If Bill and Bob each choose an investment project each (year) and receive the associated income for 20 years, will the expected gap in their incomes be larger or smaller at the end of this period than it was initially? How does this relate to attitudes toward risk? You do not need to calculate income over 20 years, just provide intuition.

Yes - Their wealth might go overunder 160, changing their utility functions

0/5

One thing which expected value does not consider is the risk

People who choose project A will experience larger fluctuations in income. People who are rich loving may choose that approach. ⤷ based on utility functions

However in the long run the expected values of the project are quite similar, so income gap will remain roughly the same

8

(c) (10 points) Now, assume that there is a job available that provides fixed wage income. What salary would the job have to provide in order to induce Bill to take the job rather than entering a new business venture? What salary would the job have to provide in order to induce Bob to take the job? Which is higher, and why? Algebraic expressions are acceptable as answers.

The jobs must pay a salary equal to the maximum utility of A and B for them to be considered

Bill

$$\log(S_{bill} - 60) = \max\left\{ \tfrac{1}{2}\log(70) + \tfrac{1}{2}\log(40), \tfrac{1}{2}\log(55) + \log(54) \right\}$$

Bob

$$\frac{S_{bob}}{80} = \max\left\{ \frac{220}{160} + \frac{100}{160}, \frac{205}{160} + \frac{204}{160} \right\}$$

2/10

Intuition? Compare to actually chosen project

3. Costs and oligopoly (45 points)

A firm produces output q using capital and labor inputs according to the production function

$$q = f(K, L) = 4K + 2L$$

Capital and labor are both supplied in perfectly elastic input markets at prices of $r = 4$ and $w = 4$. Unlimited available at that price

(a) (5 points) Draw a representative set of isoquants for this firm. On the same graph, draw and label the firm's expansion path at these prices of capital and labor.

−3

$$MRPL = \frac{dq}{dk} \bigg/ \frac{dq}{dL} = -\frac{4}{2} = -2$$

At q=4 will use 24 at $8   ✗
q=8 " " 4 at $16
q=12 " 6 $24

Constant expansion curve / economies of scale

(elerving)

(b) (5 points) Find the factor demands for capital and labor as functions of output.

−3

$$Q_c = 0$$
$$Q_L = \frac{Q_{output}}{2}$$ ✗

(c) (6 points) Derive an expression for the firm's total cost as a function of q.

−3 $$Cost(Q)_{at} = \frac{Q_{output}}{2}, 4$$

$$= 2 Q_{out}$$

10

(d) (8 points) Suppose that in this market, our original firm competes with one other identical firm, and that both firms set their quantities at the same time. Furthermore, inverse demand for q is given by $p = 7 - q$. Regardless of what you found in part (c), you should now assume that both firms produce at a constant marginal cost of 1. Find the equilibrium price as well as the quantities and profits for each of these duopolists.

$$P = 7 - q_1 - q_2$$
$$R_1 = q_1(7 - q_1 - q_2)$$
$$= 7q_1 - q_1^2 - q_1 q_2$$
$$MR_1 = 7 - 2q_1 - q_2$$
$$MR_1 = MC_1$$
$$7 - 2q_1 - q_2 = 1$$
$$-2q_1 = -6 - q_2$$
$$q_1 = 3 - \frac{q_2}{2}$$

in terms of q_2

$$R_2 = q_2(7 - q_1 - q_2)$$
$$= 7q_2 - q_1 q_2 - q_2^2$$
$$MR_2 = 7 - q_1 - 2q_2$$
$$MR_2 = MC_2$$
$$7 - q_1 - 2q_2 = 1$$
$$-2q_2 = -6 - q_1$$
$$q_2 = 3 - \frac{q_1}{2}$$
$$\Pi_1 = \Pi_2 = 3 \cdot 2 - 2 \cdot 1$$
$$= 4$$

$$q_1 = 3 - \frac{\left(3 - \frac{q_1}{2}\right)}{2}$$
$$= 3 - \frac{3}{2} + \frac{q_1}{4}$$
$$\frac{3u}{4} = \frac{3}{2}$$
$$\cdot \frac{4}{3} \quad , \frac{4}{3}$$
$$q_1 = 2$$
$$q_2 = 3 - \frac{2}{2} = 2$$
$$p = 7 - 2 - 2 = 3$$

(e) (6 points) What is the maximum amount that an outside investor would be willing to pay to purchase one of these firms? Explain.

He would purchase at the net present value of the firms assets (assumed to be 0) and future cash flows

So $\frac{4 \cdot 1}{r}$

$r =$ interest rate of capital used to buy firm or return on next best investment

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Finally Staples

4. Labor supply and income and substitution effects (40 points)

There are three periods, $t = 0, 1, 2$. In $t = 1$ Mary maximizes her utility over leisure and consumption given the following function.

$$U_1(N_1, C_1) = N_1^{\frac{1}{2}} C_1^{\frac{1}{2}}$$

subject to the following budget constraint.

$$C + 10N = 240$$
$$C_1 + w_1 N_1 = 24 w_1$$
$$C = 240 - 10N$$

where $w_1 = 10$. Note the price of the consumption good is assumed to be one in all periods. After she has made this decision, in $t = 2$ she maximizes this utility function.

$$U_2(N_2, C_2) = N_2^{\frac{1}{3}} C_2^{\frac{2}{3}}$$

subject to the following budget constraint

$$C + 20N = 480$$
$$C_2 + w_2 N_2 = 24 w_2$$

where $w_2 = 20$.

(a) (6 points) For $t = 1, 2$ calculate Mary's choice of leisure and consumption in each period.

$MRS = MRT$

Period 1

$$\frac{\frac{\partial U}{\partial N}}{\frac{\partial U}{\partial C}} = \frac{\frac{1}{2} N^{-1/2} C^{1/2}}{\frac{1}{2} C^{-1/2} N^{1/2}} = \frac{P_N}{P_C} = \frac{10}{1}$$

$$N^{-1/2} C^{1/2} = 10 C^{-1/2} N^{1/2}$$

$$\frac{\sqrt{C}}{\sqrt{N}} = \frac{10\sqrt{N}}{\sqrt{C}}$$

$$C = 10N$$

see back

2

$$\frac{\frac{\partial U}{\partial N}}{\frac{\partial U}{\partial C}} = \frac{\frac{1}{3} N^{-\frac{2}{3}} C^{2/3}}{\frac{2}{3} C^{-1/3} N^{1/3}} = \frac{P_N}{P_C} = \frac{20}{1}$$

$$\frac{\frac{2}{3} \frac{C^{2/3}}{N^{2/3}}}{} = \frac{20}{3} \frac{N^{1/3}}{C^{1/3}}$$

$$\frac{2}{3} C = \frac{20}{3} N$$

$$C = 20n$$

See back

(b) (6 points) For $t = 1$, provide economic intuition for the income and substitution effects of a wage increase on leisure. Can you say anything about the relative magnitudes of these income and substitution effects?

income →

At first, the person substitutes more consumption for leasure

, with the extra income.

substitution → however the price of consumption has gone up as well, Since they now forgo more money per hr of work missed

13

Substitution effects are larger based on results here

-5 ✗

major state by

1 | 2

Column 1:

Intersection $C + 10N = 240$

$C = 10N$

$C + 10N = 240$

$\overline{10N + 10N = 240}$

$20N = 240$

$N = \dfrac{240}{20} = \dfrac{120}{10} = 12$

$C = 10 \cdot 12 = 120$

$120 + 10 \cdot 12 = 240$

$C = 120$
$N = 10$

Column 2:

$C + 20N = 480$
$C = 20N$

$\overline{}$

$20N + 20N = 480$

$40N = 480$

$N = \dfrac{480}{40} = \dfrac{48}{4} = 12$

$C = 20(12) = 240$

$240 + 20 \cdot 12 = 480$

$C = 240$
$N = 12$

(c) (7 points) Go back to your solution in part a. If the interest rate is (10%) per period, what is the present value of her consumption in $t = 0$? Please use 0.9 and 0.8 as approximations for $1/(1.1)$ and $1/(1.1)^2$ respectively.

Say C_0 is consumption year 0 = 120 ← at start of year

C_1 " " " 1 = 160

Discount $\frac{C_0}{1.1}$ ←end of this year $+ \frac{C_1}{(1.1)^2}$ = $\frac{120}{1.1} + \frac{240}{(1.1)^2}$

(−1)

or $.9 C_0 + .8 C_1$

$.9 \cdot 120 + .8 \cdot 240$

$108 + 198$

306

(d) (7 points) Mary now has the option of obtaining additional job training in $t = 0$ at an investment cost of \$200. As a result, her wage rate increases in $t = 1$ to $w_1 = 20$ and in $t = 2$ to $w_2 = 30$. Calculate the net present value of this investment on consumption. Consider only the value of consumption (and not the value of leisure). — i.e don't recalculate everythl ago.

Confused what asking

(−6)

10 extra an hour is the new price of consumption

w/ old utility function and new income

$C = 10N$
$C + 20N = 480$
_____
$10N + 20N = 480$
$30N = 480$
$N = \frac{480}{30} = 16$
$C = 10(16) = 160$

40 gain in consumption

$C = 20N$
$C + 30N = 720$
$C = 30N$

$20N + 30N = 720$
$60N = 720$
$N = \frac{720}{50} = 14.4$
$C = 20(14.4) = 288$

48 gain in Consumption

24
30
0 0
720

$-200 - \frac{40}{(1.1)} - \frac{48}{(1.1)^2} + \frac{6 \cdot 20}{1.1} + \frac{4.4 \cdot 30}{(1.1)^2} =$

14

(e) (7 points) For more general utility functions, when will the net present value of the investment on consumption from part likely be negative? Use income and substitution effects in your explanation.
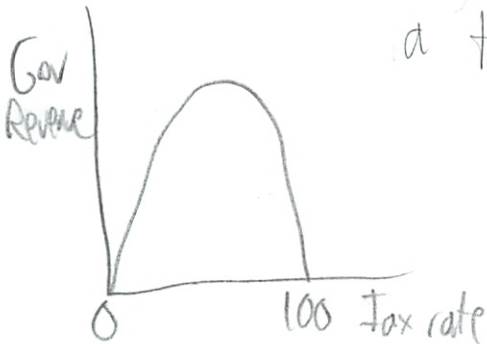
(-7)

when $200 - .9c_0 - .8c_i < 0$

When your wage rises so much that your income is so much higher that it is so much more costly for you to not work than it would be to work

(f) (7 points) Does Mary have a Laffer curve for income taxes (as opposed to consumption taxes)?

↳ or work

(-4)

Both taxes would disincentivize her, but a tax on income would not be enough to reduce it

Gov Revenue

0   100 Tax rate

i isn't it about the tax rate?

15

5. Trade and price discrimination (20 points) monopoly

A U.S. pharmaceutical firm sells its patent-protected drug Levemir in the U.S. and E.U. markets. The domestic demand function is $Q_{US} = 120 - 2p_{US}$, and the E.U. demand function is $Q_{EU} = 60 - p_{EU}$, where all prices are measured in U.S. dollars and quantity is measured in vials. The firm's marginal cost is $MC = 10$ in both countries.

(a) (6 points) Initially, the U.S. and EU governments prevent resale of Levemir. What are the firm's optimal p_{US} and p_{EU}? (The same price has to be charged to all consumers in the U.S. market and all consumers in the E.U. market.) How many vials does it sell in the U.S. and E.U. markets?

$$MR = MC$$

$$Q_{US} = 120 - 2p_{US}$$

$$Q_{US} + 2p_S = 120$$

$$2p_S = 120 - Q_{US}$$

$$P_{US} = 60 - \frac{Q_{US}}{2}$$

$$R = Q_{US}\left(60 - \frac{Q_{US}}{2}\right) = 60Q_{US} - \frac{Q_{US}^2}{2}$$

$$MR = 60 - Q_{US} = 10 = MC$$

$$-Q_{US} = -50$$

$$Q_{US} = 50$$

$$P_{US} = 60 - \frac{50}{2} = 35$$

$$Q_{EU} = 60 - p_{EU}$$

$$Q_{EU} + P_{EU} = 60$$

$$P_{EQ} = 60 - Q_{EU}$$

$$R = Q_{EU}(60 - Q_{EU}) = 60EU - Q_{EU}^2$$

$$MR = 60 - 2Q_{EU} = 10 = MC$$

$$-2Q_{EU} = -50$$

$$Q_{EU} = 25$$

$$P_{EU} = 60 - 25 = 35$$

(b) (6 points) Now assume that the U.S. and E.U. governments permit resales and per unit transportation and other transaction costs are negligible, so that the pharmaceutical monopoly can no longer price discriminate. What price will the firm charge and how many vials will it sell in the U.S. and in the E.U. markets?

Producers will buy vials in the EU and import them to the US
so firm must consider markets same

Combined market $Q = Q_{US} + Q_{EU} = 120 - 2p + 60 - p = 180 - 3p$

$$Q + 3p = 180$$

$$3p = 180 - Q$$

$$P = 60 - \frac{Q}{3}$$

$$R = Q\left(60 - \frac{Q}{3}\right) = 60Q - \frac{Q^2}{3}$$

$$MR = 60 - \frac{2}{3}Q$$

$$MR = MC$$

$$60 - \frac{2}{3}Q = 10$$

$$\frac{2}{3}Q = 50$$

$$Q = 50 \cdot \frac{3}{2} = 75$$

$$P = 60 - \frac{75}{3} = 35$$

But consumers must compete w/ each other

No change in market

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(c) (8 points) Use one graph for the U.S. market and one graph for the EU market to show the welfare impacts of the policy change in (b). What happens to consumer and producer surplus in each nation? Overall, is this a social welfare improvement or reduction? Please provide intuition for the overall welfare impact.

(-3)
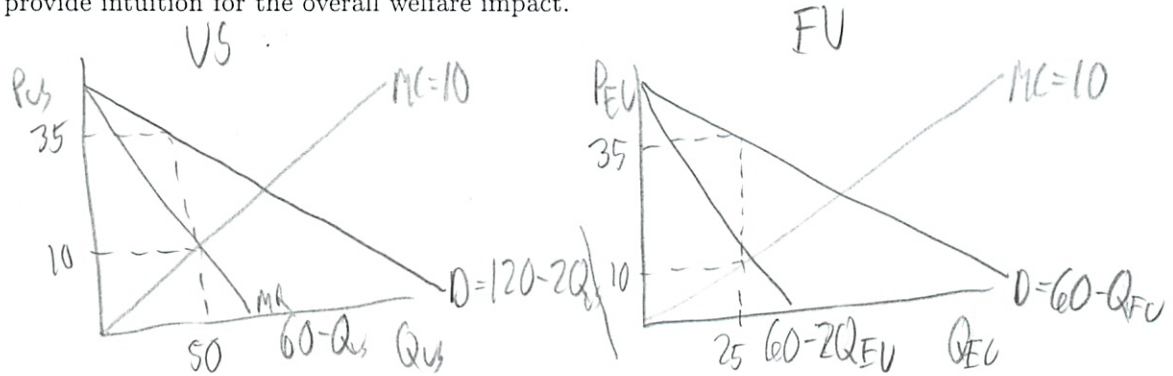
Welfare impacts are 0 in both markets since no significant trade happens

END OF EXAM

17

6 min

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was overconfident on math
Should have practiced more

Should have had more practice on this section math
well the # behind them are always fishy