Midterm
Intermediate Microeconomics
Fall 2015
October 20, 2015

Name: _____

Instructions

1. Answer all questions.
2. The exam will be graded out of 100 points. Points for each section and points for each question are indicated on the exam.
3. Write legibly. Illegible exams cannot be graded.
4. Do your best to fit all your answers on the front side of the exam. If you need to use the back of a page, indicate that clearly.
5. Label all figures as needed.
6. Make sure you **explain** your answers as needed. When appropriate, you should also explain any assumptions that you make to arrive at your answer. Explanations may yield partial credit.
7. Be concise.
8. The final page is intentionally left blank for extra work. If you do extra work on this page (or in any other non-standard location) that you would like to be counted, you must note it clearly near the question you are answering.
9. Write your name on each page.

A. Ripped From the Headlines (12 points)

Read the article from the *Wall Street Journal* at the end of the exam.

1 (6). Draw two pictures: (a) supply and demand for skyscraper glass during the Great Recession, and (b) supply and demand for skyscraper glass now. What do your pictures imply has happened to (i) demand for glass, (ii) supply of glass, and (iii) prices for skyscraper glass?

During the Great Recession, demand decreased and so did supply (both shrank from pre-recession levels). Now demand has increased, but supply has not. Prices have increased substantially.

See pictures at the end of this answer key.

Economists would not call this a shortage. Prices are high because supply is low.

- *1 point off, not fully explaining supply shifts*
- *1 point off, no price information*
- *1 point off, picture doesn't show price increases*
- *1 point off, supply curve moves wrong direction*
- *1 point, something correct*

2 (3). Name a fixed cost in the production of skyscraper glass, and explain why it is a fixed cost.

A super big vat for producing glass is a fixed cost because you need the vat to produce any amount of glass. Any other well-reasoned argument is acceptable.

- *1 point off, right answers, explanation is off*

3 (3). Name a sunk cost in the production of skyscraper glass, and explain why it is a fixed cost.

The glass that you have to chip out of the tank to get started again is a sunk cost. Once you have been producing and you stop, you incur this cost and cannot resume or sell the equipment to others without chipping it out – apparently at great cost.

Other good answers included property taxes, electricity (inasmuch as you have already paid the bill).

- *1 to 1.5 points off, assuming no alternative use of factory or land*
- *1 point off, you do not acknowledge that sunk costs are sunk because you can't recover them*
- *1 point, something true*

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B. Short Answer Questions (40 points)

1 (5). Name two factors that influence supply, and briefly explain why they influence supply.

Factors that influence supply include costs, the ability to change production to another product, the number of firms in the market, and government regulations (inasmuch as they change costs). The answer here should not include "price," as price moves you along the supply curve, rather than shifting the curve.

Demand does not influence the shape of the supply curve. It influences the equilibrium price.

- *2 points off, one answer is incorrect*

2 (5). Imagine Anne and Betsy. Anne likes apples a lot and bananas a little. Betsy likes bananas a lot and apples a little. Draw two pictures, each with apples on the vertical axis and bananas on the horizontal axis. In the first, draw Anne's indifference curves. In the second, draw Betty's. Briefly explain why you drew them this way.

See pictures at end. Anne is willing to give up a lot of bananas for a little apples; Betsy the reverse.

- *1 point off, picture is off, but explanation is good*
- *3 points off, really off picture*
- *1 point, something correct*

3 (5). Define the income elasticity of demand for coffee. What is the sign of your income elasticity of demand for coffee? Why?

The income elasticity of demand is the percent change in price given a percent change in income:

$$E_I^D = \frac{\%\Delta Q}{\%\Delta I},$$

where Q is the quantity of coffee you consume, and I is your income.

For me, if my income increased, I would barely increase my consumption of coffee because I don't like it very much! So my income elasticity of demand for coffee is positive but very very small.

Any similarly argued answer is acceptable.

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Many answers confused the income elasticity of demand with the price elasticity of demand.

- *2 points off, right definition, wrong explanation*
- *1 point, something correct*

4 (5). Which one the following two equations is the supply curve, and which one is the demand curve? Explain your reasoning.

- $Q = 1000/P$
- $Q = 10P$

If you draw each line on P-Q axes, you will notice that the first equation has a negative slope and the second has a positive slope. The line with the negative slope should be the demand curve, since we think that demand curves almost always slope downward.

Alternatively, you could re-write the second equation into a $y = mx + b$ form, where P is y and Q is x. This would yield

$$Q = 10P$$
$$P = Q/10,$$

from which we can see that the slope (m) is positive (and $b = 0$).

You can re-write the first equation, $Q = 1000/P$, as $PQ = 1000$. Here you can see that if P increases, Q must decrease, and if Q increases, P must decrease. In other words, there is a negative relationship between P and Q, which is what we expect in a demand curve.

- *1 point off, somewhat wrong explanation*
- *2 points off, right logic, wrong answer*
- *3.5 points, right answer, no explanation*

5 (5). Suppose that the price of butternut squash increases, and that the quantity of butternut squash decreases. Further suppose that only supply or demand changed. Which changed, and in which direction?

If S increased $\rightarrow$ prices fall, and Q increases. Not possible

If D increased $\rightarrow$ prices increase, and Q increases. Not possible.

If S decreased $\rightarrow$ prices increase, and Q decreases. Possible.

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If D decreased $\rightarrow$ prices fall, and Q decreases. Not possible.

6 (5). Can a firm display (increasing) economies of scale if it does not have increasing returns to scale? Explain.

Increasing returns to scale imply economies of scale. Economies of scale do not imply increasing returns to scale. Returns to scale measures whether, when inputs remain in a fixed ratio but are doubled, whether output doubles. Economies of scale measures whether, when total input cost is doubled, output doubles.

Therefore, yes, a firm can have economies of scale without returns to scale.

- *3 points, some right argument, wrong answer*
- *1-2.5 points, wrong answer, some correct logic*
- *3-4 points, right answer, some right argument*

7 (5). Suppose the federal budget is fixed (meaning that it cannot be increased). What is the opportunity cost of funding a policy that increases subsidies for affordable housing?

The opportunity cost of funding a new program in a world of fixed budgets is whatever program you cut to deliver the new program.

8 (5). Name two goods you perceive to be substitutes and explain why they are substitutes to you.

A good answer to this question must (a) explain what substitutes are, which is two goods that, to you, have some interchangeability – which means that as the price of one goes up, you consume the other – and (b) must give a well-reasoned example that is true for **you**.

- *1 point off, no mention of prices*

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C. Medium Answer Questions (48 points)

1 (16). Consumer Optimization and Cost of Living

Phil's utility function is $U = XY$, where $MU_X = Y$ and $MU_Y = X$. In Lancaster, Pennsylvania, Phil's income would be \$500, and the prices of good X and good Y are \$5 and \$5, respectively. In Washington, D.C., Phil's income would be \$800, and the prices of good X and good Y are \$8 and \$10, respectively.

(a, 4) Draw Phil's two potential budget constraints in a graph, labeling axes and x- and y-intercepts.

See pictures at end.

- *1 point off, small picture error*
- *2 points off, big picture error*

(b, 4) What is Phil's maximal utility in Lancaster?

Set $MRS_{XY} = P_X/P_Y$ to find optimal consumption, with prices as in Lancaster. This implies that $Y/X = 5/5$. Solving for Y yields $Y = X$. Plug this into the budget constraint: $500 = 5X + 5Y$, or $500 = 5X + 5X$. This resolves to $X = 50$ and $Y = 50$.
Then find utility with the formula given: $U = 50 * 50 = 2,500$.

- *1 point, true statement that is not the answer*
- *1 point off, not calculating U if everything else is correct*
- *2 points, right equilibrium condition, without figuring out utility*
- *2 points, right method, but slightly wrong set-up*

(c, 4) What is Phil's maximal utility in Washington, D.C.?

Again set $MRS_{XY} = P_X/P_Y$. This implies that $Y/X = 8/10$. Solving for Y yields $Y = 0.8X$. Plugging this into the budget constraint ($800 = 8X + 10Y$) gives $800 = 8X + 8X$. Solving for X yields $X = 50$. Then solve for Y (remember that $Y = 0.8X$) and find $Y = 40$.

Then find utility with the formula given: $U = 50 * 40 = 2,000$.

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Same grading scheme as (b).

(d, 4) Where should Phil live and why?

Phil should live in Lancaster. He gets more utility! His income is lower, but prices are sufficiently lower to compensate.

You can actually see this from the picture you drew for 1(a): the Lancaster budget constraint is farther from the origin (except for the x-intercept) than the DC one. Phil should never be less happy in Lancaster than he is in DC. In fact, he will always be happier in DC unless he prefers to consume only X. But we know that Phil gets utility from consuming both X and Y (and no utility if he consumes only one good), so he is not likely to consume only X.

- *2 points, right answer, wrong logic*
- *1 point, good logic, wrong answer*
- *3 point, drawing right picture, without nothing that goods are complementary*
- *2 points, wrong answer, right logic*
- *1 point, some true statement that is not the answer*

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2 (15). Firm production

Suppose the firm's production function is $Q = K^{1/3}L^{2/3}$, where the $MP_K = \frac{L^{2/3}}{3K^{2/3}}$ and $MP_L = \frac{2K^{1/3}}{3L^{1/3}}$.

(a, 5) If the rental rate of capital $R = 30$ and the wage rate $W = 40$, what is the cost-minimizing capital-to-labor ratio?

We know that cost minimization occurs when $MRTS_{KL} = W/R$. Rewriting, this is $MP_L/MP_K = W/R$. Plugging in the prices, this becomes $2K/L = 40/30$, or $K/L = 2/3$.

To minimize production costs, the firm uses two-thirds as much capital as labor.

- *4 points, right set-up, math error*
- *1 point, right optimal condition*
- *2 points, right optimal condition plus some work*

(b, 5) If the rental rate of capital $R = 35$ and the wage rate $W = 70$, how many units of labor and capital should the firm use to produce 12 units of output?

Again, the firm would like to minimize costs, and it does this when $MRTS_{KL} = W/R$. Rewriting, this is $MP_L/MP_K = W/R$. Plugging in prices, we find $2K/L = 70/35$, which resolves to $K/L = 1$, or $K = L$. Plug this relationship into the production function: $12 = K^{1/3}K^{2/3} = K$. This yields $K = 12$, and since $K = L$, $L = 12$.

- *1 point, some effort*
- *2 points, part of right set-up*
- *2 points off, substantive error in set-up*
- *1/2 point, something related*
- *1 point off, small math error*
- *1 point off, right answer, wrong interpretation*

(c, 5) Suppose that the government decides to subsidize capital so that $R = 30$, and also suppose that the firm still believes it is optimal to produce 12 units. Would the firm likely

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increase or decrease its consumption of labor? Why?

If the price of capital declines, which is what the government is doing with its subsidy, we expect that the firm should substitute toward capital and away from labor.

- *1 point off, right answer, some wrong logic*
- *3 points, right answer, limited or incorrect explanation*

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3 (17). Supply, Demand, Quotas and Cookies

The market for cookies is represented by the following supply and demand conditions: $Q_D = 1,000 - 200P$ and $Q_S = 400P - 200$. P is price per box of cookies and Q measures boxes per day.

(a, 4) Solve for the equilibrium price and quantity and illustrate your answer with supply and demand curves.

$$\begin{aligned} Q_D &= \qquad\qquad Q_S \\ 1,000 - 200P &= 400P - 200 \\ 600P &= 1,200 \\ P^* &= 2 \end{aligned}$$

Given this answer, we can solve for $Q^* = 1,000 - 200(2) = 600$.

(b, 4) Suppose the government places a quota on cookies of 500 boxes per day. Solve for the equilibrium price and quantity and then use supply and demand curves to illustrate your answer.

The equilibrium quantity is 500, by decree. How much are consumers willing to pay for 500 boxes? Plug this quantity into the demand equation:

$$\begin{aligned} 500 &= 1,000 - 200P \\ P &= 2.50 \end{aligned}$$

See the picture at the end of the exam answers.

- *1 point off, something is wrong with picture*
- *2 points off, make 500 equal to supply, not demand equation*
- *1 point, something true*

(c, 3) Calculate consumer surplus before and after the quota.

Consumer surplus before the quota is $0.5(5 - 2)(600) = 900$. Consumer surplus after the quota is $0.5(5 - 2.50)(500) = 625$.

- *1.5 points off, wrong after or before surplus*

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- *1 point off, right formula, wrong numbers*
- *1 point, something true*

(d, 3) Calculate producer surplus before and after the quota.

Note that the supply curve turns vertical at a price of \$1.75. You can find this price by plugging 500 into the supply equation: $500 = 400P = 200$, which implies $P = 1.75$.

Producer surplus before the quota is $0.5(2 - 0.50)(600) = 450$. Producer surplus after the quota is $(2.50 - 1.75)(500) + 0.5(1.75 - 0.50)(500) = 687.50$.

- *1.5 points off, wrong after or before surplus*
- *1 point off, right formula, wrong numbers*
- *1 point, something true*

(e, 3) Calculate the deadweight loss from the quota.

Total surplus before the quota is \$1,350 ($= PS_{before} + CS_{before}$). Total surplus after the quota is \$1,312.50 ($= PS_{after} + CS_{after}$).

The deadweight loss is therefore $1,350 - 1,312.50 = \$37.50$.

Alternatively, you can calculate the area of the deadweight loss triangle. It is 100 units wide (600-500) and 3/4 units tall (2.5-1.75). Therefore, $DWL = (0.5)(100)(.75) = 37.50$.

- *1.5 points, right formula, wrong numbers*

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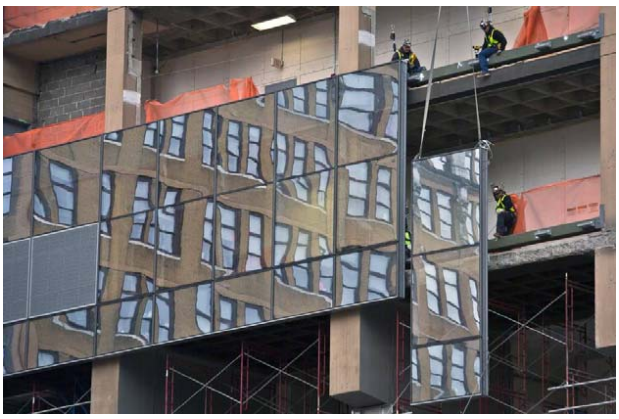
THE WALL STREET JOURNAL.

http://www.wsj.com/articles/cost-of-skyscraper-glass-hits-dizzying-heights-1441666736

BUSINESS

Cost of Skyscraper Glass Hits Dizzying Heights

Earlier manufacturing cutbacks create delays, add to price tag as construction rebounds



A typical high-rise office tower can need hundreds of thousands of square feet of metal-framed glass panels. A Brookfield Property under construction in New York City. *PHOTO: BEBETO MATTHEWS/ASSOCIATED PRESS*

By **ROBBIE WHELAN**

Updated Sept. 8, 2015 10:42 a.m. ET

A shortage of glass is taking a toll on the nation's commercial building boom, adding millions of dollars to the cost of new skyscrapers and halting some projects midway through construction.

Demand is soaring for the metal-framed glass panels, or curtain wall, used to sheath skyscrapers. Those buildings need a lot of glass—hundreds of thousands of square feet for a typical high-rise office tower.

Glass manufacturers and fabricators can't keep up. Many glass makers mothballed their operations or went out of business in 2008 and 2009, during the recession, which hit the construction industry hard.

Now, however, apartment buildings are sprouting up at their briskest pace in decades, and new office towers are rising in major markets like Manhattan at the fastest rate since the early 1990s.

Restarting idled glass factories is a costly and time-consuming process, so property developers say the current shortage could last well into next year, if not longer.

In the meantime, builders are reporting that curtain-wall prices, which have risen more than 30% in the past 18 months, are setting records.

Glass accounts for roughly one-quarter of a construction project's budget, so the extra expense can add tens of millions of dollars to a building's cost, according to Brett Atkinson, executive vice president of Moss & Associates, a Florida-based company with 30 buildings under construction that require curtain wall.

Delays are also a problem: Several towers in San Francisco's trendy Rincon Hill neighborhood, home to some of the city's most expensive apartments, are standing bare while their builders wait for glass.

"Nowadays, the glass guys are dictating the timetables of a project to us, instead of the other way around," said Ralph Esposito, who oversees commercial construction by the New York office of Lend Lease Corp. , one of the country's largest building contractors, with nearly 30 high-rise towers under way. "I don't think people had the leap of faith that the [real-estate] industry would be as strong as the run we're currently on."

The glass that ends up on the outside of an office building is manufactured in giant tanks in which sand is melted at temperatures north of 2,000 degrees Fahrenheit. Long ribbons of raw glass are floated down a river of molten metal. This "float glass" is then cut into pieces, customized to order, and the panels are

New Hudson Facades is a glass-making business that is an offshoot of real-estate developer Related Cos., which teamed up with a specialty-metal manufacturer so as to ensure a supply of glass panels. *PHOTO: ROBBIE WHELAN/THE WALL STREET JOURNAL*

sent to contractors who fit them into metal frames to produce panels that meet the builder's specifications. A contractor typically installs the curtain wall on the side of a building.

Producers shut 11 out of 47 float-glass manufacturing plants in North America between 2007 and 2014, according to PPG Industries Inc., a Pittsburgh-based glass maker, as demand for glass of all kind—from building facades to auto windshields—sagged during the downturn. Building a new plant can cost hundreds of millions of dollars, PPG says, and restarting an idled line can take months because workers have to jackhammer thousands of pounds of hardened glass to remove it from melting tanks.

"Once you take one of those tanks out of commission, you can't just turn it back on," said Glenn Miner, director of construction for PPG's flat-glass division. The downturn "affected all the suppliers in the marketplace. None of them were unscathed."

As the glass shortage worsens, some developers are taking matters into their own hands. This summer, Related Cos., a large New York real-estate firm, got into the glass-panel manufacturing business. Teaming up with M. Cohen & Sons,

New Hudson Facades is producing mockups for the panels set to go on the Manhattan building. *PHOTO: ROBBIE WHELAN/THE WALL STREET JOURNAL*

a specialty-metal manufacturer, the developer, opened a $16 million, 180,000-square-foot factory in a wooded industrial park in Linwood, Pa., near the Delaware border.

Related, which is known for glitzy properties like Manhattan's Time Warner Center, decided to open its own curtain-wall factory after waiting months for delivery of window panels intended for new apartments last year in the New York borough of Queens.

The developer needs more than 3,000 panels of architectural glass for an apartment tower it is building on Manhattan's West Side, said Bruce Beal Jr., Related's president.

The new glass company, dubbed New Hudson Façades, is producing mockups for those panels. It predicts that by next year its factory will be at full capacity, producing two million square feet of curtain wall annually.

"With the logistical issues, small number of producers and growing costs, we'd rather bet on our ability to domestically produce and control the supply" of glass, Mr. Beal said.

The glass industry is gearing back up, but progress is slow because some parts of the supply chain still haven't recovered from the recession, said Troy Hansen, director of materials at Viracon Inc., a division of Minneapolis-based Apogee Enterprises Inc. and one of the largest fabricators of the glass panes that go into curtain wall.

"As these [float glass] plants have shut down, glass has to travel farther and farther from the raw manufacturer to our facilities," Mr. Hansen said. "There's definitely a future of shortage of raw glass coming."

Viracon closed one of its three manufacturing plants, in St. George, Utah, in early 2013 amid flagging demand. In late 2014, as construction picked up, the company rushed to bring the plant back online. Even so, Viracon told customers in July that prices would rise by as much as 12% due to shortages of float glass, a once-unusual price increase that is becoming commonplace, Mr. Hansen said.

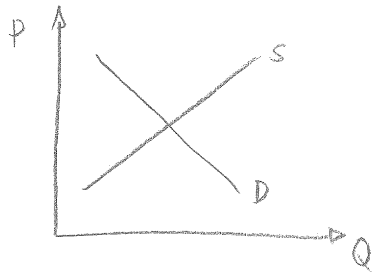
Scott Kinter, a senior vice president in Boston with AvalonBay Communities Inc., one of the largest U.S. apartment-builders, said his team began hearing about glass-related delays about a month ago, and he expects a significant curtain-wall shortage in the fourth quarter of 2015 and into early 2016. Prices are up between 35% and 45% from 2013, he said.

"Everyone is so busy and they can't keep up with the demand," he said. "If I were starting a new high-rise anywhere on the East Coast today, the first thing I'd try to lock down is the glass. Then I'd pray nothing goes wrong."

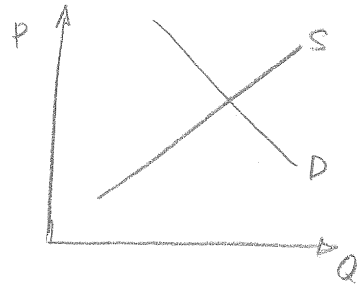
Write to Robbie Whelan at robbie.whelan@wsj.com

A. RFH

(a) - Great Recession



(b) - Now

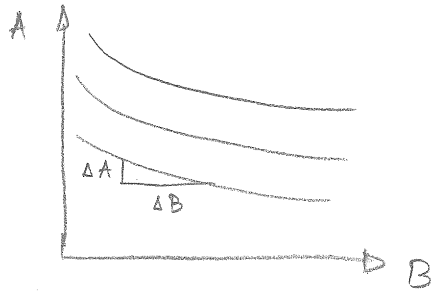


demand shifts outward, but supply is unchanged (or virtually unchanged).

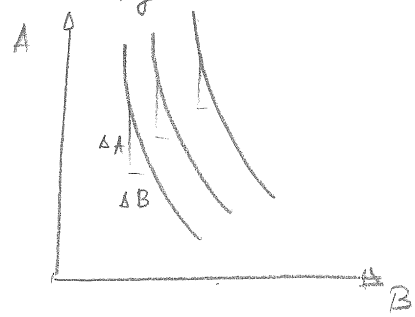
B. Short Answer

2. Apples & Bananas

Anne



Betsy



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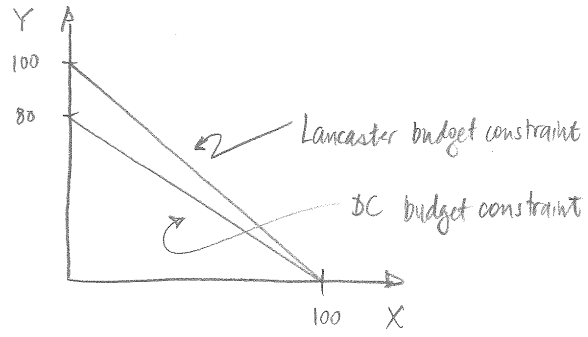
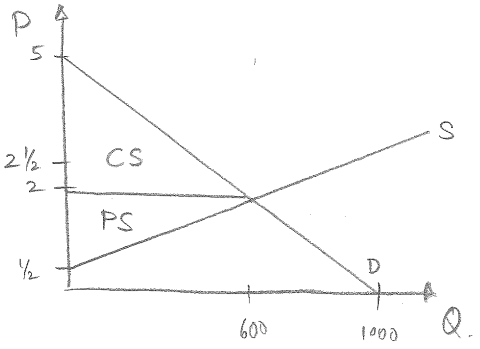
C. Medium Answer

1 (a).

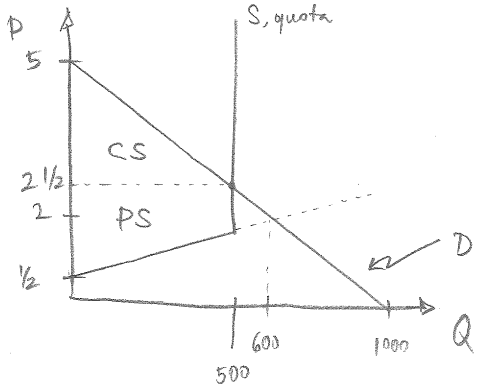


3(b)

Before Quota



After Quota



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