

Midterm  
Microeconomics for Public Policy I  
Fall 2017  
October 17, 2017

GWID: \_\_\_\_\_

Instructions

1. Write your name on page .
2. Write your GWID on each page.
3. Answer all questions.
4. The exam will be graded out of 100 points. Points for each section and points for each question are indicated on the exam.
5. Write legibly. Illegible exams cannot be graded.
6. 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.
7. Label all figures as needed.
8. 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.
9. Be concise.
10. 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.

For marking purposes only

Part A \_\_\_\_\_

Part B \_\_\_\_\_

Part C \_\_\_\_\_

total \_\_\_\_\_

### A. Ripped From the Headlines (9 points)

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

1 (2). Assume you can consume mobile phone data and one other composite good called “everything else.” Draw a picture of your budget constraint before and after the price increase in mobile phone data. Label the relevant lines and axes.

The total amount of EE you’re able to consume – if you consume nothing else – should be unchanged. The total amount of mobile phone data you can consume – assuming you consume nothing else – should be smaller.

See picture at end.

2 (2). If the anecdotes at the beginning and end of the article are true, are eating out and mobile phone service complements or substitutes? Explain why.

As people consume more mobile phone service, they eat out less. This suggests that they are substitutes.

3 (5). Suppose that incomes increase by same amount as the “household expenditures” referenced in the middle of the article. Using the value of the change in telephone service consumption in the same paragraph, make a reasoned guess as to whether telephone services are a normal, inferior, or luxury good.

The income elasticity of demand is defined as

$$E_I = \frac{\% \Delta Q}{\% \Delta I}$$

When  $E_I < 0$ , the good is inferior. When  $0 < E_I < 1$ , the good is a normal good, and when  $E_I > 1$ , the good is a luxury good.

The numerator is the percent change in telephone services. You know that the value of the change from 2007 to 2011 was \$116, but you don’t know the initial value of telephone service consumption before this change. Similarly, you assume that household income increased by \$67, but you don’t know the original level of household income. Therefore, you can write

$$E_D = \frac{\frac{116}{\text{initial telephone consumption}}}{\frac{67}{\text{initial income}}}$$

It seems very likely that the numerator here is larger than the denominator (because the initial income should be much larger than the initial telephone consumption). If this is true, mobile phone data is a luxury good.

**B. Short Answer Questions** (40 points, 5 points each question)

- need an income and substitution effect question

1. Give two examples of things that could shift the supply of apples, and explain which way each shifts the supply curve and why.

We discussed a variety of potential factors that can shift the supply curve:

- suppliers' cost of production
- the number of sellers in the market
- sellers' outside options

More sellers: Many new apple farmers enter the market. This is likely to shift the supply curve outward.

Bad weather: Bad weather for apples (maybe too much heat?) should shift the supply curve inward.

Any reasonably argued answer is acceptable.

Price is not a correct answer to this question, as changes in price move you along the demand curve.

2. You are a person who really likes chocolate and somewhat likes bananas. Draw indifference curves for these preferences, putting chocolate on the horizontal axis and bananas on the vertical axis, and explain why your curves look the way you've drawn them.

See the picture at the end. You're willing to give up a lot of bananas for some chocolate, as the curves at the end describe.

3. If your utility function is  $U = 5XY^8$  are  $X$  and  $Y$  complements or substitutes? Explain.

Given this utility function,  $X$  and  $Y$  are at least complementary. If you consume no  $X$ , you get no utility. If you consume no  $Y$ , you get no utility. Furthermore, additional  $Y$  enhances the utility you get from  $X$ , and vice versa.

However, as your consumption of  $Y$  increases, with  $X$  held constant, your utility increases, suggesting that there is some substitutability between  $X$  and  $Y$ .

A good answer points out both of these features.

4. Suppose that the equilibrium price of iron ore falls and the equilibrium quantity of iron ore increases. Assume that only supply or demand changed. Which changed? Explain your answer.

There are only four possible pairs of outcomes:

- If  $S$  increased  $\rightarrow$  prices fall, and  $Q$  increases. Possible
- If  $D$  increased  $\rightarrow$  prices increase, and  $Q$  increases. Not possible.
- If  $S$  decreased  $\rightarrow$  prices increase, and  $Q$  decreases. Not possible.
- If  $D$  decreased  $\rightarrow$  prices fall, and  $Q$  decreases. Not possible.

5. The elasticity of supply of chocolate is 0.2. If price increases by 5%, how much more chocolate will suppliers make?

$$\begin{aligned}E_s &= \frac{\% \Delta Q}{\% \Delta P} \\0.2 &= \frac{\% \Delta Q}{0.05} \\ \% \Delta Q &= (0.2)(0.05) \\ \% \Delta Q &= 0.01\end{aligned}$$

Chocolate suppliers will increase production by 1% in response to a 5% price increase.

6. A Congressional Joint Committee on Taxation report states that "... CBO updated its distribution methods to reflect that a portion of the corporate income tax is borne by labor. The CBO now allocates 75 percent of corporate income taxes to capital owners and 25 percent to labor in its long-run estimates."<sup>1</sup> Explain what this means.

This means that when the corporate tax changes, the Joint Committee on Taxation says that three-quarters of the incidence falls on shareholders, and one-quarter on workers. That is, if there is a \$100 million tax cut, owners of capital will receive \$75 million, and workers \$25 million.

Some answers correctly pointed out that capital owners must be more inelastic than workers.

Note that this split is not a legislative choice. This question is focused on the economic incidence of the tax.

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<sup>1</sup><http://www.actontaxreform.com/wp-content/uploads/2013/10/JCT-Report-10-16-13.pdf>

7. If your demand curve is  $Q = 600 - 100P$ , how many peaches do you want when the price is \$6?

Plug in  $P = 6$ , and you find that  $Q = 600 - 100(6) = 0$ . You want no peaches at  $P = 6$ .

8. Define the diminishing marginal utility of consumption of a good, and describe it in action for something you consume.

Marginal utility is the increase in happiness (utility) experienced with the consumption of an additional unit of the good. We usually assume diminishing marginal utility, which implies that you get less happiness from each additional unit of the good consumed. In math, we can write

$$MU_{x,x=5} < MU_{x,x=4} < MU_{x,x=3} \dots$$

For me, I certainly have diminishing marginal utility of Werther's Carmels. The first is great, the second is somewhat less so, and by the fifth I am somewhat grossed out.

**C. Medium Answer Questions** (52 points, each sub-point worth 4 points)

1 (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  $Q_S = 400P - 200$ . The variable  $P$  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.

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

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.

(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  $0.5(5 - 2.50)(500) = 625$ .

(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  $(2.50 - 1.75)(500) + 0.5(1.75 - 0.50)(500) = 687.50$ .

(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,  $DWL = (0.5)(100)(.75) = 37.50$ .

(f, 3) Define deadweight loss and explain why a policymaker should care about it.

Deadweight loss is the total loss in welfare (consumer + producer surplus) lost when the market fails to reach equilibrium, usually due to some type of external limitation from government. Policymakers should care about this because it is the direct cost of the policy. Policymakers should compare what they consider the gains of the policy to this loss in social welfare.

## 2 (17). Consumer Optimization

Suppose that Seema's budget constraint is  $75 = 10X + 4Y$ .

(a) Draw the budget constraint, labeling the axes and intercepts. Put  $X$  on the horizontal axis and  $Y$  on the vertical axis.

See the picture at end.

(b) What is the slope of this budget constraint?

The slope of this budget constraint is the rise over the run. If you've calculated the intercepts correctly in part (a), you can solve for this slope directly:

$$\begin{aligned}\text{slope} &= \frac{\text{rise}}{\text{run}} \\ &= -\frac{75/P_Y}{75/P_X} \\ &= -\frac{P_X}{P_Y} \\ &= -\frac{10}{4} \\ &= -2.5\end{aligned}$$

(c) Can Seema afford 4 units of good  $X$  and 10 units of good  $Y$ ?

If Seema wanted to buy 4 units of  $X$  and 10 units of  $Y$ , she would need to spend  $4(10) + 10(4) = 80$ . Her total income is \$75, so she can't afford this combination of goods.

(d) Draw an indifference curve on your picture from (a) (or repeat the picture) such that Seema is consuming optimally. What is the  $MRS$  at this point?

The indifference curve that you draw should be tangent to the budget constraint. When Seema is consuming optimally, it must be the case that  $MRS_{XY} = \frac{P_X}{P_Y}$ . We don't know  $MRS_{XY}$ , but we do know that the ratio of the prices is  $\frac{10}{4} = \frac{5}{2} = 2.5$ , so we know that  $MRS_{XY} = 2.5$ .

(e) Now assume that for Seema,  $X$  and  $Y$  are perfect complements in a 1 to 1 ratio. Draw a new picture and add the indifference curve showing Seema's optimal consumption in this case.

If  $X$  and  $Y$  are complements in a 1:1 ratio for Seema, then she prefers to consume exactly

the same amount of  $X$  and  $Y$ , or  $X = Y$ . What is the most  $X$  and  $Y$  she can consume such that  $X = Y$ ? To answer this, you combine two equations: we know that  $X = Y$  and  $75 = 10X + 4Y$ .

I can rewrite as

$$\begin{aligned}75 &= 10X + 4Y \\75 &= 10X + 4X \\75 &= 14X \\X &= 5.35\end{aligned}$$

Alternatively, I could have written

$$\begin{aligned}75 &= 10X + 4Y \\75 &= 10Y + 4Y \\75 &= 14Y \\Y &= 5.35\end{aligned}$$

See the picture at the end for Seema's indifference curve.

### 3 (17). Taxation and Unhappiness

Suppose that the market for solar panels is characterized by demand,  $Q = 400 - 10P$  and supply  $Q = P + 26$ .

(a) What is initial equilibrium price and quantity? Draw a graph, showing this point, and clearly labeling axes and the equilibrium.

See the full graph here: <https://www.desmos.com/calculator/5fxbtbzdxs>. Remember that  $P$  is on the vertical axis, and  $Q$  is on the horizontal axis. The initial equilibrium is  $P = 34$  and  $Q = 60$ .

To solve, I write

$$\begin{aligned}400 - 10P &= P + 26 \\400 - 26 &= 11P \\374 &= 11P \\P &= 34\end{aligned}$$

And we can solve for  $Q = P + 26 = 34 + 26 = 60$ .

(b) Suppose that the government levies a tax of \$22 per unit on solar panels, where the statutory incidence falls on producers. Find the new relevant equation, and add the new curve to your picture.

Because producers mail the tax check to the government, their curve is affected.

You can find the new supply curve one of two ways. The first is to recognize that this tax shifts the supply curve upward by \$22 – it increases by \$22 the price of each unit. If you write the supply curve in terms of  $P$ , you can add \$22 to increase the y-intercept, or  $P = Q - 26 + 22 = Q - 4$ .

Alternative, you can recognize that the after-tax price along the new supply curve is equal to the before-tax price plus 22:  $P_{at} = P_{bt} + 22$ . Therefore, we can write  $Q = P_{bt} + 26$ , or  $Q = P_{at} - 22 + 26 = P_{at} + 4$ .

Bottom line: the new supply curve is  $P = Q - 4$ , or  $Q = P + 4$ , and either form is acceptable.

(c) What are the new equilibrium price and quantity?

The new equilibrium is  $P = 36$ , and  $Q = 40$ .

You find these by setting the new supply curve equal to the old demand curve:

$$\begin{aligned}400 - 10P &= P + 4 \\396 &= 11P \\P &= 36\end{aligned}$$

And then plug this  $P$  into the supply or demand curve:  $400 - 10(36) = 400 - 360 = 40$ .

(d) What is the consumer burden? and the producer burden?

The price increased by \$2. Consumers are worse off due to this increase in prices and pay no taxes. Therefore, the consumer burden is \$2. Producers are paying taxes of \$22 per unit, and benefiting from only a \$2 increase in prices. Producers' burden is therefore \$20. Net burden – consumer burden plus producer burden – is \$22.

(e) Which burden is larger? Explain why.

The producer burden is substantially larger than the consumer burden. If you examine the supply and demand curves, you see that supply is more inelastic than demand. The inelastic party bears the burden of taxes. We can interpret from this that producer behavior is more fixed (at least in the short run) than consumer behavior. Perhaps this is because the producer can't make things other than solar panels, which consumers have other electricity options.

Name: \_\_\_\_\_ Blank – for extra work

10/16/2017

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DJIA Futures ▲ 22885 0.24%

S&P 500 F ▲ 2556.50 0.15%

Stoxx 600 ▲ 391.54 0.03%

U.S. 10 Yr ▼ -6/32 Yield 2.299%

Crude Oil ▲ 51.94 0.95%

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TECH

# Cellphones Are Eating the Family Budget

By Anton Troianovski

Updated Sept. 28, 2012 3:28 p.m. ET

Heidi Steffen and her husband used to treat themselves most weeks to steak at Sodak Shores, a restaurant overlooking a lake near their hometown of Milbank, S.D. Then they each got an iPhone, and the rib-eyes started making fewer appearances.

"Every weekend, we'd do something," said Ms. Steffen, a registered nurse whose husband works at a tire shop. "Now maybe once every month or two, we get out."

JOURNAL COMMUNITY »

More than half of all U.S. cellphone owners carry a device like the iPhone, a shift that has unsettled household budgets across the country. Government data show people have spent more on phone bills over the past four years, even as they have dialed back on dining out, clothes and entertainment—cutbacks that have been keenly felt in the restaurant, apparel and film industries.

The tug of war is only going to get more intense. Wireless carriers are betting they can pull bills even higher by offering faster speeds on expensive new networks and new usage-based data plans. The effort will test the limits of consumer spending as the draw of new technology competes with cellphone owners' more rudimentary needs and desires.

So far, telecom is winning. Labor Department data released Tuesday show spending on phone services rose more than 4% last year, the fastest rate since 2005. During and after the recession, consumers cut back broadly on their spending.

RELATED VIDEO

But as more people paid up for \$200 smartphones and bills that run around \$100 a month, the average household's annual spending on telephone services rose to \$1,226 in 2011 from \$1,110 in 2007, when Apple Inc.'s

iPhone first appeared.

Families with more than one smartphone are already paying much more than the average—sometimes more than \$4,000 a year—easily eclipsing what they pay for cable TV and home Internet.

The trend has been a boon for companies like Verizon Wireless and AT&T Inc. [↑ +1.39% ▲](#) U.S. wireless carriers brought in \$22 billion in revenue selling services such as mobile

<https://www.wsj.com/articles/SB10000872396390444083304578018731890309450>

1/3

email and Web browsing in 2007, according to analysts at UBS AG. By 2011, data revenue had jumped to \$59 billion. By 2017, UBS expects carriers to be pulling in an additional \$50 billion a year.

But the question for the industry is how much bigger bills can get before the cuts in other parts of the family budget grow too painful.

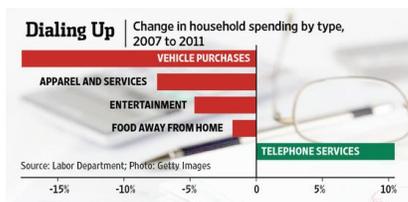
Audio

Anton Troianovski stopped by The Wall Street Journal This Morning with just how much a family will sacrifice to pay for their cellphones.

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Melinda Tuers, an accounting clerk at a high school in Redlands, Calif., said she already pays close to \$300 a month for her family's four smartphones. She and her husband have cut back on dining out, special events and concerts to make room for the bigger phone bill.

Her household may soon have an even bigger hole to fill. Two of the Tuers's smartphones are on unlimited data plans, meaning she pays the same price no matter how much she surfs the Web. She has taken advantage of that freedom to watch TV shows such as "Covert Affairs" and "Grey's Anatomy" on her phone almost every day.



Ms. Tuers now wants to replace those three-year-old smartphones. But her carrier, Verizon, announced this summer that customers would have to give up unlimited data plans if they want to upgrade their phones at the subsidized price.

Ms. Tuers figures that she and her husband would need to scrape together more than \$1,000 to pay full price for two new high-end phones or settle for one of Verizon's tiered-data plans, which she fears would cost a lot more given her video habit.

Streaming 30 minutes of video per day over a 4G connection and doing nothing else on her phone would cost Ms. Tuers roughly \$120 a month on one of Verizon's new data plans, according to the carrier's website.

Carriers fully expect people to use more data and pay more for it. "Speed entices more usage," Verizon Chief Financial Officer Fran Shammo said at an investor conference last week, according to a transcript. "The more data they consume, the more they will have to buy."

But some question where the money for that data will come from. Americans spent \$116 more a year on telephone services in 2011 than they did in 2007, according to the Labor Department, even as total household expenditures increased by just \$67.

Meanwhile, spending on food away from home fell by \$48, apparel spending declined by \$141, and entertainment spending dropped by \$126. The figures aren't adjusted for inflation.

The increase in telephone-services spending masks an even higher rise in cellphone bills, because people have been paying less for landline service.

Much of the revenue growth that industry executives and investors are hoping for is likely to come from higher-income households that do have the money to spend more on wireless data. But the wireless industry also generates a lot of revenue from lower-income users.

Almost nine in 10 of all U.S. adults have a cellphone, according to a Pew Research Center survey. Middle-income consumers increased their telephone spending in 2011 by \$59,

10/16/2017

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almost as much as the \$64 in additional telephone spending by the 20% of consumers with the highest incomes, according to the Labor Department data.

As wireless service gets more expensive, the trade-offs become more painful. That could threaten to further crimp consumer spending elsewhere—or slow the upward swing in consumer spending on wireless.

That trend is evident in the home of 40-year-old Scott Boedy, a neighborhood service representative for a cable company.

Mr. Boedy said he and his wife now pay \$200 a month for cellphone service, up by about \$50 from early last year, even as they have managed to cut spending on groceries by shopping at discount chain Aldi and on "fun stuff" by going out to dinner and movies less often.

Looking over the family budget on Sunday night, Mr. Boedy said, his wife marveled at how much of it was going to the phone company.

"It stinks," Mr. Boedy said. "I guess it's the cost of modern-day America now."

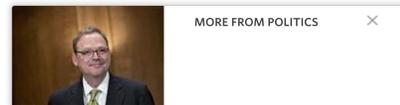
**Write to** Anton Troianovski at [anton.troianovski@wsj.com](mailto:anton.troianovski@wsj.com)

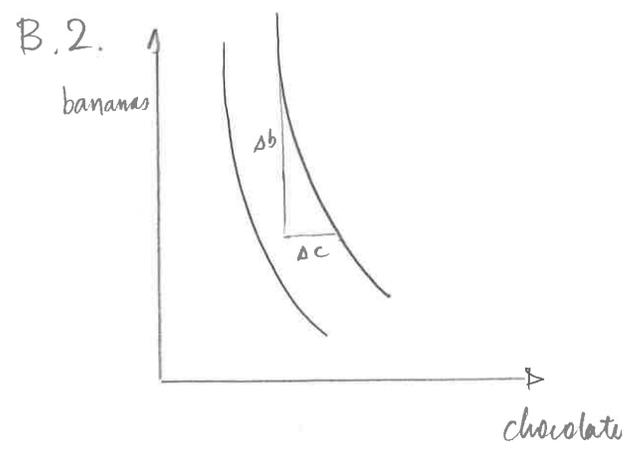
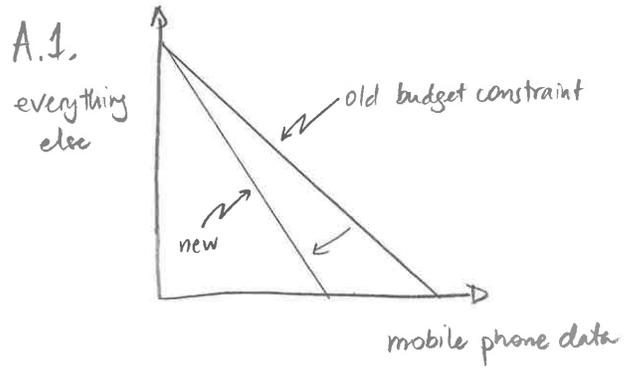
#### **Corrections & Amplifications**

An earlier version of this article misspelled Scott Boedy's surname as Boedie.

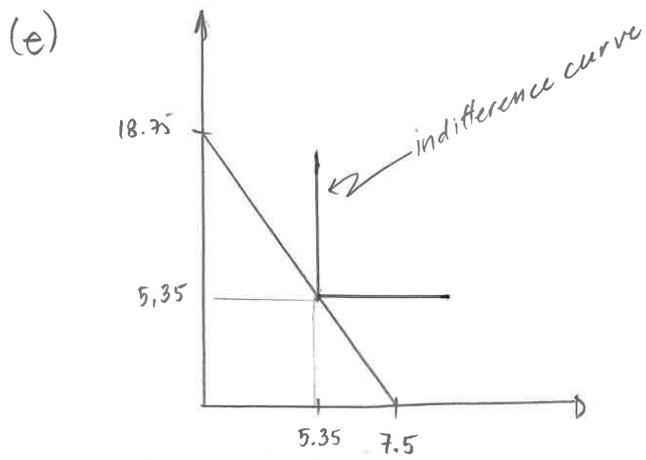
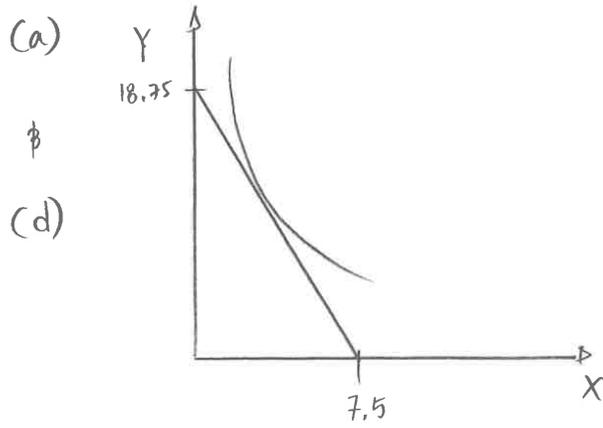
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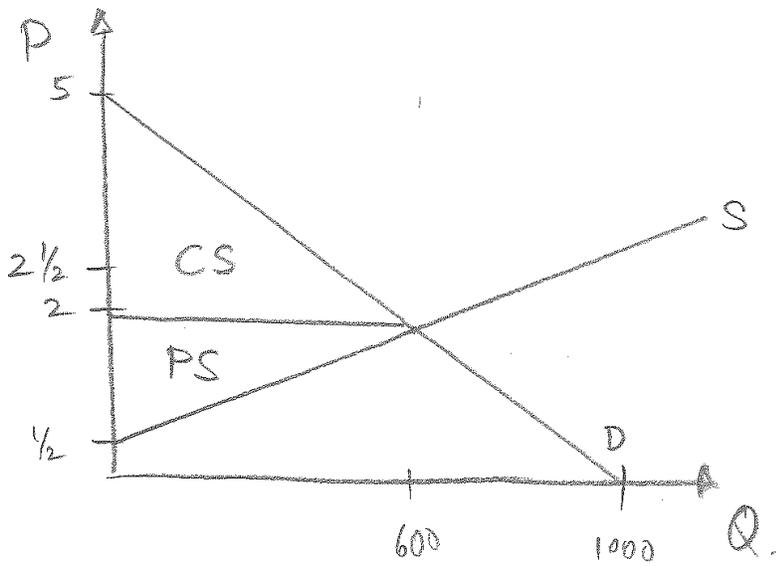




Part C, Q2



## Before Quota



## After Quota

