Economics 111 Exam 1 Fall 2005 Prof Montgomery

Answer all questions. 100 points possible.

1. [20 points] Policymakers are concerned that Americans save too little. To encourage more saving, some policymakers have suggested imposing a "consumption tax" on the portion of income that is spent rather than saved. To explore the effects of this type of tax, we might begin with the model discussed in lecture. Suppose a consumer will live two periods, with consumption level x_1 in period 1 and consumption level x_2 in period 2. The consumer's utility function is given by $U(x_1, x_2)$; assume that both goods are normal goods. The consumer has income I in period 1, and no income in period 2. However, the consumer can save some of her income in period 1 in order to have positive consumption in period 2. Any income saved in period 1 is placed in the bank, earning interest at rate r. Given no consumption tax, period 2 consumption is thus given by $x_2 = (1+r)(I - x_1)$.

Now suppose that consumption in period 1 (but not period 2) is subject to a consumption tax. More specifically, suppose that consumption in period 1 is taxed at rate t. Thus, if the consumer chooses x_1, she must also pay tx_1 in taxes. Consequently, period 1 saving becomes $I - (1+t)x_1$, and period 2 consumption is given by $x_2 = (1+r)(I - (1+t)x_1)$.

(a) Using a graph, show how the consumption tax affects the consumer's budget constraint. Then, reasoning about substitution and income effects, discuss how the consumption tax will affect consumption and savings in period 1. [HINT: Savings in period 1 are proportional to consumption in period 2.]

(b) If the consumption tax was instead imposed on consumption in *both* periods, how does this change your answers to part (a)? [HINT: The consumer's bank balance in period 2 must now cover her consumption plus her tax payment in period 2.]

2. [30 points] Consider a firm with variable cost function $VC(Q) = 10Q + 2Q^2$, where Q is the quantity produced by the firm. The firm has fixed costs FC = 98. Assume that all fixed costs are sunk costs.

a) Derive the firm's marginal cost (MC), average cost (AC), and average variable cost (AVC) functions. Then plot the MC, AC, and AVC curves for Q between 0 and 12. [HINT: You can solve this problem by constructing a table or by solving analytically for these functions using calculus. Your graph doesn't need to be perfectly to scale, but should be properly labeled and indicate relevant x and y coordinates on the axes.]

b) Suppose that the firm has already entered the market, and can sell each unit of output at price P = 50. Compute the firm's optimal quantity and profit level. If the price falls to P = 30, compute the firm's new optimal quantity and new profit level.

c) How low would the price need to fall before the firm exits the market? If the firm had not yet entered the market, what is the lowest price at which entry would occur? Explain how your answers can be determined from your graph in part (a).

3. [10 points] Suppose that the short-run elasticity of demand for gasoline is .3, and that price rises by 50%. Find the percentage change in quantity demanded and the percentage change in the revenue received by gasoline producers. How would you expect the long-run analysis to differ?

4. [40 points] Consider a market with 5 potential buyers (B1 through B5) and 5 potential sellers (S1 through S5). Each seller possesses one unit of the good, and each buyer would purchase at most one unit of the good. The tables below report each buyer's willingness to pay (i.e., the highest price she would be willing to pay for the good) and each seller's willingness to accept (i.e., the lowest price she would be willing to accept for the good).

buyer	willingness to pay
B1	15
B2	18
B3	13
B4	25
B5	10

seller	willingness to accept
S1	12
S2	5
S3	14
S4	7
S5	20

a) On a graph, plot the market supply curve and the market demand curve. [HINT: Your graph doesn't need to be perfectly to scale, but should be properly labeled and indicate relevant x and y coordinates along the axes.]

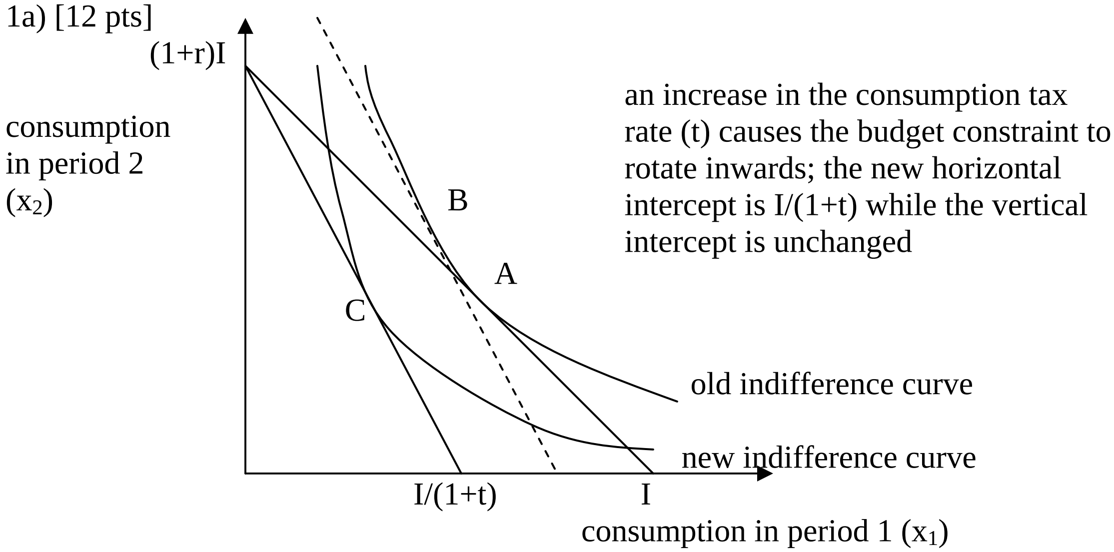
b) Assuming that price adjusts to equate supply and demand, find the equilibrium price and quantity. [HINT: If there is a range of possible prices, you should identify the range and then arbitrarily choose a price within this range.] Then compute consumer surplus, producer surplus, and total surplus.

c) Suppose that the government now sets a price floor, making it illegal to trade at a price below 16. Does this regulation create a surplus or shortage? How many units of the good will be traded? Assuming production efficiency, compute the new levels of consumer surplus, producer surplus, and total surplus. Comparing your answer to part (b), how much deadweight loss is created by the regulation? Given other (producer) rationing procedures, compute the *largest* deadweight loss that might have been created.

d) Suppose that the government attempts to bypass the market altogether, simply dictating (through "command and control") that buyers B1, B2, and B3 will receive goods from sellers S1, S2, and S3 (while the remaining buyers and sellers do not trade). Is this outcome Pareto efficient? If not, discuss if and how this outcome violates exchange efficiency and/or production efficiency and/or product-mix efficiency.

Econ 111 Exam 1 Fall 2005 SOLUTIONS

1a) [12 pts]



Substitution effect: Intuitively, an increase in the consumption tax causes period 1 consumption to become more expensive. Thus, the individual will decrease x_1 and increase x_2 (and hence increase period 1 savings). Graphically, the substitution effect is represented by a change from point A (determined by tangency between old indifference curve and old budget constraint) to point B (determined by tangency between old indifference curve and dotted budget constraint).

Income effect: Intuitively, an increase in the consumption tax effectively reduces the individual's income, causing her to decrease both x_1 and x_2 (and hence decrease period 1 savings). Graphically, the income effect is represented by the change from point B to point C (determined by the tangency between the new indifference curve and the new budget constraint). Because both inputs into the utility function are normal goods, this decrease in income (represented by the parallel shift from the dotted budget constraint to the new budget constraint) causes consumption levels to fall in both periods.

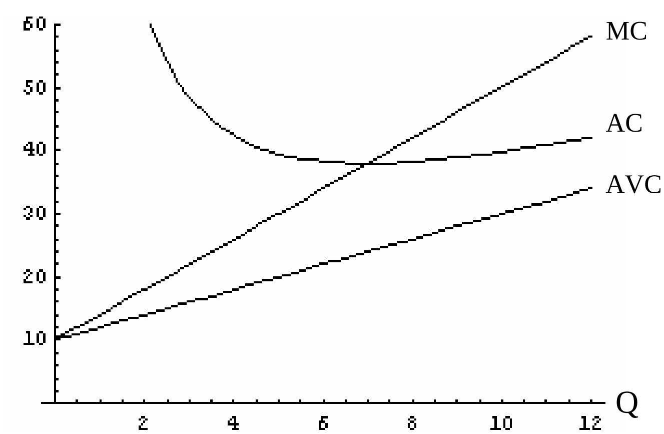
Overall effect: Both the substitution and income effects imply that period 1 consumption (x_1) will fall. The change in period 1 savings is ambiguous because the substitution and income effects have different signs. Above, I have drawn the case where the overall effect on savings is close to zero. (The graph isn't drawn very precisely, but it appears that x_2* is about the same at points A and C.) But we could have drawn the indifference curves so that the overall effect on savings would be positive or negative.

b) [8 pts] The budget constraint now becomes $(1+t)x_2 = (1+r)(I - (1+t)x_1)$, which may be rewritten as $x_2 = ((1+r)/(1+t))I - (1+r)x_1$. Thus, a change in the tax rate affects the height but not the slope of the budget constraint. Consequently, an increase in the tax rate generates an income effect (both x_1 and x_2 fall) but no substitution effect. Thus, the overall effect on period 1 savings must be negative.

2a) [12 pts] Note that TC = FC + VC = 98 +10Q + $2Q^2$, AC = TC/Q = 98/Q + 10 + 2Q, and AVC = VC/Q = 10 + 2Q. You can use the following table to determine MC (= ΔTC/ΔQ), and then plot the MC, AC, and AVC curves.

Q	VC	TC	MC	AC	AVC
0	0	98	–	–	–
1	12	110	12	110	12
2	28	126	16	63	14
3	48	146	20	48.7	16
4	72	170	24	42.5	18
5	100	198	28	39.6	20
6	132	230	32	38.3	22
7	168	266	36	38	24
8	208	306	40	38.3	26
9	252	350	44	38.9	28
10	300	398	48	39.8	30
11	352	450	52	40.9	32
12	408	506	56	42.2	34

[Alternatively, using calculus, you could have derived the MC function by differentiating the VC function: MC(Q) = VC′(Q) = 10 + 4Q. This differs slightly from the MC column in the table above, which presumes that output must be produced in whole units.]

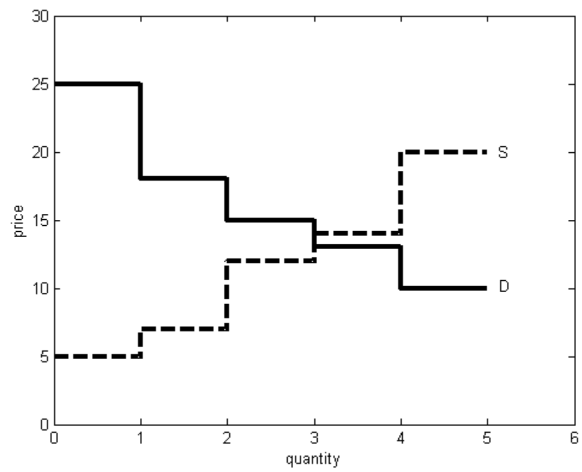


b) [10 pts] The firm's optimal quantity (Q*) is determined by the rule P = MC(Q*).
If P = 50, the firm sets Q* = 10, and profit equals PQ* – TC(Q*) = (50)(10) – 398 = 102.
If P = 30, the firm sets Q* = 5, and profit equals (30)(5) – 198 = – 48.

c) [8 pts] The firm would exit if P fell below AVC(Q*). Graphically, this is the price at which the MC curve intersects the AVC curve. (Equivalently, this is the price at which the AVC curve reaches a minimum.) Thus, in the example above, the firm would remain in market if P > 10. The firm would be unwilling to enter this market if P fell below AC(Q*). Graphically, this is the price at which the MC curve intersects the AC curve. (Equivalently, this is the price at which the AC curve reaches a minimum.) Thus, in the example above, the firm would enter if P > 38.

3) [10 pts] Elasticity is given by the formula $\varepsilon = | \%\Delta Q / \%\Delta P |$. Because demand curves slope downwards, an increase in price causes quantity to fall. Thus, $\%\Delta Q = -(\varepsilon)(\%\Delta P) = -(.3)(50\%) = -15\%$. Suppose that the original price and quantity were P_1 and Q_1, so that the original revenue was $R_1 = P_1Q_1$. The new price and quantity are given by $P_2 = (1.5)P_1$ and $Q_2 = (.85)Q_1$. Thus, the new revenue is $R_2 = P_2Q_2 = (1.5)(.85)P_1Q_1 = (1.275)R_1$. That is, revenue has risen by 27.5%. In the long run, elasticity of demand would be higher. Thus, the change in revenue would be smaller (even negative if $\varepsilon > 1$).

4a) [8 pts] Recognizing that the market supply and demand curves are horizontal summations of the individual supply and demand curves, we obtain the graph:



b) [10 pts] The graph in part (a) shows that the equilibrium price P* is between 13 and 14, and that the equilibrium quantity is 3. Consumer surplus is the difference between willingness to pay and the price actually paid, summed over all actors who actually buy. Thus, CS = (25–P*) + (18–P*) + (15–P*) = 58–3P*. (For example, if you assumed P* = 13.5, then CS = 17.5.) Similarly, producer surplus is the difference between price and willingness to accept, summed over all actors who actually sell. Thus, PS = (P*–5) + (P*–7) + (P*–12) = 3P*–24. TS = CS + PS = 34.

c) [14 pts] This price floor creates a surplus. At P = 16, four sellers (S2, S4, S1, S3) are willing to sell, while only two buyers (B4, B2) are willing to buy. Because the actual quantity is given by the minimum of quantity demanded and quantity supplied, only 2 units will be traded. Production efficiency requires that the two sellers with lowest willingness to accept (S2 and S4) will actually sell. CS = (25–16)+(18–16) = 11. PS = (16–5)+(16–7) = 20. TS = 11+20 = 31. DWL = 34–31 = 3. DWL would highest if, from among those sellers willing to sell at P = 16, the goods were actually sold by S1 and S3. In that case, PS = (16–12)+(16–14) = 6, TS = 11+6 = 17, and DWL = 34–17 = 17.

d) [8 pts] This outcome is not Pareto efficient. Exchange efficiency requires that the buyers with highest willingness to pay will actually buy. This is violated because B4 values the good more highly than B1, B2, and B3. Production efficiency requires that the sellers with the lowest willingness to accept will actually sell. This is violated because S4 has lower willingness to accept than does S3. Product-mix efficiency is satisfied because the equilibrium quantity is the same as the equilibrium quantity in part (b).

Economics 111 Exam 2 Fall 2005 Prof Montgomery

Answer all questions. 100 points possible.

1) [25 points] Consider a monopolist facing the demand curve $P = 30 - 5Q$. Assume that the monopolist has total cost $TC = 2Q + 2Q^2$ (and hence marginal cost $MC = 2 + 4Q$).

a) Compute the monopolist's optimal quantity, the price charged by the monopolist, and the profit earned by the monopolist.

b) Briefly define "deadweight loss." Then, given the monopolist's optimal choice in part (a), compute the deadweight loss caused by output restriction. [HINT: It may be helpful to draw a graph.]

c) Empirical estimates suggest that the deadweight loss caused by monopoly power is actually fairly small. Give two other reasons why the government might attempt to reduce monopoly power.

d) Derive the firm's average cost function. In this problem, is the firm a natural monopoly? Briefly explain why or why not.

2) [35 points] Consider an industry with two firms (1, 2). The industry demand curve is given by $P = 120 - 4Q$ where Q is total quantity produced by both firms ($= Q_1 + Q_2$). Firm 1 has total cost $TC_1 = 4Q_1$ (and hence marginal cost $MC_1 = 4$), while firm 2 has total cost $TC_2 = 8Q_2$ (and hence marginal cost $MC_2 = 8$).

a) Derive the reaction function for each firm.

b) Suppose the firms choose quantities simultaneously. Compute the Nash equilibrium, the market price, and the profit for firm 1.

c) Now suppose the firms choose quantities *sequentially*, with firm 1 moving first. Before firm 1 chooses Q_1, firm 2 announces that it will set Q_2 at the Nash equilibrium level from part (b) regardless of firm 1's choice. Is this threat credible? Briefly explain. If firm 1 chooses $Q_1 = 15$, compute firm 2's best response, the market price, and the profit for firm 1. Compared to part (b), did firm 1's profit rise or fall? Is there a first-mover advantage or disadvantage? Briefly discuss why.

d) Compute the industry's Herfindahl index for part (b) and then for part (c). According to this measure, did the industry become more or less competitive in part (c)?

3) [20 points] Suppose that used cars are either low-quality or high-quality. Given the market price (P) for used cars, the following table reports the number of low-quality cars (Q_L) and the number of high-quality cars (Q_H) that would be placed on the market:

P	Q_L	Q_H
1	5	0
2	20	0
3	40	0
4	50	10
5	60	30
6	60	90
7	60	180
8	60	250
9	60	300
10	60	320

Buyers place value $v_L = 3$ on low-quality cars, and place value $v_H = 8$ on high-quality cars. Assume there are many more buyers than sellers.

a) Suppose that buyers cannot observe the quality of any particular car, but do know the supply functions given in the table above. Find the equilibrium price in the used-car market. How many cars are traded? [HINT: There may be more than one possible equilibrium.]

b) Suppose that buyers can now observe quality. How does this alter the market outcome? Is total surplus (= consumer surplus + producer surplus) now higher or lower than in part (a)? Briefly explain. [HINT: You don't need to compute surplus numerically, but should offer some intuition.]

4) [20 points] The government has decided to control pollution by selling marketable permits. Firms will now need to buy one permit for each unit of pollution created. The following table shows profit (for each of 4 firms) as a function of the number of units of pollution (from 0 to 5) created by the firm

	number of units of pollution					
firm	0	1	2	3	4	5
1	2	20	34	42	48	50
2	0	25	45	60	70	75
3	60	70	78	84	88	90
4	-2	14	28	40	48	50

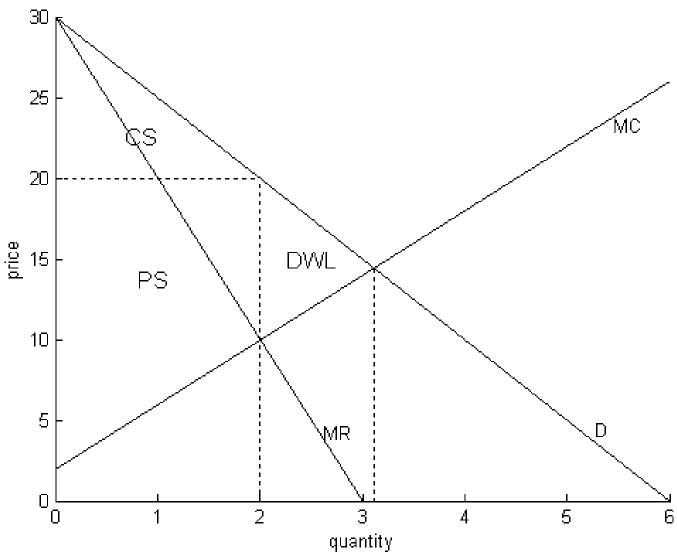
a) If the government fixes the supply of permits at Q = 8 and then allows the price of permits to adjust so that supply equals demand, what is the equilibrium price? How many permits are purchased by each firm? Compute profit levels after any permits are purchased. [HINT: Use the information in the table to construct the demand curve.]

b) If the government had instead given two permits to each firm, and then the price of permits adjusted to equate supply and demand, how would the outcome differ from part (a)? How does this problem illustrate the Coase Theorem? Briefly discuss.

Econ 111 Exam 2 Fall 2005 Solutions

1a) [7 pts] The monopolist's marginal revenue is MR = 30 – 10Q. Setting MR = MC to determine the optimal quantity, we obtain 30 – 10Q = 2 + 4Q, and hence Q* = 2. The monopolist thus charges price P(Q*) = 30 –5(2) = 20, and earns profit π = P(Q*)Q* – TC(Q*) = (20)(2) – 12 = 28.

b) [7 pts] Deadweight loss is the decrease in total surplus caused when a monopolist restricts output below the competitive level (or when the government imposes a price ceiling or price floor in a competitive market). In other words, deadweight loss equals the net benefits from trade that could have occurred (but didn't). In this problem, the competitive output level would have been 28/9 (given by the intersection of the MC and D curves), and the deadweight loss corresponds to the DWL triangle in the graph below. Thus, DWL = (1/2)(20–10)((28/9)–2) = 100/18 = 5.55.



[I didn't ask about consumer surplus or producer surplus, but you can also see from this graph that CS = (1/2)(30–20)(2–0) = 10 and that PS = (20–10)(2–0) + (1/2)(10–2)(2–0) = 28. Note that PS equals the firm's profit computed in part (a) because the firm has no fixed costs.]

c) [6 pts] Even if DWL is small, the government may want to restrict monopoly power because: (1) it is concerned about the division of total surplus between consumers and the producer (and the government isn't able to use non-distortionary taxes to redistribute this surplus), (2) monopoly profits create incentives for wasteful "rent seeking" behavior, or (3) monopolies may be less efficient than firms in more competitive environments (due to "organizational slack").

d) [5 pts] AC = TC/Q = 2 + 2Q. A firm is a natural monopoly if average cost falls as Q rises. But here, AC increases as Q rises, so the firm is not a natural monopoly.

2a) [8 pts] Given demand function $P = 120 – 4Q_1 – 4Q_2$, firm 1's marginal revenue function is $MR_1 = 120 – 4Q_2 – 8Q_1$. Setting $MR_1 = MC_1$ and solving for Q_1, we obtain firm 1's reaction function: $Q_1 = 14.5 – (1/2)Q_2$. Given the demand function, firm 2's marginal revenue is $MR_2 = 120 – 4Q_1 – 8Q_2$. Setting $MR_2 = MC_2$ and solving for Q_2, we obtain firm 2's reaction function: $Q_2 = 14 – (1/2)Q_1$.

b) [8 pts] The Nash equilibrium is determined by the intersection of the firm's reaction functions. Given $Q_1 = 14.5 – (1/2)(14 – (1/2)Q_1)$, we obtain $(3/4)Q_1 = 7.5$, and hence $Q_1 = 10$. Thus, the Nash equilibrium quantities are $Q_1 = 10$ and $Q_2 = 14 – (1/2)(10) = 9$. The market price will be $P = 120 – 4(10+9) = 44$. Firm 1's profit is $PQ_1 – TC_1 = (44)(10) – (4)(10) = 400$.

c) [12 pts] Firm 2's threat is not credible. After firm 1 chooses Q_1, firm 2's best response is given by its reaction function (derived in part a). If firm 1 does not choose $Q_1 = 10$, then $Q_2 = 9$ will not be firm 2's best response. If firm 1 chooses $Q_1 = 15$, firm 2 will choose $Q_2 = 14 – (1/2)(15) = 6.5$. The market price will be $P = 120 – 4(15 + 6.5) = 34$. Firm 1's profit is now $PQ_1 – TC_1 = (34)(15) – (4)(15) = 450$. Thus, firm 1's profit rises. More generally, this problem illustrates that there is a first-mover advantage in the Cournot game. In the Nash equilibrium of the simultaneous game, both firms are on their reactions functions. But in the sequential game, firm 1 can choose its most preferred outcome along firm 2's reaction function.

d) [7 pts] The Herfindahl index is given by the sum of the squares of market shares. In part (b), firm 1 produces 10/19 = 52.6% of total output, while firm 2 produces 9/19 = 47.4% of total output. Thus, $HI = (52.6)^2 + (47.4)^2 = 5013$. In part (c), firm 1 produces 15/21.5 = 69.8% of total output while firm 2 produces 6.5/21.5 = 30.2% of total output. Thus, $HI = (69.8)^2 + (30.2)^2 = 5784$. According to the HI, the market thus appears less competitive in part (c).

3a) [12 pts] To solve this problem, you should first compute buyers' expected value Ev(P) at each possible price P. For $P \leq 3$, only low-quality cars are placed on the market, and hence $Ev(P) = 3$ for $P \leq 3$. Given $P = 4$, 50/60 (= .833) cars on the market would be low-quality while 10/60 (= .167) cars would be high quality. Thus, Ev(4) = (.833)(3) + (.167)(8) = 3.83. Similar calculations yield the following table:

P	Q_L	Q_H	Ev
1	5	0	3
2	20	0	3
3	40	0	3
4	50	10	3.83
5	60	30	4.67
6	60	90	6
7	60	180	6.75
8	60	250	7.03
9	60	300	7.17
10	60	320	7.21

Buyers are willing to actually purchase used cars when Ev(P) ≥ P. The preceding table shows this condition holds for prices P ≤ 3 and P = 6. But because there are many more buyers than sellers, demand would be greater than supply at any price strictly less than 3. Thus, the two possible market prices are P = 3 or P = 6. Given P = 3, 40 cars would be traded. Given P = 6, 150 cars (60 low quality + 90 high quality) would be traded.

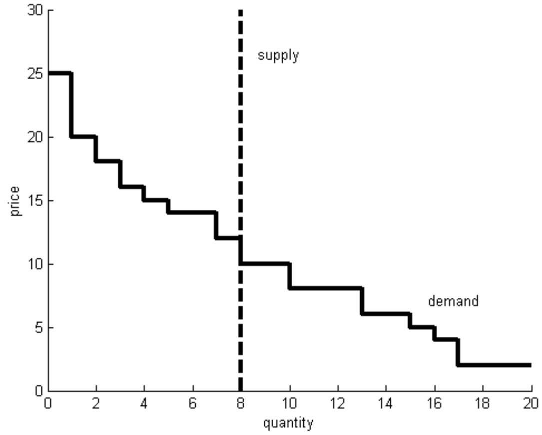
b) [8 pts] There would now be two separate markets. The low-quality market would clear at price P = 3 and quantity Q = 40. The high-quality market would clear at price P = 8 and quantity Q = 250. Consumer surplus is higher in part (b). Intuitively, as the price of low-quality cars rises from 3 (in part b) to 6 (in part a), the additional low-quality cars that are traded are actually worth less to buyers (whose willingness to pay is 3) than sellers (whose willingness to accept is greater than 3). Thus, trading those cars actually reduces total surplus. Moreover, as the price of high-quality cars falls from 8 (in part b) to 6 (in part a), those high-quality cars that are now untraded would have been worth more to buyers (whose willingness to pay is 8) than sellers (whose willingness to accept is less than 8). Thus, failure to trade those cars also reduces total surplus.

[You did not need to compute total surplus, but this could have been done with the information provided. In part (a), given P = 6, producer surplus = (6-1)(5) + (6-2)(15) + (6-3)(20) + (6-4)(10+10) + (6-5)(10+20) + (6-6)(0+60) = 215, while consumer surplus = (3-6)(60) + (8-6)(90) = 0. Thus, total surplus = 215. In part (b), producer surplus in the low-quality market = (3-1)(5) + (3-2)(15) + (3-3)(20) = 25; producer surplus in the high-quality market = (8-4)(10) + (8-5)(20) + (8-6)(60) + (8-7)(90) + (8-8)(70) = 310; consumer surplus in the low-quality market = (3-3)(40) = 0; consumer surplus in the high-quality market = (8-8)(250) = 0. Thus, total surplus = 335.]

4a) [12 pts] Given the profit table given on the exam, we can compute each firm's marginal gain from purchasing additional permits:

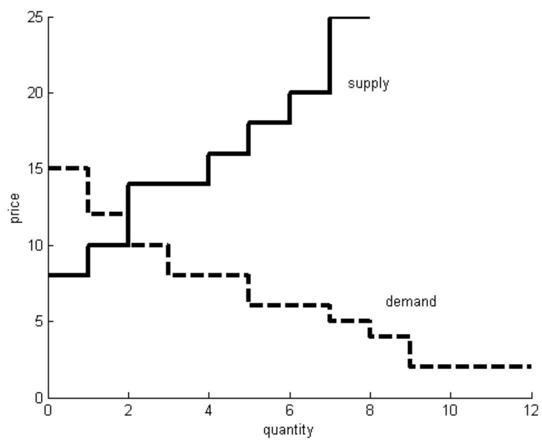
	marginal gain from permit				
firm	1	2	3	4	5
1	18	14	8	6	2
2	25	20	15	10	5
3	10	8	6	4	2
4	16	14	12	8	2

Essentially, each row of this table reveals that firm's demand curve. For instance, depending on the price (P) of permits, firm 1 would purchase 0 permits if P > 18, 1 permit if 18 ≥ P > 14, 2 permits if 14 ≥ P > 8, 3 permits if 8 ≥ P > 6, 4 permits if 6 ≥ P > 2, and 5 permits if P ≤ 2. The market demand curve is given by the horizontal summation of the individual demand curves:



Assuming that price adjusts to equate supply and demand, P will be between 10 and 12. Firm 1 will buy 2 permits (profit = 34-2P), firm 2 will buy 3 permits (profit = 60-3P), firm 3 will buy 0 permits (profit = 60), firm 4 will buy 3 permits (profit = 40-3P).

b) [8 pts] You could use the marginal gain table from part (a) to construct supply and demand curves. For instance, firm 1 would sell 1 permit if $18 > P \geq 14$, and sell 2 permits if $P \geq 18$. Firm 1 would demand 1 permit if $8 \geq P > 6$, would demand 2 permits if $6 \geq P > 2$, and would demand 3 permits if $P \leq 2$. Note that firm 1 would neither supply nor demand permits given $14 > P > 8$. The market supply and demand curves are:



Note that the equilibrium price is the same as in part (a): P between 10 and 12. Further, after buying/selling permits, each firm will hold the same number of permits as before: firm 1 neither buys nor sells (thus has 2 permits); firm 2 buys 1 permit (thus has 3); firm 3 sells 2 permits (thus has 0); firm 4 buys 1 permit (thus has 3). Thus, comparing parts (a) and (b), the only difference is that firms have each been granted valuable property rights, increasing each firm's profit by 2P. Consistent with the Coase Theorem, the efficient outcome occurs regardless of the initial allocation of property rights. But the allocation of property rights does obviously affect the payoffs received by actors.

Economics 111 Exam 3 Fall 2005 Prof Montgomery

Answer all questions. 100 points possible.

1) [28 points] Consider an economy that produces two final goods: food and clothing. The following table lists the quantity of each good produced and the price of each good for the years 2001, 2002, and 2003.

	food	clothing
quantity (in millions)		
2001	40	25
2002	45	30
2003	50	35
price (in dollars)		
2001	8	4
2002	9	6
2003	16	7

a) Compute nominal GDP for 2001, 2002, and 2003. Then, using 2001 as a baseline, compute real GDP and the GDP deflator for 2002 and 2003.

b) For this economy, we can construct a Consumer Price Index (CPI) by assuming a fixed consumption bundle, computing the nominal cost of this bundle in each year, and then dividing by the nominal cost of this bundle in a baseline year. Assuming that the fixed consumption bundle includes an equal number of units of food and clothing, and choosing 2001 as the baseline year, compute the CPI for 2002 and 2003.

c) The government adjusts Social Security benefits for inflation using the CPI. Why wouldn't the government use the GDP deflator to adjust these benefits for inflation?

d) Consider a retiree whose only source of income is her Social Security benefit, which is adjusted each year for inflation according to the CPI. Suppose that the retiree's nominal benefit in 2001 was $1200, and that she bought 100 units of food and 100 units of clothing. Further suppose that the retiree's utility function (and hence indifference map) does not change over time, and that the retiree spends all of her income each period (neither borrowing nor saving across time). What is the retiree's nominal benefit in 2002? Will she purchase more or less food in 2002 than she did in 2001? Is her utility in 2002 higher or lower than it was in 2001? [HINT: Plot the retiree's budget constraint for both years.] Given this result, does the CPI adjustment seem to undercorrect or overcorrect for inflation?

CONTINUED

2) [30 points] Consider a *closed* economy (with a government but no foreign sector). Suppose that

consumption is	$C = 5 + (.85)(1-\tau)Y$
private savings are	$S_p = -5 + (.15)(1-\tau)Y$
tax revenue is	$T = \tau Y$
tax rate is	$\tau = .1$
investment is	$I = 80 - 10r$
government spending is	$G = 12$

where r is the interest rate and Y is income.

a) Draw the circular flow diagram, labeling each flow with the appropriate symbol (C, S_p, T, …). Suppose the macroeconomy is initially in equilibrium with Y = 200 and r = 5. Compute the numerical value for each flow, and then write each numerical value alongside the corresponding symbol on the circular flow diagram. [HINT: If you've done this correctly, inflows = outflows at every node in the diagram.]

b) Suppose that the macroeconomy is initially in the equilibrium given in part (a). Using the *full employment* model, how would this equilibrium change if G rises from 12 to 17? To illustrate your answer, draw another circular flow diagram, and then write the new numerical value for each flow on this diagram.

c) Suppose that the macroeconomy is initially in the equilibrium given in part (a). Using the *unemployment* model, how would this equilibrium change if G rises from 12 to 17? To illustrate your answer, draw another circular flow diagram, and then write the new numerical value for each flow on this diagram.

d) Comparing your answers to parts (b) and (c), which model (full employment or unemployment) predicts that an increase in government spending will "crowd out" investment? Why doesn't this effect arise in the other model? Briefly explain.

3) [6 points] What are "open market operations"? How does the Federal Reserve use open market operations to decrease reserves in the banking system? Given a decrease in reserves, by what factor does the money supply decrease?

CONTINUED

4) [36 points] For this question, you should use the *full employment* model to analyze the effects of an increase in government spending given an *open* economy. Suppose that

domestic consumption is	$C_d = 5 + (.75)(1-\tau)Y - 5e$
imports are	$M = (.1)(1-\tau)Y + 5e$
private savings are	$S_p = -5 + (.15)(1-\tau)Y$
tax revenue is	$T = \tau Y$
investment is	$I = 80 - 10r$
government spending is	$G = 48$
net capital flows are	$NCF = 50 + 5r$
exports are	$X = 50 - 3e$

where e is the exchange rate, r is the interest rate, τ is the tax rate, and Y is income. Further assuming tax rate $\tau = .1$ and full-employment income Y = 200, these equations simplify so that

domestic consumption is	$C_d = 140 - 5e$
imports are	$M = 18 + 5e$
private savings are	$S_p = 22$
tax revenue is	$T = 20$
investment is	$I = 80 - 10r$
government spending is	$G = 48$
net capital flows are	$NCF = 50 + 5r$
exports are	$X = 50 - 3e$

a) Why do imports (M) depend positively on the exchange rate (e)? Why do exports depend negatively on the exchange rate (e)? Why do net capital flows (NCF) depend positively on the interest rate (r)?

b) What equation determines equilibrium in the capital market? Compute this equilibrium. What is the equilibrium level of investment (I)? of net capital flows (NCF)?

c) What equation determines equilibrium in the foreign exchange market? Compute this equilibrium. [HINT: The equilibrium level of NCF is determined by the capital-market equilibrium already computed in part (b).]

d) Suppose that the government now increases G from 48 to 60. Compute the new macroeconomic equilibrium. [HINT: As above, you should first compute the capital-market equilibrium, and then compute the foreign-exchange market equilibrium.]

e) Summarize your results, briefly discussing the effect of increased government spending on the macroeconomy. Draw supply and demand diagrams for the capital and foreign-exchange markets to illustrate the changes occurring in each of those markets. [HINT: You have enough information to plot the supply and demand curves precisely – and have already solved algebraically for the intersections of these curves – but in this part I'm merely looking for qualitative answers.]

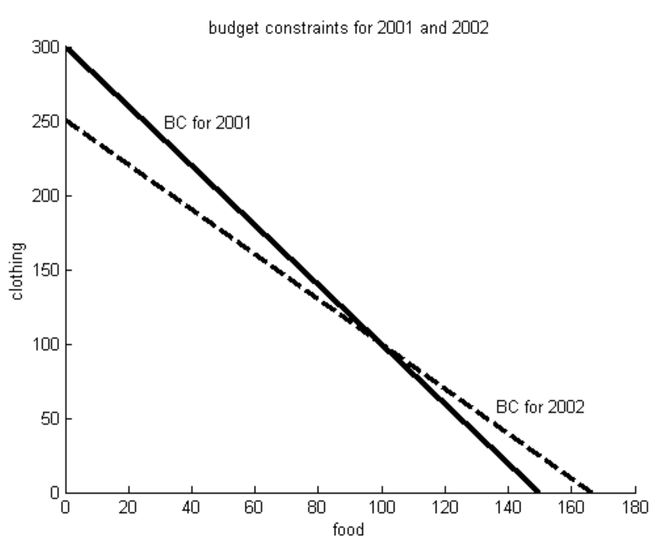
Econ 111 Exam 3 Fall 2005 Solutions

1a) [11 pts] nominal GDP for 2001 = (8)(40)+(4)(25) = 420 (million)
nominal GDP for 2002 = (9)(45)+(6)(30) = 585 (million)
nominal GDP for 2003 = (16)(50) + (7)(35) = 1045 (million)
Given 2001 baseline,
real GDP for 2002 = (8)(45)+(4)(30) = 480 (million)
real GDP for 2003 = (8)(50)+(4)(35) = 540 (million)
GDP deflator for 2002 = 585/480 = 1.22
GDP deflator for 2003 = 1045/540 = 1.93

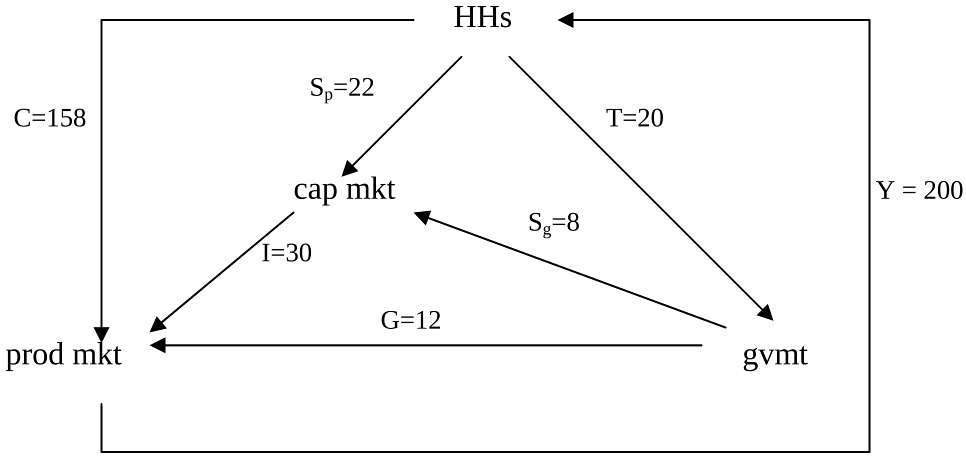
b) [4 pts] If the CPI consumption bundle contains x units of food and x units of clothing, the nominal cost of this bundle would be (8+4)x in 2001, (9+6)x in 2002, and (16+7)x in 2003. Thus, CPI for 2002 = 15x/12x = 1.25; CPI for 2003 = 23x/12x = 1.92. Note that the CPI doesn't depend on x (the absolute number of units in the bundle), merely on the relative proportions of food and clothing.

c) [4 pts] The CPI reflects the consumption bundle chosen by an average consumer, and holds this bundle fixed over time. The GDP deflator, on the other hand, reflects the entire output of the economy, and this bundle isn't held fixed. Thus, the GDP deflator is less appropriate as a measure of inflation as experienced by the average consumer.

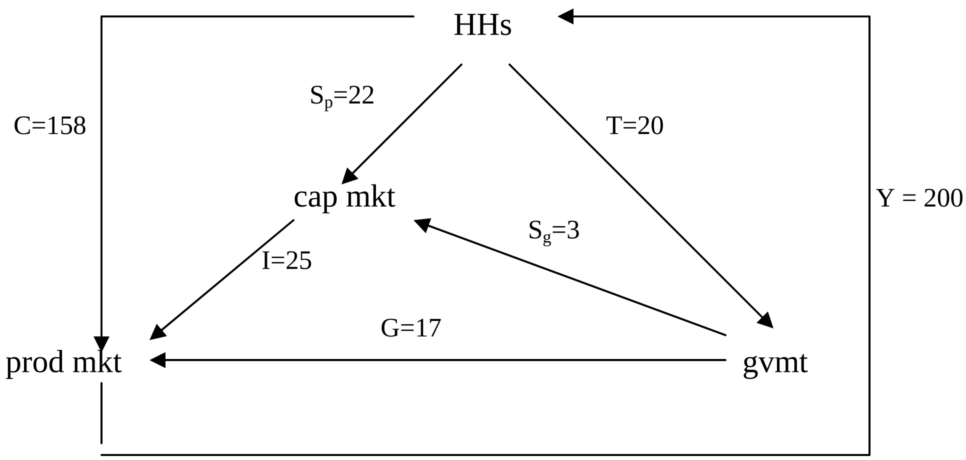
d) [9 pts] The nominal benefit for 2002 would be (1200)(1.25) = 1500. As shown, the budget constraints for 2001 and 2002 both pass through the point {100,100}, but the budget constraint for 2002 is flatter because food has become relatively cheaper. Given that {100,100} was the retiree's optimal solution in 2001, her indifference curve must be tangent to the 2001 budget constraint at that point. Thus, as the budget constraint rotates, she increases her consumption of food and moves to a higher indifference curve (and hence higher utility level). Because it ignores this substitution effect, the CPI overadjusts (i.e., overcompensates the retiree) for inflation.



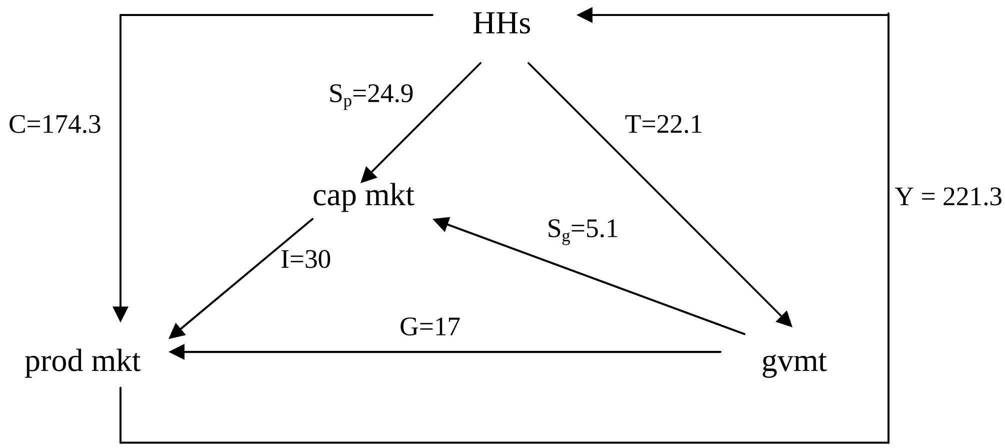
2a) [7 pts] Substituting Y = 200 and r = 5 into the equations given, we obtain:



b) [8 pts] In the full employment model, income is constant while the interest rate adjusts to clear the capital market. Capital market equilibrium is determined by the equation $S_p+S_g = I$, which may be rewritten as $S_P+T–G = I$. Given Y = 200, this equation becomes 22+20-17 = 80-10r, and hence the equilibrium interest rate will be r = 5.5. The new values in the circular-flow diagram are given below. Note that only I, G, and S_g have changed from part (a).



c) [10 pts] In the unemployment model, the interest rate is constant while income adjusts. The equilibrium level of income is determined by the equation Y = C + I + G. Given r = 5, this equation becomes Y = 5 + (.85)(.9)Y + 30 + 17, and hence the equilibrium level of income is Y = 221.3. The new values in the circular-flow model are given below. Note that, compared to part (a), every flow except for I has changed.



d) [5 pts] In the full-employment model, an increase in government spending increases the interest rate and thus reduces ("crowds out") investment, as illustrated in part (b). In the unemployment model, the interest rate is assumed constant (and hence is unaffected by an increase government spending). Flows in and out of the capital market remain balanced because the decline in government savings (from 8 to 5.1) is offset by an increase in private savings (from 22 to 24.9).

3) [6 pts] The Fed conducts "open market operations" when it buys or sells government bonds ("Treasury bills" or "T-bills" for short). In order to decrease bank reserves, the Fed would sell T-bills. The change in the money supply would equal (1/RR)(Δreserves) where RR is the reserve ratio.

4a) [6 pts] An increase in the exchange rate (i.e., a "stronger" dollar) makes foreign goods less expensive for Americans (so that imports rise) and makes American goods more expensive for foreigners (so that exports fall). Given an increase in the US interest rate, foreigners become more willing to invest their savings in the US (and Americans become less willing to invest their savings overseas). Thus net capital flows rise.

b) [10 pts] The supply of funds in the capital market is given by $S_p + S_g + NCF$, while demand is given by I. Thus equilibrium is determined by the equation

$$S_P + S_g + NCF = I$$

which may be rewritten as

$$S_P + T - G + NCF = I.$$

Given the functional forms assumed in the problem, this equation becomes

$$22 + 20 - 48 + 50 - 5r = 80 - 10r$$

$$44 + 5r = 80 - 10r$$

and hence the equilibrium interest rate is $r = 2.4$, the equilibrium level of investment is $80\text{-}10(2.4) = 56$, and the equilibrium level of net capital flows is $50+5(2.4) = 62$.

c) [6 pts] The supply of dollars in the foreign exchange market is given by M, while the demand for dollars is given by X + NCF. Thus, capital market equilibrium is determined by the equation

$$M = X + NCF.$$

We have already (in part b) solved for the equilibrium interest rate (= 2.4) and found that the equilibrium level of NCF = 62. Given the functional forms for M and X, capital market equilibrium is thus determined by the equation

$$18 + 5e = 50 - 3e + 62$$

$$18 + 5e = 112 - 3e$$

and hence the equilibrium exchange rate is $e = 11.75$.

d) [8 pts] If G rises to 60, the supply curve in capital market shifts leftwards, and equilibrium is now determined by equation

$$S_P + T - G + NCF = I$$

$$32 + 5r = 80 - 10r$$

Thus, the new equilibrium interest rate is $r = 3.2$, the equilibrium level of I = 48, and equilibrium level of NCF = 66.

Because the equilibrium level of NCF has risen, the demand curve in the foreign exchange market shifts rightwards, and equilibrium is now determined by the equation

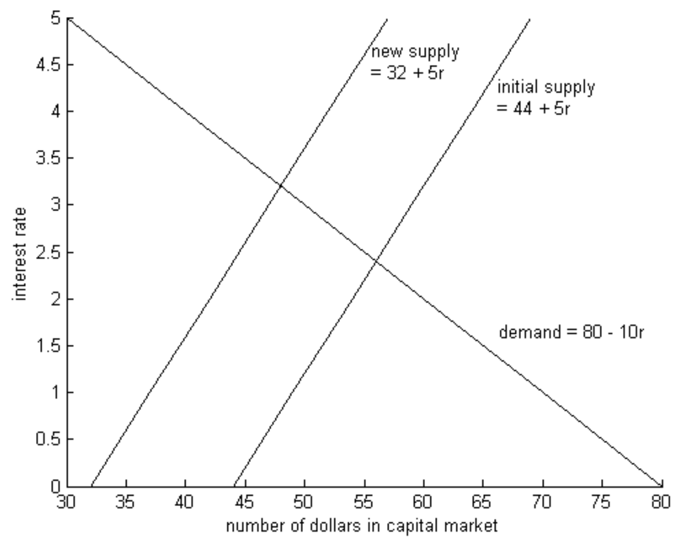
$$M = X + NCF$$

$$18 + 5e = 116 - 3e$$

Thus, the new equilibrium exchange rate is $e = 12.25$.

e) [6 pts] To summarize: The increase in G causes the supply curve in the capital market to shift leftwards, which increases the equilibrium interest rate and increases net capital flows. The increase in NCF causes the demand curve in the capital market to shift rightwards, which raises the equilibrium exchange rate. Given the information provided in this problem, you could have plotted the supply and demand curves precisely, as shown below. Note that, following the usual convention in economics, the independent variable (r or e) is placed on the vertical axis, while the dependent variable (quantity supplied or demanded) is placed on the horizontal axis.

CAPITAL MARKET



FOREIGN EXCHANGE MARKET