

# The Encyclopedia of T/F/U Short Questions in Price Theory I

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Expanded and Modified by the Entering Class of 2008

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## “The Hitman” writes:

“This document was prepared for the “True/False/Uncertain Short Questions” of the Price Theory (Microeconomics) Core Examination in the University of Chicago. The questions will cover the first out of the three quarters of Microeconomics sequence in this university. Of course, THE SOLUTIONS MAY BE INCOMPLETE, MISLEADING, OR INCORRECT. I expect the solutions here will receive about 70-80% of the total possible points on average if the same solutions are submitted for the same questions.

The references include:

Price Theory Core Examination, 2003 - 1992.

Price Theory I Final Examination, 2002 - 1998.

GSB Material of Prof Kevin Murphy, 2002 - 1999.

Note: Traditionally, the grade for short questions is completely based on the justification. Sometimes you will find the barrier between “False” and “Uncertain” is unclear. For example, the right answer for “If you add three to  $x$ , then you will get four” can be either False or Uncertain. Please do not be confused between these two words in this document.”

## Class of 2008 writes:

We contribute the questions from the following:

Price Theory Core Examination, 2008 - 2004.

Price Theory I Final Examination, 2008 - 2007.

Price Theory II Midterm Examination (Winter), 2009 - 2008.

For, Price Theory I (Fall) 2008 Final and Price Theory II (Winter) 2009 Midterm, the Entering Class of 2008 provides the actual answers written by one of the students during the exam along with the score the answer received.

For, Price Theory I (Fall) 2007 Final and Price Theory II (Winter) 2008 Midterm, the En-

tering Class of 2007 provides the actual answers written by one of the students during the exam along with the score the answer received.

Our hope is that the future entering class will continue to update this document. Each class will be expected to update the Final and Midterm that they had during their first year, and the questions from core exams from the previous year.

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# 1 HOUSEHOLD THEORY

## 1.1 Elasticities: The Concepts

1. The share of income spent on necessities declines with the level of income. Therefore, all necessities are inferior goods.

FALSE - The income elasticity for a good,  $\eta$ , measures the consumer's percentage increase in the consumption of good  $j$  to a one percent increase in nominal income holding all goods' prices constant. A good is normal if  $\eta > 0$ , and inferior if  $\eta < 0$ . A good is a necessity if  $\eta < 1$ , and a luxury if  $\eta > 1$ . Hence all inferior goods are necessities.

2. A good can be inferior through the entire range of income.

FALSE - No good can be inferior through its entire range since consumption must increase from zero at least for a while before it can decline.

3. The market demand for a good is more inelastic the greater the elasticity of supply of goods for which it is a substitute. (Core 1998)

FALSE - If the elasticity of supply of a good  $Y$  for which a good  $X$  is a substitute is high, the consumers can easily substitute  $Y$  for  $X$ . Hence when the price of  $X$  increases, they can easily replace  $X$ , that is, the market demand for  $X$  is elastic.

4. The elasticity of demand for an input is smaller when complementary inputs are inelastically supplied. (Core 1997)

TRUE - If its complementary input is inelastically supplied, then it is hard to change the quantity of an input when its price is decreasing. Hence the demand is not elastic.

5. All else equal, the price elasticity of demand of a good will be larger when there are more demanders of the good. (Andrew Sellgren)

UNCERTAIN - In order to get the overall demand of a good, we horizontally add the demand curve of each of the demanders. The addition is horizontal because the overall quantity at a given price is the sum of the individual quantities, and quantity is on the horizontal axis. Adding an additional demander necessarily makes the slope of the aggregate demand less steep, i.e., the absolute value of  $\frac{dp}{dq}$  smaller. At the same time, the equilibrium point  $(q, p)$  will move right upward, i.e., both  $p$  and  $q$  larger but  $\frac{p}{q}$  can be smaller or larger. Since the price elasticity is the absolute value of  $\frac{q}{p} \frac{dp}{dq}$ , we cannot say that the price elasticity will necessarily be larger. (Andrew Sellgren)

6. In general, the demand for a good is more inelastic for the poor than for the rich. (Final 2002)

FALSE - (Solution 1) There is no reason to expect goods to be less elastically demanded at low levels of income. There may be some tendency for the poor to consume low elasticity of demand goods since they tend to consume more of low-income elasticity goods. To the extent that low income elasticity and low price elasticity are correlated, then there would be some tendency in this direction. But this does not really work for individual goods. (T.A.)  
 (Solution 2) The price elasticity is determined by the shape of the demand curve. Hence we have to compare the two individual demand curves for the same good; we can easily see there is no relationship, e.g., the demand for a good is more inelastic for the poor, but that for another is less inelastic for them. (Mo)

7. The price elasticity of demand for a good by a poor person is greater than the elasticity of a rich person who faces the same market price and has the same preferences. (Core 2002)

FALSE - See the above question.

8. In general, the demand for an input will be more elastic than the demand for the output produced due to the ability to substitute among factors as well as adjust output. (Core 2003)

FALSE - We cannot say this in general. For example, consider a fixed input. Such an input is very hard to be replaced, and sometimes is not affected even we adjust output. (Mo) Also, it really depends on the production function. For example, if you have a Leontieff production function in which a fixed proportion of the inputs have to be used, each input is infinitely inelastic. In this case, the output produced is more elastic than the demand for an input.

9. If  $x$  is a substitute for  $y$  and  $y$  is a substitute for  $z$ , then  $x$  must be a substitute for  $z$  (i.e., substitution has a transitive property.) (Final 1998)

UNCERTAIN - We have  $\frac{dx}{dp_y} > 0$  and  $\frac{dy}{dp_z} > 0$ . But since  $\frac{dx}{dp_z} = \frac{dx}{dp_y} \frac{1}{\frac{dy}{dp_z}}$ ,  $x$  is not a substitute for  $z$  unless  $y$  is a Giffen good, i.e.,  $\frac{dy}{dp_y} > 0$ . (Mo)

10. If the sum (across goods) of all uncompensated own price elasticities is -12, then the sum of all compensated own price elasticities must be -13. (Core 2006)

FALSE - Using the Slutsky equation, we know that

$$\epsilon_{ij}^M = \epsilon_{ij}^H - s_j \eta_i$$

Therefore, for own price elasticities, we get

$$\epsilon_{ii}^M = \epsilon_{ii}^H - s_i \eta_i$$

So, summing this across all goods we get

$$\sum_i \epsilon_{ii}^M = \sum_i \epsilon_{ii}^H - \sum_i s_i \eta_i$$

But since  $\sum_i s_i \eta_i = 1$ , the equation above tells us that if the sum (across goods) of all uncompensated own price elasticities is -12, then the sum of all compensated own price elasticities must be -11 instead of -13. (Class of 2008)

## 1.2 Elasticities: Real World Examples

11. A new technology that increases the amount of output per man hour in the U.S. electronics industry will increase production more when there is free trade (i.e. U.S. firms compete in a global market) than when there is no trade between countries due to tariff barriers. (GSB Final 1999)

TRUE - With free trade, the demand for output facing U.S. producers is more elastic (they can spread increased sales over more customers and can take sales away from foreign producers). The increase in productivity will lower production costs and shift the supply of electronics outward. A given increase in supply (i.e. shift outward in the supply curve) will increase production more the greater is the elasticity of demand. (Kevin Murphy)

12. Richer families are more likely in any given society to employ maids and other domestic help than poorer families. This implies that the importance of domestic help should increase over time as a country develops and per capita incomes grow. (Final 2001)

FALSE - We know the income elasticity of “maids and other domestic help” is positive. However, we have to consider the price elasticity, too. If the prices of “maids and other domestic help” increase as per capita incomes grow (which actually happens because the opportunity cost of maids will be increasing and hence so will the wage of maids), we cannot say that more “maids and other domestic help” are consumed as a country develops. (Mo)

13. Suppose the supply function of servants is constant over time. A growth in income and wages in the country may reduce the number of servants even though the income elasticity of demand for servants is very strongly positive. (Core 1993)

TRUE - See the above question.

14. If the demand for illegal drugs is inelastic, then an intervention that seizes and destroys 10% of drug production will raise the profits of drug suppliers. (Core 2002)

TRUE? - If the drugs are already produced but 10% of them are destroyed, this is just like a shift of the supply curve to the left by 10%. In the new equilibrium, the price increases (by at most 10%), and the equilibrium quantity decreases but not to the ratio of the price increase because the demand is inelastic. Hence the revenues to the suppliers increase, but the costs remain the same. The profits will be raised. (Mo)

15. Demand for self-service gas stations in the U.S. were the result of rational substitution of own for purchased pumping time when OPEC raised oil prices. (Core 1995)

FALSE - It has nothing (little) to do with pumping time since it takes (almost) the same time whether you do it by yourself or have some other do it [at least in my opinion]. It is more likely related to the purchase of 'services'. Since oil prices have increased, the income effect will discourage you from buying the pumping services, and thereby the self-service gas station will become more preferred to the other type. (Mo)

16. An increase in the price of gasoline will lead some car owners to switch to smaller more fuel-efficient cars. These owners might end up driving more miles, and even use more gasoline, than they did before the gasoline price increase. (Core 2008)

TRUE - It's pretty obvious that an increase in the price of gasoline will lead some car owners to switch to fuel-efficient cars if the consumers judge this increase in price to be rather permanent than temporary. Once they make the discrete jump of changing the type of car they buy, they face a whole new different cost structure. It's certainly possible that with new smaller fuel-efficient car, the marginal cost of driving went down, which would make people drive more. (Class of 2008)

17. A breakout of mad cow disease that makes it riskier to consume beef would reduce the consumption of beef more by persons who initially consumed relatively large quantities of beef. (Core 2005)

FALSE - It depends on elasticities. For people who consume beef a lot, it may be that the elasticity is very low. In this case, beef would be a necessity for them, and even with the increase in price of beef, they cannot substitute to other food. For those who don't consume beef as much, elasticity is high, so they can easily substitute to chicken or pork. (Class of 2008)

### **1.3 Demand and Supply**

18. A government price control imposed on the wholesale competitive market for a good will lower its retail competitive price. (Core 2002)

FALSE - The price control will decrease the quantity supplied to the wholesale market. Hence the supply of a good goes down, and hence the retail competitive price can go up. (Mo) [Not Sure]

It raises the shadow price of the good for the people who are buying wholesale, which would mean they would recoup this cost by charging more in retail. (Class of 2008)

19. Free trade with China will reduce real wages in the United States to the same level as those of the Chinese if the Chinese workers can produce manufactured goods as efficiently as workers in the U.S. (Core 2003)

FALSE - This will happen only if the moving cost (from China to the U.S.) is zero. (Mo) [Need to think more.] Also, it will not be the case that the real wages of the two countries converge to the old real wage level of China. More likely, the real wage of China will increase compared to its old level, and the real wage of US will decrease compared its old level, meeting at the new real wage that is between the two old levels.

True/Uncertain: Suppose the relevant industry continues to operate in both countries after trade is liberalized. Then, if the industry is well approximated by the 2by2 model, the factor price equalization theorem says that the non-traded factors of production (labor) should command the same price if they are equally efficient in the two countries. This wage would not typically be the same as the pre-reform wage in China, so it depends on how one reads the question (if the “same level as those of the Chinese” refers to the level before or after the change). In practice, the wages would probably just converge somewhat but not be exactly equal. (Class of 2008)

20. Suppose there are two groups A and B. The demand by each member of A for good  $x$  at a given price depends negatively on the quantities consumed by members of B, while the demand by B at a given price depends positively on the quantities consumed by A. The aggregate demand curve for  $x$  of both A and B could have positively sloped sections and there could also be several demand levels corresponding to a given price. (Core 1992)

TRUE - Refer to Professor Becker’s social multiplier theory, but here’s a brief sketch. Suppose an individual  $j$ ’s demand function for good 1 can be written as  $x_1^j(p_1, \dots, p_n, I^j, X_1)$  where  $X_1 = \sum_{j=1}^N x_1^j$  and  $I^j$  is the income of individual  $j$ . Then differentiating  $X_1 = \sum_{j=1}^N x_1^j(p_1, \dots, p_n, I^j, X_1)$  with respect to  $p_1$

$$\begin{aligned} \frac{dX_1}{dp_1} &= \sum_{j=1}^N \frac{\partial x_1^j}{\partial p_1} + \sum_{j=1}^N \frac{\partial x_1^j}{\partial X_1} \frac{dX_1}{dp_1} \\ \implies \frac{dX_1}{dp_1} &= \frac{\sum_{j=1}^N \frac{\partial x_1^j}{\partial p_1}}{1 - \sum_{j=1}^N \frac{\partial x_1^j}{\partial X_1}} \end{aligned}$$

The social multiplier  $m$  is defined as

$$m = \frac{1}{1 - \sum_{j=1}^N \frac{\partial x_1^j}{\partial X_1}}$$

When  $m < 0$ , you have overreaction of the conformity good, and you can have positively sloping demand curve. (Class of 2008)

21. Assume the demand by consumers for a good X at a given price depends positively on the quantities of X demanded by other consumers. There may be multiple positions on the aggregate demand curve at a given price. Consumers prefer the one with the largest amount of X consumed, given the price. (Fall 2008 Final)

FALSE - It is true that there may be multiple positions on the demand curve at a given price. However, it may not be the case that consumers prefer the one with the largest amount of X. In this case, it is possible that consumers would overconsume. The key is that X may not necessarily be a “good.” It is possible that X would not be consumed by people except that the “social multiplier” raises their marginal utility from consuming X. This is the difference between marginal utility and absolute utility. (Class of 2008: 8/10)

#### 1.4 Demand and Supply: Deadweight Loss

22. The more elastic the supply of a good, the smaller will be the deadweight loss from imposing a marginal tax on sales of that good. (Andrew Sellgren)

FALSE - The easiest way to show this would be with two supply-and-demand diagrams. In the first, have supply be perfectly inelastic, i.e., vertical. Then show that there’s no distortion and hence no deadweight loss. In the second, have supply be partially elastic, i.e., upward sloping. Then show the deadweight loss triangle. (Andrew Sellgren)

23. A world market for saleable quotas for greenhouse-causing gases with a fixed supply of quotas, Q, would lead to more efficient allocation of production of these gases than would a unit tax on the emission of these gases by all firms in the world, if the tax also led to Q units of these gases being produced worldwide. (Core 2003)

FALSE - The two policies have the same deadweight losses, which means two policies are “equivalent” in a sense of efficiency. The only difference is the distribution issue of some part of surplus, which belongs to the producer’s surplus in the quota system, but becomes government revenue in the unit tax system. You can easily find this out by the figure. (Mo)

24. If labor supply is perfectly inelastic (both compensated and uncompensated), then a tax on labor income will not generate any deadweight loss. (Spring 2008 Midterm)

UNCERTAIN - If supply is inelastic, there is no distortion in behavior as long as all income is taxed, and the revenue is not spent in a distorting way. However, if, for instance, fringe benefits (like health insurance, pensions, better working conditions) were untaxed, then firms could attract labor by offering these untaxed forms of income in lieu of monetary compensation. For instance, health care is treated this way in the US, and most firms opt to offer this untaxed compensation. (Class of 2007: 6/10)

25. Suppose the government attempts to cut the pollution of carbon dioxide gas by firms. The government could either tax the output of this gas, or give firms a limited number of salable permits to emit this gas. If the tax system and the permit system lead to the same total output of the gas, firms would be indifferent between the two systems. (Core 2007)

FALSE - The surplus generated by these policies accrue to two different entities. Taxing the output of this gas means the surplus becomes government revenue while giving firms permits means that the surplus will be part of producer's surplus as firms can trade these permits between themselves. Since both system was assumed to lead to the same total output of the gas (which means DWL is the same between two options), the firms will definitely prefer salable permits that will enable them to increase producer surplus. (Class of 2008)

### **1.5 Demand and Supply: Substitute and Complement in Consumption and Production**

26. If corn and soybeans can be produced on the same land and are both used as animal feed, then a tax on soybeans will reduce the price of corn and increase corn production. (GSB Final 1999)

FALSE - The tax on soybeans will raise the price of soybeans paid by buyers and reduce the price of soybeans received by sellers. (1) Since soybeans and corn are substitutes on the demand side, this will increase the demand for corn. (2) Since they are also substitutes on the supply side, the lower seller's price for soybeans will increase the supply of corn as well. Since both the supply and demand for corn are increasing, the quantity of corn produced will certainly rise but the price could go either way. (Kevin Murphy)

27. A tax on imported oil will increase U.S. oil prices, increase U.S. oil production, and reduce U.S. oil consumption. (GSB Final 1999)

TRUE - The tax on imported oil will raise the price of all oil (since domestic oil and foreign oil are close substitutes.) The increase in oil prices will reduce consumption (in the short run) while the rise in domestic oil prices will increase domestic oil production. (Kevin Murphy)

28. An increase in the cost of refining oil should lead to greater production of coal and higher coal prices. (GSB Final 1999)

TRUE - An increase in the cost of oil refining will raise the retail price of oil products. This will increase the demand for coal (as substitute form of energy) and therefore increase both the price and quantity of coal as we move along the supply curve. (Kevin Murphy)

29. An increase in the cost of refining oil should lead to higher prices for oil products (like gasoline) but lower prices for crude oil. (GSB Final 1999)

TRUE - An increase in the cost of refining will reduce the supply of the output of refining (products) and reduce the demand for the inputs to refining (crude). Less supply of products will raise product prices while less demand for crude will depress crude prices. (Kevin Murphy)

30. If a significant amount of the supply of natural gas comes as a byproduct of extracting crude oil from the ground, then a tax on domestic crude oil production could raise the market price of natural gas and reduce total natural gas production. This would be more likely when the supply of crude from abroad is very elastic. (GSB Final 1999)

TRUE - The tax on domestic oil production will reduce the price of domestic oil to producers and reduce domestic oil production. The lower production of domestic oil will reduce the domestic supply of natural gas (a complement in production). The higher price for domestic oil to consumers will increase the demand for natural gas (a substitute on the consumption side). The price of natural gas should rise (since supply has fallen and demand has risen) and the quantity of natural gas produced may either fall or rise. When the supply of oil from abroad is very elastic, domestic oil producers will pay much of the tax (cutting oil and hence gas production significantly) while the consumer's price of oil will not increase much (minimizing the increase in the demand for natural gas). Both effects make it more likely that natural gas production will fall. (Kevin Murphy)

31. If leather and beef are both produced by slaughtering cattle, then reduced demand for beef (due for example to increased concerns about health) should increase the price of leather products. (GSB Final 1999)

TRUE - Leather and beef are what we would call joint products. Producing one results in producing the other. Less demand for beef will reduce the price of beef; which will reduce the price of cattle (equal to the value of the beef and leather from the animal). The lower price for cattle will reduce cattle production. Lower cattle production will reduce the supply of leather. Less supply of leather will raise the price of leather products. (Kevin Murphy)

32. Suppose I take cream with tea and with coffee, although I use less cream per cup of coffee than per cup of tea. Still, cream is complementary with both tea and coffee. Yet a reduction in the price of coffee could reduce my demand for cream. (Core 2004)

UNCERTAIN - Total differentiating  $\frac{dX_{\text{cream}}}{dP_{\text{coffee}}}$ , we get

$$\frac{dX_{\text{cream}}}{dP_{\text{coffee}}} = \underbrace{\frac{\partial X_{\text{cream}}}{\partial P_{\text{coffee}}}}_{-} + \underbrace{\frac{\partial X_{\text{cream}}}{\partial P_{\text{tea}}}}_{-} \underbrace{\frac{\partial P_{\text{tea}}}{\partial X_{\text{tea}}}}_{-} \underbrace{\frac{\partial X_{\text{tea}}}{\partial P_{\text{coffee}}}}_{+}$$

where the first term is the direct effect, and the second term is the indirect effect. (Here,

we're assuming tea is not a Giffen good.) Hence, we cannot tell what the sign of the LHS is. (Class of 2008)

33. Oil and natural gas are complements in production, but are substitutes in consumption by firms and consumers. This implies that an increased demand for oil would lower the price of natural gas. (Fall 2008 Final)

UNCERTAIN - Increased demand for oil means prices of oil increases, so more oil is produced. Since oil and natural gas are complements in supply side, more production of oil leads to more production of natural gas. This means the supply curve of natural gas shifts to the right, which means price of natural gas decreases. However, at the same time, since oil and natural gas are substitutes in the demand side, increase in price of oil leads consumers to demand more of its substitute, natural gas. This causes demand curve of natural gas to shift outward, which increases price. So, we have supply curve shifting to the right, and demand curve shifting to the right, which means that while quantity of natural gas definitely increases, changes in price depends on which curve shifts out more. If the supply curve shifts more than demand curve, only then will the price of natural gas decrease. (Class of 2008: 8/10)

34. If it is costly for consumers to learn how to use computers then products that require computer use such as on-line music and digital photography will tend to be complements. (Core 2007)

TRUE - X and Y are complements when increase in price of X causes less consumption of Y. Take on-line music and digital photography, which both require use of computer. Suppose cost of on-line music has increased. This means that it has become even more costly for consumers to learn how to use computers. This means consumption of digital photography will decrease also. Therefore, increase in cost of on-line music has decreased the consumption of digital photography, which means the two goods are complements. (Class of 2008) Initially, without such cost of using the computers, the two goods will tend to be substitutes. This cost of learning how to use computers will tend to drive the relationship into becoming more complements of each other, but whether it will depends on how high the cost of learning how to use computers is.

## 1.6 Demand and Supply: Long Run versus Short Run

35. A permanent decrease in the cost of producing gasoline will lead to a greater increase in gasoline sales in the long run than in the short run, but could increase car sales more in the short run than in the long run. (GSB Final 1999)

TRUE - We would expect gasoline sales to rise more in the long run since both the supply and demand for gasoline are more elastic in the long run. The sales of cars may rise more in

the short run, however, since the lower price for gas will increase the demand for a durable good (cars) and sales will increase sharply in the short run as we adjust the stock of cars upward. (Kevin Murphy)

It is uncertain whether maintenance will fall or rise in the long run. I think a better way to view this as that a permanent decrease in the price of gasoline will increase the purchase of car services (not necessarily cars). That is, I may now buy the same number of cars as before, but simply trade up and get a nicer car. Alternatively, I may simply replace my car more frequently. If the stock of cars does increase, this should increase the demand for maintenance (and more so in the long run since everything is more elastic). However, if people start getting nicer cars instead of more cars and/or replacing old cars with new cars at a higher rate, it is possible that maintenance on the overall fleet may fall. (Class of 2008)

36. A permanent reduction in the cost of producing gasoline may increase car sales more in the short run than in the long run but will increase the demand for car maintenance services more in the long run than in the short run. (GSB Final 1999)

TRUE - The reduction in the cost of producing gasoline will reduce gasoline prices. This will increase gasoline consumption more in the long run than in the short run. With lower gasoline prices, the demand for cars will increase. This may cause the sales of cars to rise more in the short run as we build up the stock of cars (the usual stock adjustment effect). The demand for car maintenance would be related to the stock of cars or the amount of driving both of which will rise more in the long run. Hence the demand for car maintenance would rise more in the long run. This coupled with the fact that the supply of car maintenance is more elastic in the long run would cause maintenance to rise more in the long run. (Kevin Murphy)

37. For a non-durable good, a per unit tax will reduce output more in the long run than in the short run. (GSB Final 1999)

TRUE - Since both supply and demand are more elastic in the long-run than in the short run, the effect of a tax on output will be greater in the long-run. (Kevin Murphy)

38. A price control on a competitive market with non-identical firms will increase the effective price (i.e. the full price paid by consumers inclusive of any costs from the rationing scheme such as the cost of waiting in line) more in the long run than in the short run. (GSB Final 1999)

FALSE - Since supply is more elastic in the long run, the reduction in output will be greater in the long run than in the short run (this will tend to make the effective price higher in the long run). But since demand is more elastic in the long run the effective price could actually be lower. (Kevin Murphy)

39. A permanent increase in the demand for beef could lead cattle farmers to supply less beef in the short run. (Fall 2008 Final)

TRUE - If ranchers know that demand has increased permanently, then they will optimize by growing their herd to a new steady state level that can support a higher rate of slaughter. In order to bring about that growth, they will slaughter less in the short run. (I also had a phase diagram that shows the permanent increase in demand giving rise to a new saddle path where the transitional dynamic is a spike upward in price from the old steady state to the new saddle path followed by a drift down in price along the new saddle path to the new steady state.) (Class of 2008: 6/10)

When demand increases, initially the stock of cattle is unchanged. Since demand has shifted out this implies that the rental rate for cattle must also increase. This will increase the current price of cattle since the price is just the discounted flow of rentals (each of which is now higher). Then investment will increase since the price is higher. In cattle, this means that the herd size will grow, but since the price is much higher in the short term the market clearing demand may fall. (Class of 2008)

### 1.7 Utility Maximizing Behavior of a Rational Person

40. A person volunteers to provide blood for hospitals when all blood is acquired by voluntary donations. Then the system changes to allow hospitals to also purchase blood and this person stops donating it. Such behavior cannot be derived from utility maximization if utility does not directly depend on whether blood can be purchased. (Core 1998)

FALSE - If the utility depends on the amount of blood “stored” in hospitals, a person would volunteer to provide blood. After the system is changed, this person may quit because he may think the blood is supplied enough by other people.

41. If voters are all rational, the number of voting in large elections should be independent of the state of the economy and the policy positions of candidates. (Final 2000)

FALSE - A rational voter will go and vote if the cost of voting, such as time spent, etc., is less than the benefit, i.e., “the change in probability that the winner is changed to his preferred candidate by his own vote” times “the difference in the expected utility in that case” ( $\delta P(U^1 - U^2)$ ). If his wage is affected by the state of the economy, then his opportunity cost of voting is high when the economy is “good” and hence he is less likely to vote. Also, the policy positions of candidates matters since, for example, if I don’t like one candidate at all, then the benefit of voting increases and hence he is more likely to vote. (Furthermore,

if “who is elected” is expected to influence the future state of the economy, then his benefit goes up and he is more likely to vote.) (Mo)

TRUE - Mo’s answer is the classic “rational voter” story. However, I think the answer is TRUE. The rational gain to voting is the value the voter places on his preferred outcome over the alternative times the probability his vote is pivotal less the costs of going to the polls. In any large election this probability is extremely small and so to rationalize voting behavior this way requires extremely large values of the preferred outcome (in the many millions of dollars). A better story for why people vote is that they like to vote or feel obligated to. If this is their primary motivation, then whether they vote or not will be fairly unrelated to the state of the economy or the policy positions of the candidates. (Class of 2008)

42. Terrorist bombs on buses in Israel typically reduce bus more by infrequent users of buses than by frequent users. This is evidence that many of the more frequent bus users do not maximize utility. (Core 2004)

FALSE - If a person does not own his own form of transportation, and must use buses in order to commute to work, even with the higher probability of dying, unless if the probability goes to 1, the person will continue to use the buses so that he can earn wage. For the frequent users of buses, the bus rides are necessities to them, and even though the cost of bus rides has effectively risen due to higher probability of death, they would not reduce the consumption of bus rides that much. (Class of 2008)

43. If leisure and goods are separable at a moment in time, if the utility function is separable over time, if wages and other income in the future are perfectly foreseen, and if capital markets are perfect, the change in the amount of leisure between two adjacent periods is determined solely by the change in wage rates between those periods. (Core 2005)

FALSE - It would also necessarily have to depend on the interest rates and discount rates in those periods (assuming that it would not be always constant over time). (Class of 2008)

44. Hyperbolic discount rates lead to the same behavior for someone addicted to drugs as sufficiently high exponential discount rates. (Core 2005)

FALSE - Hyperbolic discount rate and exponential discount rate do not generate the same behavior for a rationally acting person. The statement above assumes that the people addicted to drugs are not rational and/or have weird utility function, which will not be true in this class. (Class of 2008)

## 1.8 Preferences

45. The “Law of Demand” is a direct implication of diminishing marginal utility. (Andrew Sellgren)

FALSE - It is a direct implication of diminishing marginal rate of substitution (MRS). The “Law of Demand” states that the quantity demanded falls as the price rises. “Diminishing marginal utility” is a fallacy, since utility functions preserve preferences when those utility functions undergo any monotonic transformation, including those that cause marginal utility to be increasing. The MRS is the slope of an indifference curve. Since these curves are convex, as we increase the price of the good  $x$  on the horizontal axis, holding on the same indifference curve, the budget line rotates clockwise, and the optimal consumption of  $x$  decreases. This gives us downward-sloping (compensated) demand curves. (Andrew Sellgren)

46. If an agent prefers lottery  $L$  to lottery  $L'$  and lottery  $L$  to lottery  $L''$ , but prefers a compound lottery that give probability  $a$  to  $L'$  and probability  $1 - a$  to  $L''$  to the original lottery  $L$ , one can design a series of deals leading the agent to a sure loss of money. (Core 1998)

TRUE - Suppose the agent has the lottery  $L$  (and some money). This agent is willing to pay  $L + \$A$  (for some  $A$ ) for  $aL' + (1 - a)L''$ . But he is also willing to pay  $aL' + \$B$  (for some  $B$ ) for  $aL$  and  $(1 - a)L'' + \$C$  (for some  $C$ ) for  $(1 - a)L$ . Then he has  $L$ , as he originally had, but he lost  $\$(A + B + C)$ . (Mo)

47. Suppose someone buys a bottle of wine when cheap and the wine is young, and she holds the bottle until it is worth \$200. She would never pay that much to buy a bottle of wine, yet she refuses an offer of \$200. She violates the axioms of revealed preference for consistent behavior. (Core 1996)

FALSE - The important thing is that, unlike other wine, this wine is “special to her”. Suppose this “special” bottle of wine is worth \$300 “to her”. (Just like a wedding ring or a laptop computer, she values it more than the market price.) Then she will refuse the offer of \$200, but she would pay \$200 for a “normal” bottle of wine. No axiom is violated. (Mo)

48. If we find that an individual’s 1990 consumption bundle cost \$20,000 in 1990 and \$30,000 in 2000 and this same person’s 2000 consumption bundle cost \$45,000 in 2000 and less than \$30,000 in 1990, we can reject the hypothesis that this individual has stable homothetic preferences. (Final 2001)

TRUE - Since a homothetic function is just a linear transformation of a homogeneous function, we can simply think of the case where the utility function is homogeneous of degree 1, i.e.,  $u(tx) = tu(x)$  where  $t > 0$  and  $x$  is a consumption bundle. We will show that the

stated situation never happens under the homogeneous utility function. Suppose the 1990 consumption bundle  $x^*$  maximizes her utility under price vector  $p$  and income 20000, i.e.,

$$u(x^*) \geq u(x), \forall x \text{ s.t. } px \leq 20000 \text{ and } px^* = 20000$$

Since  $u$  is homogeneous, this implies

$$u(1.5x^*) \geq u(1.5x), \forall x \text{ s.t. } 1.5px \leq 30000 \text{ and } 1.5px^* = 30000 \quad (1)$$

Assume the new price vector is  $q$  in 2000 where  $qx^* = 30000$ . (Why? Because we assume that the 1990 consumption bundle cost \$30,000 in 2000.) The 2000 consumption bundle  $y^*$  should be such that

$$u(y^*) \geq u(y), \forall y \text{ s.t. } qy \leq 45000 \text{ and } qy^* = 45000$$

We want to show that  $py^* \geq 30000$ . Assume to the contrary that  $py^* < 30000$ , i.e., the 2000 consumption bundle cost less than \$30,000 in 1990 as stated in the question. Since she chooses  $1.5x^*$  while  $y^*$  is feasible in (1), we have  $u(1.5x^*) > u(y^*)$ . (There is no equality since  $py^* < 30000$ , i.e.,  $y^*$  is not on the budget line and it cannot be  $u(1.5x^*) = u(y^*)$ !) However, the consumption bundle  $1.5x^*$  is feasible in 2000 since  $qx^* = 30000$ , i.e.,  $1.5qx^* = 45000$ . Therefore,  $u(1.5x^*) > u(y^*)$  contradicts to the fact that  $y^*$  is optimal in 2000. This means we should have  $py^* \geq 30000$ , that is, the 2000 consumption bundle cost at least \$30,000 in 1990. Hence we can reject the hypothesis that this individual has stable homothetic preferences. (Mo)

49. Data on the degree of “happiness” of individuals indicate that richer persons on average report themselves as much happier than the average poorer person in the same country. However, as the average income of the country rises over time, the average degree of happiness does not change. Accept that these findings on happiness are accurate ordinal measures of utility. Then these two findings imply that utility mainly depends on a person’s income relative to the average income in the country. (Core 2003)

FALSE - We can explain this phenomenon using the utility function which depends only on the consumer’s own consumption vector. Assume it is monotone increasing in each good. The first part (“richer persons on average report themselves as much happier”) is easily explained because the rich people will consume more. Now consider the second part (“As the average income of the country rises over time, the average degree of happiness does not change”). Assume  $x_1$  and  $x_2$  are consumption vectors chosen at times 1 and 2,  $p_1$  and  $p_2$  are price vectors, and  $M_1$  and  $M_2$  are (nominal) incomes. So we have  $p_1x_1 = M_1$  and  $p_2x_2 = M_2$ . Then, even though  $M_1 < M_2$ , it can be true that  $U(x_1) = U(x_2)$  because  $p_1$  and  $p_2$  differ in each period. (Mo) This depends on whether this income is nominal or real income.

## 1.9 Income Effect and Substitution Effect

50. Holding the nominal income of each consumer constant, an increase in the price of one good holding the price of other goods constant will reduce the consumption of the good for which the price increased as long as that good is a normal good for each consumer. (Core 2003)

TRUE - The good is normal. Hence if the price of this good increases,

- Income effect: consume less for this good
- Substitution effect: consume less for this good since the price increases

That is, a consumer will consume less. (Mo)

51. An increase in the present value of income for a household generated by a fall in real interest rates will increase *current* consumption. (Final 2002)

UNCERTAIN - Consider net-borrowers. The fall in interest rates makes them better off. Hence

- Income effect: consume more
- Substitution effect: consume more today since current consumption becomes relatively cheaper

Consider net-savers. The fall in interest rates makes them worse off. Hence

- Income effect: consume less
- Substitution effect: consume more today

If the income effect is large enough, they will consume less.

52. According to the theory of lifecycle consumption, consumption and interest rates should negatively related. (Core 2002)

UNCERTAIN - See the above question.

53. Suppose an exogenous influx of immigrants into California increases the market price of California housing. Then those considering moving to California are more affected by the price change than those considering leaving California.

TRUE - Assume the California housing is a normal good. Consider those planning on moving to California. The increase in the California housing price makes them worse off. Hence

- Income effect: negative, i.e., consume less California housing

- Substitution effect: consume less California housing

Consider those considering leaving California. The increase in the California housing price makes them better off. Hence

- Income effect: consume more California housing
- Substitution effect: consume less California housing

Hence the income and substitution effects go in opposite directions and thus they would tend to respond less for a given substitution effect. Those who were net sellers could respond perversely if the income effect is large enough.

54. A recent paper credits new household durables - such as dishwashers and vacuum cleaners - with much of the growth in labor force participation of married women during the 20th century in richer nations. But that hypothesis is contradicted by the sharp declines in fertility in these nations. (Final 2001)

FALSE - It is true that the childbearing becomes less expensive by the introduction of dishwashers and vacuum cleaners. This will make the fertility increasing. However, there are other factors to consider. For example, since the female participate in the labor force,

- Income effect: they are richer; they can spend more time (and money) in childbearing
- Substitution effect: the price of childbearing becomes expensive

Hence we are not sure whether the fertility should increase or not. Furthermore, it should be noted that other changes during the 20th century can also influence on fertility. For example, lower mortality rate.

55. As labor productivity increases over time, we would expect wages and average hours of work to increase. (GSB Final 1999)

UNCERTAIN - Assume leisure is normal. We should expect wages to rise, but hours of work could either fall or rise since two effects are to the opposite directions:

- Income effect: consume more leisure, i.e., work less
- Substitution effect: the price of leisure increases, i.e., work more

(Kevin Murphy)

56. A rise in the price of one good holding nominal income of each consumer and the prices of all other goods constant will lead to less aggregate consumption of that good. (Core 2002)

UNCERTAIN - A rise in the price will have two effects to each consumer:

- Income effect: consume less if normal, consume more if inferior
- Substitution effect: consume less

Hence if the good is inferior, we cannot say that it will lead to less consumption. (Giffen goods are the exceptions for the law of demand!) Whether the aggregate consumption increases or decreases will depend on the mix of the consumers. (Mo)

57. If we double income and all other prices holding the price of one commodity constant, consumption of that commodity will increase.

UNCERTAIN - This will have exactly the same effect as cutting the price of that good in half holding income and the other prices constant. Then it becomes the same question as the previous one. (Mo)

58. With two goods and stable preferences, relative prices and relative consumption of the two goods always move in opposite directions. (Final 1998)

FALSE - A counterexample: Suppose the price of  $X$  increases while the price of  $Y$  remains the same, which implies  $\frac{P_X}{P_Y}$  increases:

- Income effect: consume  $X$  less, consume  $Y$  less
- Substitution effect: consume  $X$  less if it is normal

If the income effect to  $Y$  is sufficiently large, it may be the case that  $X/Y$  increases. (Mo)

59. Since a rise in the real interest rate will reduce wealth holding, current and future income fixed, higher interest rates make consumers worse off unless they are compensated by greater real incomes today or in the future. (Fall 2008 Final)

FALSE - If you are a net borrower, then rise in interest rate does make you poorer since you will have to pay more interest to the money you borrowed. Net borrowers spend more currently than their current income, so they borrow money with the promise that they'll pay back in the future. If interest rate rises, then these people have to pay back even more, so they are definitely worse off. However, net savers are NOT worse off. These people spend less currently than their current income, earn interest on their saved income, and then spend it in future. So, if interest rate increases, these people are earning more on their savings, so they are better off. (Class of 2008: 6/10)

UNCERTAIN - The net borrowers are clearly worse off. The net savers get a gain as creditors. However, holding future wage income fixed the present value of the future earnings has fallen so they may also be worse off. (Class of 2008)

60. The recent fall in housing prices in many parts of the country has reduced people's real wealth and therefore should reduce their current and future consumption of income elastic goods. (Core 2008)

UNCERTAIN - This depends on whether you're a home owner or not. If you are a home owner, it's clear that you're worse off with the recent fall in housing prices. However, if you're a potential home owner looking to purchase a new house, the recent fall in housing prices has worked wonders for you. If you do not own a home (a renter) and even if you do not plan on purchasing a new home, the recent drop in housing prices will lead to decrease in rental price also, so it's hard to say this person is worse off. (Class of 2008)

61. A rise in the price of housing will make those that own their own home better off. (Core 2004)

UNCERTAIN? - It wouldn't make them worse off, but it wouldn't necessarily make them better off. If you can't sell the house, then this rise in the price has no impact on your wealth. (Class of 2008)

If you can't sell something, it does not have a price. If you don't want to sell, you can always cash out. Your property taxes go up with the price though, so depending on your cash flow this could be a problem. (Class of 2008)

### **1.10 Income Effect and Substitution Effect: Tax on Labor Income**

62. If all individuals earn a wage rate of \$10.00 per hour, a \$1.00 per hour payroll tax offset by a \$2,000 per year tax credit for each individual (which holds government revenues and spending constant) will increase hours of work for individuals that currently work more than 2,000 hours per year but will decrease hours of work for individuals who currently work less than 2,000 hours per year. (Final 2001)

FALSE - Suppose leisure is normal. The new tax policy will decrease the wage rate that the workers actually encounter. At the same time, it will make them better off if they work less than 2,000 hours and worse off if they work more than 2,000 hours. Consider those working less than 2,000 hours:

- Income effect: since they have become better off, they work less
- Substitution effect: since the wage rate has decreased, i.e., the price of leisure has decreased, they consume more leisure, i.e., they work less

Therefore, the new policy will decrease hours of work for individuals who currently work less than 2,000 hours per year. Now consider those working more than 2,000 hours:

- Income effect: since they have become worse off, they work more
- Substitution effect: since the wage rate has decreased, i.e., the price of leisure has decreased, they consume more leisure, i.e., they work less

Therefore, we are not sure whether the new policy will increase hours of work for individuals that currently work more than 2,000 hours per year. (Mo)

63. A reduction in a flat rate tax on labor income offset by the introduction of a flat rate tax on a subset of consumption goods so as to keep government revenues fixed will increase labor supply. (Final 2000)

(Comment: In my opinion, the answer depends on whether the statement means that “. . . will increase labor supply of the economy, or, say, a representative consumer”, or, “. . . will increase labor supply of an (or any) individual”. My answer is TRUE and FALSE, respectively.)

TRUE - Suppose leisure is normal. Following the first interpretation, consider a representative consumer. Since the government revenues are fixed, “the amount of reduction in tax on labor income” to her is exactly the same as “the amount of increase in tax on consumption goods” to her. Hence this will not create any income effect:

- Income effect: none
- Substitution effect: since the opportunity cost of leisure increases, she will work more (Notice that the question is about the labor supply. This is why we are thinking about labor side only.)

Hence a representative consumer will increase labor supply.

FALSE - Suppose leisure is normal. Following the second interpretation, the result depends on the individual’s consumption set, i.e., how the individual is affected by the tax on the subset of consumption goods. Suppose “the amount of reduction in tax on labor income” to her is larger than “the amount of increase in tax on consumption goods” to her.

- Income effect: since she becomes better off, she will work less
- Substitution effect: since the opportunity cost of leisure increases, she will work more

Hence it is ambiguous. Now suppose the opposite. Then since the income effect makes her work more, she will increase labor supply. (Mo) [Not 100% sure.]

64. A 10% tax on all consumer goods has the same effect on both hours worked and on consumption as 10% tax on wage rates for people who work, but not for people who are out of the labor force. (Core 1997)

FALSE - Suppose leisure is normal. Consider the people in the labor force. A 10% tax on all consumer goods makes:

- Hours worked: Increased because the consumers are worse off and hence work more (income effect)
- Consumption: Decreased because the consumers are worse off (income effect) and the price of consumption goes up (substitution effect)

On the other hand, a 10% tax on wage rates makes:

- Hours worked: Uncertain because the consumers are worse off and hence work more (income effect), and at the same time, the opportunity cost of leisure decreases and hence consume more leisure, i.e., work less (substitution effect)
- Consumption: Decreased because the consumers are worse off (income effect)

Definitely they can have different effects. The people who are out of the labor force do not care about the wage rate or hours worked. A 10% tax on all consumer goods makes:

- Consumption: Decreased because the consumers are worse off (income effect)
- and the price of consumption goes up (substitution effect)

On the other hand, a 10% tax on wage rates makes:

- Consumption: Unchanged because the consumers do not care about wage rate

Therefore, they have different effects. (Mo)

### 1.11 Marginal versus Average Consumers

A Summary: One key thing to remember seems to be that we should look at the willingness to pay of the average consumer when the efficiency is concerned while what we see in the market (especially in the monopolistic market) is the willingness to pay of the marginal consumer. In particular, the monopolistic firm is interested in how to attract the marginal consumers, not the average ones. See the following section: Monopolistic Choice of Product Quality.

65. Selling overhead bin space for carry-on baggage to passenger is efficient if different airline passengers have different values of time. (Core 2000)

FALSE - It is more efficient than not selling overhead bin space since if their values of time are high, then they would be willing to pay a positive price in order to carry luggage with them. However, it is “efficient” only for the marginal individual and not for the average individual.

(That is, it is efficient only if the willingness to pay of marginal individual equals that of average individual.) (A student)

66. If both rich and poor families want to live in the same neighborhoods as other rich families, the price of identical housing will be higher in neighborhoods with mainly rich families than in those with mainly poor families, and the allocation of families will be efficient. (Core 1995)

FALSE - Suppose there are two villages, one with rich families and the other with poor ones. Since all families want to be in rich village, the price of housing there will be higher. Whether a family will choose a rich village or poor one depends on its willingness to pay for living in a rich village. The allocation is efficient for the marginal individual and not for the average individual. (Mo) [Not sure.]

67. If the wage bill is held fixed for different soccer teams in the same professional league, one can conclude that there is discrimination against black players if the teams with above average proportions of black players have higher winning percentages than other teams. (Core 2000)

FALSE - We have to look at the marginal productivity of both black and white players. For example, if  $W = MP(\text{white}) < MP(\text{black})$ , then the blacks may be considered to be discriminated, but otherwise we cannot say that. Furthermore, we also have to look at the outside options. For example, if the blacks are discriminated outside the soccer league, then we have to be careful at comparison because the owners may pay the reservation price of the outside options. (A student)

## 1.12 Choice under Uncertainty: Expected Utility, Risk Aversion, Lotteries, and Insurances

A Note: In many cases, we “automatically” assume a risk averse consumer. Sometimes we also have to care about risk neutral cases.

68. If entrepreneurs on the average receive lower incomes than do employees with comparable education and experience, this implies that entrepreneurs are overconfident about their chances of succeeding. (Core 2000)

FALSE - The choices of the agents are based on expected utility, not on expected income. Therefore, whether they want to become entrepreneurs or employees can depend on their risk aversion, and hence the statement is false. For example, suppose you will have \$81 for sure if you become an employee but \$1 or \$256 with equal probability if you become an entrepreneur. If the agent is risk neutral, he will choose to be an entrepreneur. If the agent's utility function is  $U = W^{\frac{1}{4}}$ , he will choose to become an employee. (Mo)

Mo's answer does not use the framework given in the problem statement. In his example, the average earnings for entrepreneurs is  $(257/2) > 81$ . If you instead had a situation like 1/2 chance at 100 and 1/2 chance at 0, only a risk loving person would take the bet compared to getting 81 for sure. There are still a number of ways out without assuming irrationality. For one, the cross section of current entrepreneur incomes might not incorporate future gains (IPO's) and the like. Also, if income just means cash payments over a year, the number does not include the equity value of the business. Finally, there may be non-pecuniary gains to being an entrepreneur (flexible schedule, no boss, etc) that may compensate the self-employed. (Class of 2008)

69. The Swedish government issues "lottery bonds". Three times a year, a total fixed coupon payment is paid by the government, but a lottery chooses which of the bonds will receive it. These bonds are worth less than a Swedish government bond which pays with certainty the expected coupon of the lottery bond. (Core 1997)

TRUE if risk-averse - Assume the state-independent utility. If the individuals are risk-averse, the statement is true. If risk neutral, those two bonds are equivalent. (Mo)

70. If all bettors at a race track are identical, the odds of different horses in a race coming in first must in equilibrium be such that bettors are indifferent among the horses. (Core 2000)

FALSE if risk-averse - Suppose the utility function is state-independent. The conclusion is, again, it depends on the agents' risk aversion. To begin with, let us consider an extremely simple example. There are only two horses in the track.  $P_1$  and  $P_2$  are the probabilities that horse 1 and 2 win, respectively, and  $\pi_1$  and  $\pi_2$  are the corresponding prices of the claims. (For example, suppose you buy a \$10 claim contingent on horse 1's win. Before the game, you submit  $\$10\pi_1$ . If horse 1 wins, you get \$10. Otherwise you get nothing.) Consider the problem where you determine the claims  $I_1$  and  $I_2$ . You maximize  $P_1U(I_1) + P_2U(I_2)$  subject to  $\pi_1I_1 + \pi_2I_2 = I$ . In the equilibrium, we can conjecture that  $\pi_i$  is proportional to  $P_i$ . [Can someone prove this?] Now imagine the figure. If you are risk neutral, the budget line coincides with the indifference curve. Therefore, all points on the budget line is indifferent, and hence "you are indifferent among the horses" as in the question. However, if you are risk averse, there is only one expected-utility maximizing point on the budget line, and hence you are not indifferent among the horses.

The general case can be constructed as follows: A bettor maximizes  $\sum P_iU(I_i)$  where  $P_i$  is the probability that horse  $i$  wins and  $I_i$  is its corresponding reward, subject to  $\sum \pi_iI_i = I$  where  $\pi_i$  is the price of the claim. If  $U'' < 0$  (risk averse), then the first order condition is  $P_iU'(I_i) = \lambda\pi_i$ , the second order condition ( $U'' < 0$ ) is satisfied, and there exists an optimal

point that each bettor will choose. Hence in this case, thebettors are not indifferent among the horses. The statement is true if the bettor is risk neutral, i.e.,  $U'' = 0$ . For example, consider  $U(I) = AI$ . Then we have  $MRS = \frac{P_i U'(I_i)}{P_j U'(I_j)} = \frac{AP_i}{AP_j} = \frac{P_i}{P_j}$ . Then every point in the budget line is indifferent. (Mo) [Needs improvements]

Mo is wrong. If the claims are fairly priced,  $u'(I_i) = \lambda$  for all claims  $i$  by the FOC of the optimization. That is, on the margin they are indifferent to where they spend an extra dollar at the track. That does not mean they are indifferent to holding any amount of any of the claims, but that is never the case unless they have linear utility so I suspect this is not the nib of Becker's gist. Since everyone is identical, with a fixed supply of the claims this indifference condition must hold or the market won't clear (everyone's excess demands move in synchrony). It also depends on each individual's priors on the horses likelihood of winning. If everyone comes to the race with the exact same prior, then the statement would be true. If not, then it will be more complicated. (Class of 2008)

71. If everyone has increasing marginal utility of income and the same utility function, and if there are fair lotteries, a utilitarian social planner who maximizes the sum of utilities by lump sum taxes and subsidies would want less income inequality than the private market would produce. (Core 1999)

FALSE - Notice that everyone is risk loving, and hence the utilitarian social planner will make an extremely unequal income distribution; that is, he will give all the endowment to only one person to maximize the sum of utilities. (For example, think about the situation where there are two people and the utility function is identically given by  $U = W^2$ . Also, you will easily see that the same result holds for many people economy.) Now consider the private market. Since everyone is risk loving, everyone will love to buy a fair lottery. In particular, all the risk loving agents will agree to the following lottery design: Everyone put his money into the lottery, and there will be only one winner who will get all the money in the economy. (For example, consider again the two people economy with  $U = W^2$ . The endowment to each person is 5. Then both of them will agree to the above lottery since  $\frac{100}{2} + \frac{0}{2} = 50$  (expected utility under lottery)  $>$  25 (fixed utility). This result holds with many people economy.) The resulting "extremely unequal" income distribution is the same as the social planner's. (Mo)

72. If a person's utility function depends on her goods and leisure, if her wage rate is uncertain and can either be high or low with given probabilities, and if she can buy fair insurance against the low wage outcome, her equilibrium utility level would be independent of whether the wage outcome is high or low. (Core 1999)

TRUE if risk-averse - [This question is confusing us because we also have to take care of "leisure". In my opinion, the answer is still true. I am open to the discussion.] First, suppose

the utility function depends only on goods and is risk averse. She will be fully insured, and hence it is equivalent to the case where she works under fixed wage scheme. Now suppose the utility function depends on both goods and leisure, and it is risk averse in goods (or equivalently, income) given leisure. Under the full insurance, she will have higher expected utility when she works for the same hours. Hence she may decide to work less - which is the only difference between our two assumptions - but still the best thing for her is to be fully insured against the wages. Therefore, her equilibrium utility level would be independent of whether the wage outcome is high or low. Of course, if she is risk neutral, she is indifferent between insurance and no-insurance. Then the statement is false. (Mo)

Simpler answer. If she is risk averse, when offered full insurance she will take it, so that her wage is the same regardless of the state. Then, we just have a static labor/leisure problem with fixed consumption prices. Any optimum selected must provide the same aggregate utility. What I am not sure about is that the optimal thing to do is fully insure wages. (Class of 2008)

73. Suppose the only uncertainty is about length of life. There are two periods of life: everyone lives through the first period, but there is a probability  $S$  of surviving to the second period. The utility function in each period depends on consumption and leisure in that period. The market offers full and fair annuity insurance to each person. Everyone can affect their probability of surviving to the second period by spending resources in first period to improve their health:  $S(h), S' > 0$ . Then an individual chooses expenditures on his health that maximizes the present value of his full income net of the health spending. (Core 2007)

HMM - The probability  $S(h)$  can be thought of as a discount factor. Hence, the utility of the consumer can be written as

$$U(c_1, l_1) + S(h)U(c_2, l_2)$$

where  $I_1 = w_1T + A_1 = c_1 + h$  and  $I_2 = w_2T + A_2 = c_2$ . ( $I$  is the full income,  $w$  is the wage,  $T$  is the total hour in that period,  $A$  is the non-wage income,  $c$  is the consumption in terms of dollars,  $h$  is the health spending, and  $l$  is leisure.) My guess is that you're maximizing the present value of his intertemporal utility with respect to  $h$  subject to intertemporal budget constraint, instead of maximizing the present value of his full income net of the health spending. Then again, the full and fair annuity insurance perhaps makes two things equivalent. (Class of 2008)

74. If there is a fixed cost of  $C$  of writing an insurance policy and two possible monetary payoffs  $G$  (the good outcome) and  $B$  (the bad outcome) and a known probability  $p$  of the bad outcome

occurring then the propensity of risk averse consumers to buy insurance will be increasing in  $p$ .

UNCERTAIN - For simplicity, assume only full insurance is offered. Then, the VNM utility of not insuring compared against the utility from insuring would be

$$(1 - p)U(G) + pU(B) - U(G - C)$$

Assuming that  $U(G) > U(B)$ , it is true that the greater  $p$  is, the lower the LHS would be. However, will this be greater than the RHS is determined by the magnitude of  $C$ . If  $C$  is very big, then even if  $p = 1$ , consumer may choose not to buy insurance. (Class of 2008)

### 1.13 Choice under Uncertainty: Law and Economics

75. Consider the litigation between A and B of a legal dispute. If all information that A and B have is common knowledge, including the probability that the jury will give a verdict favorable to A, the dispute will be settled before going to trial. (Core 1993)

TRUE if risk-averse - If the probability of A's winning is common knowledge, the trial is exactly the same as a lottery with the corresponding probability. Since the trial requires a cost, the case will be settled before going to trial. (Mo)

76. In the law and economics literature, a plaintiff A and a defendant B may go to trial, and bear the costs of doing this, rather than settle their claims without a trial if A and B assess the merits of their case differently. If B loses, both sides know he pays  $J$ . A believes the probability of winning is  $p_a$  while B believes the probability he loses is  $p_b \neq p_a$ . In this case, a lottery between A and B contingent on the outcome of the trial would make both A and B better off than they would be simply by going to trial. (Core 1995)

FALSE if risk-averse - If  $p_a = p_b$ , the lottery will work exactly the same as the trial. Hence it will save the trial costs for both agents. However, if  $p_a \neq p_b$ , the equilibrium in the lottery market is not guaranteed to exist. (In fact, this is why they are going to trial!) (Mo)

### 1.14 Choice under Uncertainty: State-Dependent Preference

77. If utility functions are state-dependent, so that for a given consumption level, the marginal utility of income is higher when individuals are sick than when they are healthy, they would choose to buy fair lotteries. (Final 2001)

TRUE - The key thing is that an individual may not choose the "fully-insured" point even if they have a concave utility function when they are state-dependent. Then, she would choose

to buy fair (or even unfair) lotteries in some circumstances. To see this, consider an individual maximizing

$$V = pU_{\text{sick}}(I_{\text{sick}}) + (1 - p)U_{\text{healthy}}(I_{\text{healthy}}) \text{ s.t. } \pi_{\text{sick}}I_{\text{sick}} + \pi_{\text{healthy}}I_{\text{healthy}} = I$$

If the utility function is not concave, then we know that the individual can choose to buy fair lotteries even if the utility function is state-independent. Hence here we assume that the utility function is concave (i.e., risk neutral). The first order conditions imply  $U'_{\text{sick}}(I_{\text{sick}}) = U'_{\text{healthy}}(I_{\text{healthy}})$  if we assume  $\frac{\pi_{\text{sick}}}{p} = \frac{\pi_{\text{healthy}}}{1-p} = c$  where  $c$  is a constant. (This is a normal assumption which reflects the fact that “the more probable the state, the higher the state.”) However, since marginal utility of income is higher when individuals are sick than when they are healthy, this does not imply  $I_{\text{sick}} = I_{\text{healthy}}$ . That is, even if the utility function in each case is concave, the individual will not choose to be fully-insured. Hence she would choose to buy fair lotteries to obtain  $I_{\text{sick}}$  and  $I_{\text{healthy}}$ . (Why? For example, suppose she chooses  $I_{\text{sick}}^*$  and  $I_{\text{healthy}}^*$ . Then she will prefer a fair lottery which gives you  $I_{\text{sick}}$  and  $I_{\text{healthy}}$  in each case to the fixed income “ $I = pI_{\text{sick}} + (1 - p)I_{\text{healthy}}$ ”.) See the figure on page 28 in Becker’s note. (Mo) [It is definitely true that she “may” choose to buy fair lotteries. In fact, she will not “always” buy fair lotteries. If the question is interpreted as “she will always buy a fair lotteries”, then the statement is uncertain.]

78. Persons who have state-dependent preferences may willingly take unfair bets even when the utility of income in each state is strictly concave. (Core 1998)

TRUE - See the above question.

79. One test of whether parents love their children is whether parents take out insurance on their children’s lives. (Fall 2007 Final)

FALSE - With insurance, it’s marginal utility not the level of the utility that matters. Parents’ marginal utility of income after a child’s death is very low compared to parents’ marginal utility absent of their child’s death. Since the first order conditions require that the marginal utility of income between the two states are equal, in this case, there is no need to take insurance on their children’s lives if the marginal utility is already low enough that having additional insurance will lower the marginal utility in that state even further. (Class of 2008)

### 1.15 Principal-Agent Problem

80. In the Valdez oil spill, Exxon was assessed “punitive damages” of \$5 billion on actual damages of \$500 million. Such a large punitive damage creates bad incentives since it leads to excess care by companies to prevent a spill. (Core 1996)

UNCERTAIN - [1] It depends on the cost of monitoring. In many cases, we are not able to fully monitor a company because it costs too much. Instead, monitoring less and assessing large may be a solution. For example, if the oil spill is caught with probability  $1/10$ , then the punitive damages given in the question are efficient. (A student) [2] Also, in the moral hazard framework, this may be a way to achieve an efficiency. Recall that the inefficiency in the moral hazard appears because of the incentive compatibility (IC) condition. Consider a simple case where the firm can choose high or low effort to prevent the damages, and suppose the damages of \$500 million occurs with a positive probability only if the firm chooses low effort. One way to achieve the efficiency is to punish the firm very severely (for example, \$5 billion fine with the damages of \$500 million). See the materials in Price Theory III. (Mo)

### 1.16 Allocation of Time

81. Wealthy people spend more time shopping than poor people do. (Andrew Sellgren)

UNCERTAIN - Stigler's paper "The economics of information" provides a good framework for answering this question. Search theory implies that people will search more if (i) they are buying something more valuable and (ii) their opportunity cost of time is lower. Wealthy people buy more things and things that are more expensive, so they have more at stake in finding good prices and will tend to search more, i.e., they will spend more time shopping. On the other hand, wealthy people also tend to have a higher opportunity cost of time, so each minute they spend shopping costs them more, so they will tend to search less for good deals, so they will spend less time shopping. Either of these two effects could dominate. You might also mention Becker's article on the allocation of time; the fact that rich people are more likely to have computers with fast internet connections, so their search costs might be lower; and the possibility that people enjoy shopping per se. (Andrew Sellgren)

### 1.17 Household Production

82. An increase in the rate of divorce tends to cause GDP to fall. (Andrew Sellgren)

FALSE - As Becker explains in his treatment of household production, people are rational about the division of economic activity between what is produced at home and what is purchased on the market. For example, when there are more people in the household, making dinner at home is relatively more efficient because of economies of scale and because more people's time would be spent in getting to a restaurant. This suggests that as the rate of divorce increases, people substitute toward buying meals in restaurants. This would increase GDP. Additionally, divorces lead to obvious expenses such as legal fees, purchases of additional homes, etc., all of which increase GDP. (Andrew Sellgren)

83. Assume a household produces commodities  $Z_1$  and  $Z_2$ , with utility defined over these commodities. Assume the household production functions are:  $Z_1 = ax_1$ ,  $Z_2 = bx_2g(Z_1)$  where  $a$  and  $b$  are constants, the  $x$ 's are market goods with fixed prices, and  $\frac{dg}{dZ_1} < 0$ . For example,  $Z_1$  may be smoking and  $Z_2$  health. A rise in non-earnings income of this consumer would raise  $Z_2$  as well as  $Z_1$  if both commodities are superior commodities when their shadow prices of production are held constant. (Final 1999)

UNCERTAIN - Since  $Z_1$  and  $Z_2$  are superior commodities, an increased non-earnings income will increase the consumption of both goods by the income effect. On the other hand, the increase in  $Z_1$  consumption will make consuming  $Z_2$  more costly by the substitution effect. Hence we cannot say the consumption of  $Z_2$  should increase.

84. If all household production functions are CRS Cobb-Douglas, with household labor shares equal to  $2/3$  and goods shares of  $1/3$ , a rise in full income by 2%—for example, wage rates rise by 2%, and no other sources of income—would increase real full income by 0.67 percent. (Fall 2008 Final)

UNCERTAIN - This scenario does not consider reallocating between household and market production. If the market wage rises by 2% and household productivity remains constant, agents will substitute toward market time. The 0.67% result comes from the idea that  $2/3$  of the 2% wage increase is eaten up by an increased shadow cost of time spent in the household, leaving only  $1/3$  of 2% as the increase in real full income. But household output will be reduced as a share of real full income if the market wage increases, which means that a 2% wage increase will increase income by more than 0.67%. (This answer scored well although it's incorrect. CRS production implies constant factor shares, so although there is substitution between household and market time, after adjusting time the shares remain equal and consequently real full income increases by  $1/3$  of 2%.) (Class of 2008: 8/10)

TRUE - Let the shadow cost of the household good be  $\pi$ /unit. Then, since the production function is CRS, it must be that

$$\Delta\pi = S_L\Delta w + S_G\Delta p$$

where  $S_L$  is the household labor share and  $S_G$  is the goods share. So, plugging in the figures given in the question, we get

$$\Delta\pi = \frac{2}{3}2\% + \frac{1}{3}0 = \frac{4}{3}\%$$

The increase in real full income is calculated by  $\Delta w - \Delta\pi$ , which equals  $\frac{2}{3}\%$ . (Teaching Assistant)

85. An increase in a household's production technology that is factor neutral and uniform across commodities would not affect the total hours worked by the households in the market place. (Core 2006)

FALSE - Let's solve the cost minimization problem for one of the commodities  $Z_i$ .

$$\min_{x_i, h_i} px_i + wh_i \text{ subject to } \alpha f_i(x_i, h_i) = Z_i$$

where  $h_i$  is the amount of time spent in household production of commodity  $Z_i$ , and  $\alpha$  is the degree of factor neutral productivity in household production. The FOC's are (with  $\mu$  as the multiplier)

$$p = \mu\alpha \frac{\partial f_i(x_i, h_i)}{\partial x_i}$$

$$w = \mu\alpha \frac{\partial f_i(x_i, h_i)}{\partial h_i}$$

The statement in question tells us that  $\alpha$  increases. But since  $p$  and  $w$  still stay the same, the marginal rate of substitution of  $x_i$  and  $h_i$  have to stay the same. That is,

$$\frac{p}{w} = \frac{\frac{\partial f_i(x_i, h_i)}{\partial x_i}}{\frac{\partial f_i(x_i, h_i)}{\partial h_i}}$$

Suppose  $h_i$  increases. Then, the denominator of the RHS increases. But that means the person is working less than before, so will earn less wage than before, which means less purchase of  $x_i$ . So, the numerator of the RHS increases. So, the RHS increases in general, which means the relationship above can't be satisfied. So, it cannot be that  $h_i$  increases. [There is an issue with cross derivatives between  $x$  and  $h$ , but this should be a second order effect.](Class of 2008)

### 1.18 Rationing

86. If good X is rationed, this reduces the demand elasticities of complements to X, but rationing raises the elasticities of demand for substitutes. (Core 2001)

UNCERTAIN - If good X is rationed and is consumed more, it will increase the demand for the complements and decrease the demand for the substitutes. How the demand elasticities are affected is determined by the shapes of the demand functions. See the previous discussion on the elasticities. (Mo)

87. Some clubs ration membership based on member's characteristics and are completely segregated. Integration would occur if they were allowed to charge different applicants different prices. (Core 2000)

UNCERTAIN - It depends on the marginal willingness to pay to get mixed of the members. For example, assume there are two groups A and B. Group A thinks it will have a loss of \$1 if they are integrated. If Group B also thinks it will a loss after integration, then they will never agree to be integrated. Of course, if Group B thinks it has a benefit of, say, \$2, they will agree to be integrated because Group B can pay the amount between \$1 and \$2 and Group A will accept it. Third example: What if Group B thinks it will have a benefit of \$0.5? Then they can't agree. (Mo) [Not sure.]

88. Places in elite colleges are mostly rationed by students' quality records rather than price because local externalities among students make pure price mechanisms inefficient. (Core 1999)

FALSE - Maybe this is more likely because the University of Chicago does not want to have non-smart students. The University of Chicago is Group A and non-smart students are Group B. Consider the third example of the previous question. (Mo)

### 1.19 Addicting Goods (Habitual Goods)

89. The invention of a drug that makes it easier to quit smoking would increase smoking rates. (Final 2000)

UNCERTAIN - This will make smoking a "less addicting" good. There are two effects. (1) Since it is less addicting, the people who wish to quit will be able to quit easily, i.e., smoking rates go down. (2) Since it is less addicting, the people who was afraid of addition and didn't start smoking can actually start smoking. Hence smoking rates go up. Therefore, the result is ambiguous. (A student)

90. A monopolistic producer of a new good X that is habitual to consumers may initially price X below its stationary and constant marginal costs, but the producer will not price in this way indefinitely. (Core 1994)

TRUE - Assume a monopolist maximizes the long-term profits. In the beginning, she may price the new good X in a very low level so that X can be exposed to many consumers; since X is habitual (e.g., cigarette), the demand for X increases for the exposed consumers. This can in turn increase the long-term profits. Of course, later she will increase the price based on the "new" demands to maximize her profits. (Mo)

91. If the cigarette industry is a monopoly, if the government bans all cigarette sales starting next year, and if smoking is addictive, the price this year cannot rise if the marginal cost of producing cigarettes is constant. (Core 1993)

FALSE - The monopolist for the cigarettes can intentionally set the price lower than profit maximizing level to increase the future demand for the goods, just as we have seen in the previous question. Assuming that this year is the last time to sell the cigarettes, she will stop pricing them in a lower level (since that will no longer increase the demand!), and will set the prices to maximize the profits in this year. Since the marginal cost is constant, it will surely increase the prices. (Mo)

92. Suppose there are high and a low quality cigarette producers, H and L. Assume that not only are cigarettes addictive, but so too are the H and L brands separately. Then a limited rise in the price of H relative to L would have little effect on the consumption of H relative to L.

TRUE - Suppose that the price of H is higher than price of L. If the consumers know that the rise in the price of H relative to L is truly limited (meaning short-term), then given that each brands separately are addictive to its customers, the demand for H would be very inelastic amongst people who have always smoked H. As long as they know that the change in price is temporary, they will mostly stick to smoking H, and there will be little effect on the consumption of H relative to L. However, if the consumers do not know that the price change is “limited”, then the people who had been smoking H may change to L if the increase in price of H is sufficient. (Not sure whether a limited rise in the price of H relative to L means the price increases only by a tiny amount or whether the increase in price is temporary.) (Class of 2008)

UNCERTAIN - It is true that the addicting within brands will dampen the elasticities for people already addicted. However, at any given time some smokers are quitting or dying and some new ones are starting. If the two brands are otherwise similar, then when the price of one increases we would expect new smokers to start smoking the cheaper brand. Thus, there could be a very large jump relative flows into addiction for the two brands, so depending on the magnitudes the demand could change quite a lot. (Class of 2008)

## 1.20 Adverse Health Consequences and Government Policy

93. Assume that there are two levels of health, good and poor. Both types are equally responsive to the price of a cigarette (i.e. both have the same price elasticity of demand) but the health costs per unit of the good consumed (in dollar terms) are greater for those in poor health. Furthermore, assume that initially people are unaware of the adverse health consequences and that the two types of individuals consume the same amount of the good. If the news that the good has adverse health affects is released, the consumption should decrease for both groups.

FALSE - We would expect the demand for the good to fall more for those in poorer health since the health costs are greater for them. The decline in demand will cause the price of the good to decline. If the decline in the price exceeds the added health cost for those in good health, their consumption would increase. (This would be more likely when the health costs for the healthy are small, the health costs for those in poor health are large, there is a large share of individuals in poor health and the supply of the good is relatively inelastic.)

94. Suppose the government subsidizes foods with low fat in order to reduce the death rate from heart disease. If consumers do not know about the effect of fat on heart disease, the increase in consumer surplus from this subsidy is measured by the product of the decline in the average probability of dying from heart attack due to less use of goods with high fat content multiplied by the average willingness to pay for that change in probabilities. (Final 1999)

FALSE - The subsidy will affect the consumer's price of the foods with low fat. This will distort the choice of the consumers between the foods with low fat and with high fat, that is, the consumers will consume the former more and the latter less. Therefore, we should also consider the increase and decrease of the consumer's surplus in foods with low fat and with high fat, respectively. These together with the stated measure will determine the change in consumer surplus from this subsidy. (Mo)

95. The increase in health associated with new information that cigarette smoking is more harmful than previously believed will overestimate the gains to consumers from this new health information. (Core 2001)

TRUE in a competitive industry - Refer to the above question. The new information will move the demand curve down. If the cigarette industry is competitive, the market price is determined at the lowest point of the average cost, which will not be affected by the new information. Therefore, the consumer's surplus decreases. The increase in health overestimates the gains because it doesn't include the decreased consumer's surplus. On the other hand, if the market is not competitive, the cigarette company will react by reducing the consumer price. In this case, the two effects - lower demand and reduced price - will change the consumer's surplus from cigarette smoking. If the consumer's surplus decreases, then "the increase in health" will overestimate the gains to consumers, and vice versa. (Mo)

96. Assume the following new policy in the cigarette market: the government makes producers liable for the health consequences of their products and makes individual producers pay for the adverse health effects (i.e. compensate injured consumers for both the monetary and non-monetary costs of their injury). Then the aggregate health consequences from the consumption of this good should be improved.

UNCERTAIN - Assume that there are two levels of health, good and poor. Both types are equally responsive to the price of a cigarette (i.e. both have the same price elasticity of demand) but the health costs per unit of the good consumed (in dollar terms) are greater for those in poor health. The adverse health effects are worse when firms bare the risk since this skews consumption toward those for whom the health costs are highest and away from those for whom the health costs are smallest. (If the health costs were the same for the two groups, reassigning liability would not have this effect.) (Kevin Murphy) That is, the cost of smoking for the unhealthy decreases while that for the healthy increases. The unhealthy will smoke more and this will increase the severity of smoking related illness. The healthy will decrease the consumption of smoking, and this will increase the health consequences for the healthy people. Hence the result depends on the proportion of the people with two health levels and the original level of smoking related illness for these two groups. (Mo)

97. Making cigarette companies liable for the health consequences of smoking would increase the incidence and severity of smoking related illness. (Final 2000)

UNCERTAIN - See the above question.

98. If cigarettes are produced by a competitive industry, then a court decision that makes cigarette companies liable for the full health costs of smokers (where the health costs liability is imposed on the company the consumer purchased his cigarettes from) may reduce smoking but will increase health related disease from smoking.

UNCERTAIN - See the above question.

99. Assume that teenagers are getting fatter partly because they correctly anticipate new drugs that will reduce the likelihood of overweight persons getting diabetes. Then the effects of these drugs on the incidence of diabetes (multiplied by the cost of diabetes) will correctly measure the social value of the drugs. (Core 2004)

FALSE - These drugs allow teenagers to eat more than they would have without the drugs without having a severe adverse impact on health. This means they would not have to exercise as much, which means change in social utility (or disutility, depending on whether you like exercises or not) will exist. Also, the heavier population overall will have changes in other markets, since people would demand for bigger cars, wider airplane seats, etc. So, the overall social value of the drugs are more than just the diabetes aspect. (Class of 2008)

## 1.21 Crime, Illegal Activities and Punishment

100. Suppose the sale of drugs is illegal. The police catch a fraction of the dealers, and they are punished with a fine. An increase in the fine would increase the expected punishments, but

it would also increase the inequality in net income between those who are caught and those who avoid being caught. The increase in inequality in outcomes could attract more dealers into this industry if all dealers are risk-preferrers. (Final 2000)

FALSE - The utility of a drug seller is

$$U(W) \text{ with probability } p \text{ (if not caught)}$$

$$U(W - F) \text{ with probability } 1 - p \text{ (if caught)}$$

where  $W$  is the income from selling drugs and  $F$  is a fine. Increasing  $F$  will decrease  $U(W - F)$  and thereby decrease the expected utility

$$pU(W) + (1 - p)U(W - F)$$

However, an individual will decide whether she will enter this industry by comparing this expected utility and the (reservation) utility  $U(V)$  which can be obtained outside of this industry. Hence regardless of risk aversion, the decrease expected utility in the industry will discourage them.

101. A criminal can be penalized either by a fine if caught or by the probability of being caught. If the expected fine is held constant, the criminal's utility is reduced by raising the fine if caught. (Core 1992)

FALSE - We consider the expected utility in the previous question. Suppose  $Fp = F'p'$  where  $F' > F$ . We have to compare the following two expected utilities:

$$pU(W) + (1 - p)U(W - F)$$

$$p'U(W) + (1 - p')U(W - F') = \frac{Fp}{F'}U(W) + \left(1 - \frac{Fp}{F'}\right)U(W - F')$$

Subtracting the latter from the former, we have

$$\left(p - \frac{Fp}{F'}\right)U(W) + (1 - p)U(W - F) - \left(1 - \frac{Fp}{F'}\right)U(W - F')$$

$$> \left(p - \frac{Fp}{F'}\right)U(W) - \left(p - \frac{Fp}{F'}\right)U(W - F)$$

$$> 0$$

Hence as long as the utility is increasing in wealth, the statement is false. (Mo)

102. Legalizing drugs can increase the equilibrium consumption of drugs. (Core 1997)

TRUE - If the drugs are legalized, the production costs decrease because there is no longer a risk of being punished. Hence the supply increases, and this can increase the equilibrium consumption. (Mo)

103. The stealing of bicycles in Hyde Park is common. If a bicycle owner registers his bicycle with the police he gets a numbered sticker to place on the bicycle. If it is harder for thieves to sell a bicycle with a sticker than a bicycle without a sticker, registration by any one individual provides a benefit to other bicycle owners. (Final 2002)

UNCERTAIN - This depends on the technology of theft and the market for thieves. Me putting a sticker on my bike makes stealing my bike less attractive. This could increase the risk for others if, for example, the supply of thieves is inelastic and they can easily target in advance what bikes to steal. On the other hand, if the supply of thieves is elastic and they cannot tell in advance who has the sticker, the risk of theft for other owners will fall when I get a sticker. (T.A.)

104. In fighting child pornography, criminal punishments are given to people who sell child pornography pictures. Since this has encouraged bartering of these pictures, the result of the punishment may be an increase in the total amount of child pornography. (Core 2004)

FALSE - Before the criminal punishments were introduced, there likely existed an open competitive market for child porn. Because it will likely be cheaper to purchase child porn in an open competitive market than through finding someone who's willing to barter, the child porn from competitive market and child porn from bartering could be considered to be substitutes of one another. With the punishment, it is much easier for sellers and buyers in open competitive market to get punished than those who participate in bartering. In this case, many would substitute bartering for purchasing child porn from open market, while others will stop to consume altogether. In this case, the overall quantity of child porn would have decreased, but the bartering has increased. This clearly is not equal to the overall increase in the total amount of child pornography. (Class of 2008)

FALSE - Markets are not substitutes, so I think the wording is weird in the answer above. Before the change, people were free to barter for their porn. The fact that they were not bartering is an indication that it is generally a harder way to make markets work (porn, coconuts, money). Thus, the change raises the transaction costs to obtaining child porn, so bartering may go up but the total amount consumed will fall unless demand is totally inelastic. (Class of 2008)

## 1.22 Value of Life (and Traffic Accidents)

105. A new law requiring automobiles to have driver-side airbags will lead to an increase in the number of deaths from automobile accidents. (Andrew Sellgren)

UNCERTAIN - Peltzman (1975) presents a model in which drivers face a tradeoff between

safety and effort. If the government imposes extra safety on drivers, then they will reduce their effort to avoid accidents, and the number of accidents will increase. The number of fatalities per accident will decrease because of the imposed safety. Which effect wins is an empirical matter. If the percentage increase in accidents is smaller than the percentage decrease in fatalities per accident, then the overall number of fatalities will decrease. On the other hand, motorcycle riders and pedestrians will not benefit from the life-saving properties of imposed safety devices, and these groups will be involved in more accidents, because of the decreased effort of automobile drivers. Hence, fatalities amongst motorcyclists and pedestrians will certainly increase. (Andrew Sellgren)

106. If the number of deaths in car crashes increases as the difference in weight between cars increases (i.e., traffic deaths are greater when the difference in weight between two cars is greater holding the average weight of the two cars fixed), then it is efficient to tax both large and small cars to reduce the number of traffic deaths. (Core 2003)

FALSE - It is true that if we tax both large and small cars, then it can reduce the number of traffic deaths. However, on the other hand, this intervention will distort the consumers' choices among the cars when they buy new ones. (That is, the utility increases since they have a longer expected life, but it decreases since some will change their decision to less attractive cars.) In fact, it seems that the best way to do is to make everyone know about the fact that "the number of deaths in car crashes increases as the difference in weight between cars increases." Then a rational consumer would choose his best option based on his value of life and his utility from consuming his favorite and less favorite cars. (Mo)

107. If the price premium for safety (measured by the difference between the market prices for cars with different levels of safety) decreases over time, then we can conclude that the value of life is falling over time. (Final 2002)

FALSE - Consider a constant cost industry. In this case, price differentials will be determined on the cost side. Provided the marginal cost of safety falls over time, so will prices. As long as the cars are not perfect substitutes, we will see prices falling. We should see relative sales of the safer cars rising over time if the value of life is not falling. If we saw both the relative cost of safe cars and the relative consumption of safe cars falling, we would then conclude that the value of life was falling. (T.A.)

108. If all consumers can purchase life extending commodities like drugs, health food, medical treatment etc. in the same market, then the value of life should be equalized across consumers. (Winter 2008 Midterm)

FALSE - First of all, the existence of this market only implies that the value of a marginal

unit should be equal among those who buy. If these commodities have diminishing returns in producing extended life, then consumers could still value a marginal year differently, even if they value a marginal unit of care at the market price, because a marginal unit of care provides them with different amounts of life.

Second, even if these goods have constant returns in life, so people who bought would equate the value of a marginal year, their valuations of their remaining lifespans could be very different, just like consumers who marginally value a good at its price can have different amounts of consumer surplus. The value of your remaining lifespan is important in many decisions, and would still be unequal, in general. This is what we usually think of as the value of life.

Third, if the cost of such care is very high, only a small portion of the population would purchase it. Those who didn't purchase it could have differing marginal values of life, all less than the return of the good in life, valued at the market price. (Class of 2007: 10/10)

## 2 FIRM THEORY

### 2.1 Behavior of Firms and Profit Maximization

109. Popular bands and musicians often price their tickets below the market clearing price and, as a result, such tickets sell out very quickly. In this case, they are not profit maximizing.

FALSE - The key point here is that these bands sell multiple products. The other products could be CD's or future concerts. Charging lower than market clearing prices for concerts would have to raise the demand for these other products. There are two primary mechanisms by which this would take place. First, charging low prices for the concert may (1) change the mix of fans that attend the concert. In order for this to be profitable, those that obtain the tickets at the lower price would have to have a larger increase in their demand for these other products (CDs or future concerts) than would those that would get the tickets at the market clearing price. The second channel could be through (2) creating a "buzz" where people are willing to make an effort to get the low priced tickets. This creates a sort of advertising effect that can raise the demand for the bands CDs or future concerts. (Kevin Murphy)

110. In times of tight supply, firms often do not raise the price charged to their long-term customers to the market clearing level and instead ration the amount they can purchase at a lower price than they can sell the good for on the spot market. In this case, they are not profit maximizing.

FALSE - This is similar to the band example above. Here the two goods are the good today and the same good in the future. We need that loyal customers have a greater degree of complementarity over time (i.e. raising price may induce them to switch to other suppliers permanently). This leads the firm to want to charge them lower prices. The rationing may come in to prevent these firms from reselling the good on the market at the higher spot price. (Kevin Murphy)

111. Often the retail prices for popular videos are lower than the prices for less popular videos. This proves that the video retailing cannot follow the economic model in the theory.

FALSE - Here we need to recognize that prices are determined by the elasticity of demand, not just the level of demand. Popular videos are those with greater demand, not necessarily those with less elastic demand. In fact, some of the less popular videos appeal to a niche market while lower prices on popular videos make them attractive to a large market. Finally, the optimal price for videos that will mostly be rented is quite high (which is what is done with most less popular titles) while a popular video is often priced to appeal to the sell-through market where tapes are sold (rather than rented) to customers. (Kevin Murphy)

112. The occurrence of “sales” (markdowns of price) of goods in retail trade proves that retailing cannot follow the economic model of pure competition. (Core 1997)

UNCERTAIN - There may be some possibilities: (1) The market is in pure competition but the price is being adjusted. For example, we may think that the market is currently looking for the long run equilibrium and hence “sales” is used to decrease the firm’s price in an effort to find the zero-profit level. Or, we may think that due to the technical development, the cost has been decreased, and hence the firm is trying to decrease the price. For example, initially producing the first few units of the good recently introduced to the market may incur high cost for the firm. But as the firm gets better by producing more (a la learning-by-doing), it will eventually cost the firm less to make the same output as before. (2) If the pure competition is in the equilibrium, other things being equal, the firms will never decrease the price in any moment because then the firm will suffer a loss. In this case, we may conclude that the monopolistic competition is more fitted in the markets with retail shops. (Mo) [Not sure.]

113. In a world with ex-ante capital investments, uncertain demand, and rational expectations, the outcome may not be Pareto Optimal because some capital in firms that specialize in producing only in high states may not be used if demand ends up being low. (Final 1998)

FALSE - But that investment can still be Pareto Optimal ex ante! What else do we need to say? (Mo)

114. If an industry has both profit maximizing and non-profit maximizing firms—as with nursing homes—a shift down in the demand for the product would mainly lead to non-profits dropping out since non-profits tend to be the “marginal” firms. (Core 2006)

FALSE - It would rather be profit maximizing firms that are “marginal” firms, since they are the ones that are producing at a level where marginal cost equals marginal revenue. The non-profit maximizing firms do not face the same marginal conditions as profit maximizing firms, often maximizing utility instead of profit. Often, it’s also the case that non-profit maximizing firms have a big endowment of some sort. Hence, if demand shifts down, we would see profit maximizing firms to drop out first, given that non-profit maximizing firms have endowment that it can draw upon even if earns negative profit. (Class of 2008)

## 2.2 Marginal Cost and Average Cost in a Competitive Industry

115. If the firm is cost-minimizing and is at an optimum, the marginal cost is the same whether it changes only labor, only capital, or both.

TRUE - The first order condition of the cost-minimizing problem  $C(w, r, y) = \min wL + rK + \lambda(y - F(L, K))$  is  $w = \lambda F_L$  and  $r = \lambda F_K$ . We can rewrite this as  $\lambda = \frac{w}{F_L} = \frac{r}{F_K}$  where  $\lambda$  is what it would cost to produce an extra unit of output using only one input. Hence, at the optimum, the marginal cost is the same whether it changes only labor, only capital, or both. (Kevin Murphy)

116. A new technology which allows all firms in a competitive industry to produce twice as much output from the same inputs will reduce prices and increase firm profits in the short run (when capital is fixed in the short run) and reduce prices more in the long run than in the short run. (Final 1998)

UNCERTAIN - In the long run, this will cut the level of minimum average cost in half and double the output where minimum average cost occurs.<sup>1</sup> Hence the firms are willing to supply twice as much output at 50% of the old price in the long run. In the short run, since capital is fixed and the firms cannot fully adjust to it, the output increases and the price decreases but not to the levels of the long run equilibrium. Until here, everything is TRUE. Now the only question left is whether “it will increase the firm profits in the short run” or not. Since the short-run profit is affected by the price elasticity, this part of the statement is UNCERTAIN. For example, suppose the firms are willing to increase the output by 30% at the 30%-discounted price in the short run. If demand is inelastic, then a 30% fall in the price will increase the quantity demanded by less than 30% and hence the firms will lose money in the short run. (Mo)

117. Knowledge that productivity growth will be higher than previously expected will lead to higher stock market valuation. (Core 2002)

FALSE - The stock market valuation is determined by the long-run expected discounted profits of the company. If the productivity growth is expected to increase the profits, then the statement is true, but it will not always happen. An example: Consider a competitive industry. When the productivity growth increases unexpectedly, it may increase or reduce the firm’s short-run profit, as we have seen in the previous question. Furthermore, the long-run profits remain zero. (Mo)

118. If all firms in a competitive industry with identical firms currently produce 1000 units of output, then the introduction of a \$1 per unit subsidy on output together with a \$1000 per

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<sup>1</sup>For example, suppose the production function is  $y = (x - 1)^{\frac{1}{3}} + 1$  where  $x$  is the input. If the price of input is 1, the total cost is  $x$ , that is,  $TC(y) = x = (y - 1)^3 + 1 = y^3 - 3y^2 + 3y$ , and hence the average cost is  $AC(y) = y^2 - 3y + 3$ . This makes the firm produces  $\frac{3}{2}$  units at the price of  $\frac{3}{4}$  in the long run. After the technological progress, we have the new production function  $y = 2[(x - 1)^{\frac{1}{3}} + 1]$ , the new total cost  $TC(y) = (y/2 - 1)^3 + 1$ . Obtaining the long run equilibrium point, we see that each firm produces 3 units (which is a double) at the price of  $\frac{3}{8}$  (which is a half).

firm lump sum tax will reduce the number of firms and prices to consumers in the long run. (GSB Final 1999)

FALSE - The combination of the \$1 per unit subsidy will leave average cost unchanged but reduce marginal cost at the original output level of 1000 units per firm. Since marginal cost is below average cost at 1000 units of output, average cost will now be falling at 1000 units of output. Therefore, at levels of output somewhat in excess of 1000 units, average costs will be below the old level of minimum average cost. Since in the long run price will fall to the new lower level of minimum average cost, the long run price will fall and total output will rise. Output per firm will rise and the number of firms could even rise if the demand for output were sufficiently elastic. (Kevin Murphy)

119. A per-unit tax on a competitive industry with identical firms will raise the price of output more in the long run than would a lump sum tax that generates the same revenue for the government in the long run. (GSB Final 1999)

FALSE -The price will be higher under the lump sum tax. The easiest way to see this is to compare the revenues to the government when prices are the same. With identical competitive firms, we must have zero profits. Hence, government revenues are just industry revenues less industry production costs. At the same product price, industry revenues would be the same but production costs would be higher since output per firm would no longer be produced at minimum average costs (output per firm would expand output under the lump sum tax). Hence at the same product price tax revenues would be lower under the lump sum tax. As a result the lump sum tax would need to be somewhat higher to raise the same revenues (resulting in a somewhat higher price). (Kevin Murphy) [I strongly disagree to this solution. I think the statement is true.]

120. A unit tax on cigarettes raises the price of cigarettes by more than the tax. This proves that the industry is not competitive. (Final 2001)

TRUE - The statement is true because it never happens in the competitive industry. The equilibrium price in the competitive industry is the minimal point of the average cost curve. Suppose the optimal output of a competitive firm is  $q^*$ . Then  $q^*$  should minimize the average cost  $TC(q)/q$  and hence the market price should be  $\frac{TC(q^*)}{q^*}$ . If a unit tax on cigarettes is added, now the average cost is  $\frac{TC(q)+tq}{q} = \frac{TC(q)}{q} + t$ . But still this is minimized at  $q^*$ , and hence the market price should be  $\frac{TC(q^*)}{q^*} + t$ . That is, the price cannot be raised by more than  $t$  in a competitive market. (Mo)

121. A few studies suggest that even if employers match the contributions of employees, employees would put less of their income into their pension fund if they have to “opt in”—employees

contribute nothing unless they specify a particular amount—than if they have to “opt out”—say employees would automatically save 10% of their earnings unless they explicitly chose a smaller amount. Even if employees are better off with the “opt out” option, they would be given the “opt in” pension plans by employers in a competitive market since that benefits employers. (Core 2007)

FALSE - (Assuming the match rate is same regardless of “opt in” or “opt out”.) By choosing the “opt in” pension plan, the employer has higher probability of saving more money than the “opt out” pension plan if the study mentioned above is true. Then, there’s no reason why an employer would not do this if it means it will have to match the contributions of employees less frequently than otherwise. However, because this is a competitive market, the outcome has to be the one in which efficiency is attained in the perspective of the employees. Also, there exists costs to filling out paper work when opting out. In the equilibrium, this cost has to equilibrate with the preference for the “opt out” rather than “opt in”.

Also, an employer could appear to be “employer-friendly” if it chooses an “opt out” pension plan, and this reputation may attract more workers to the firm, which may result in being able to hire more productive workers than it would have otherwise. The weird thing is that whether the pension plan is “opt in” or “opt out”, an employee would always have an option to automatically save 10% of their earnings and have the employer match the contribution. But because employees often times lack the necessary information that will enable them to make an informed decision (or are unwilling to undertake the effort to find out that there actually exists no difference between the two pension plans), this “reputation” that this firm really looks after its employees may attract more productive workers. (Class of 2008)

FALSE/Uncertain - The answer depends on who knows what. If the company knows that employees are better off with opt out but the employees do not, I see no reason why the firm would tell them (since this does likely cost them more money). If everyone knows the relevant study, the Coase Thm comes swooping in to tell us that the two parties should bargain to something efficient. If the value to employees is sufficiently large, then the opt out will be implemented (since the employer could just reduce wages). Similarly, if the cost to the employer is too great, then even though ceteris paribus employees would prefer to opt out they would not be willing to sacrifice the wages required to accomplish this. Thus, in this case it is not clear what happens. (Class of 2008)

122. In a cross section of firms in a competitive market, more productive firms should have higher profit rates (measured as profits/sales). (Core 2005)

TRUE - The least productive firm in a competitive market will be the marginal firm that sets its quantity where marginal revenue (which is the horizontal price) is equal to its marginal cost.

More productive firms will have smaller marginal cost, and since profit of a firm is quantity\*difference between marginal revenue and marginal cost, more productive firms should have higher profit rates. (Class of 2008)

### 2.3 Returns to Scale

123. If all production functions have constant returns to scale, then all supply curves in the economy are infinitely elastic. (Core 1996)

FALSE - In a partial equilibrium, the supply curve is often assumed to be infinitely elastic for the CRS technology. In the general equilibrium with many industries, however, even though all industries have CRS technologies, if the proportional use of factors (i.e., K/L) is different among them, then the supply curve can be rising. For example, assume the economy is in the long run equilibrium with zero profits to all industries. If the price of a good A decreases, this industry A will need to fire some factors (to maximize the profit), which will affect the relative prices of factors. The whole economy will find a new (general) equilibrium based on the new equilibrium factor prices, and the industry A will produce less output in the new equilibrium. This will make the supply curve right-upward sloped. On the other hand, if K/L are the same to all industries, the supply curves will be infinitely elastic. (Mo)<sup>2</sup>

124. If all industries in a competitive economy have constant returns to scale and there are no industry-specific factors of production, all supply curves must be infinitely elastic. (Core 1994)

TRUE - See the above question.

### 2.4 Some Issues on Production Factors

125. If a firm has firm-specific human or physical capital, it is more efficient to allow the firm if it gets into financial difficulties to enter legal proceedings - such as Chapter 11 in the USA - that may permit the firm to emerge after a while as a going firm than to simply allow the market forces to determine the fate of the firm if it gets into these difficulties. (Core 2003)

UNCERTAIN - It has two different effects. Suppose some human or physical capital is efficient to be used in a specific firm. If this firm is out of the market, then it becomes inefficient because this kind of capital needs to be used by other firms, not that specific firm. In this

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<sup>2</sup>Although I failed to solve it, the following problem will make the point very clear. Consider a two-good industry. The production functions are given by  $X = AL^{\frac{1}{4}}K^{\frac{3}{4}}$  and  $Y = BL^{\frac{3}{4}}K^{\frac{1}{4}}$ . Of course, the wages  $w$  and  $r$  should be the same across the industries. In the general equilibrium, we should be able to obtain the rising supply curves. If you can solve this problem mathematically, please let me know.

sense, Chapter 11 can be considered as an efficient way. On the other hand, by this policy, even the firms which do not make profits may survive in the economy, which is inefficient. Therefore, we cannot tell whether it is more efficient or not. (Mo)

126. If there are a fixed number of firms in an industry and each firm has decreasing returns to scale, then capital and labor are more likely to be substitutes at the firm level than at the industry level. (Final 1999)

UNCERTAIN - Two inputs are substitutes if  $\frac{\partial L^D(w,r)}{\partial r} > 0$  and complements if  $\frac{\partial L^D(w,r)}{\partial r} < 0$  where  $L^D$  is the uncompensated labor demand. The **scale effect** tends to make this demand complement since when  $r$  decreases,  $y$  goes up more and hence  $K$  and  $L$  increase more. Since output demand is downward sloping (and since it has decreasing returns to scale), this scale effect at the industry level is smaller, making complementarity less likely. On the other hand, the heterogeneity across the firms can increase the substitution effect. (A student) [Not sure.]

127. An automobile company has economies of scope with respect to cars and trucks because its cost of product is  $k + c_1q_c + c_2q_t$ , where  $q_c$  and  $q_t$  are its output of cars and trucks, respectively. (Final 2001)

TRUE - A technology exhibits economies of scope if the cost of supplying two products jointly is lower than the costs of supplying them separately. In this case, suppose the company produces two goods separately. Then the total cost will be  $(k + c_1q_c) + (k + c_2q_t)$ , which is greater. Hence by supplying two products jointly, an automobile company has economies of scope with respect to cars and trucks. (Mo)

128. Industries with more variable demand will tend to have more elastic supply than industries with less variable demand. (Fall 2008 Final)

TRUE - This may be true if firms in such industries realize that demand for their product is variable. If that is the case, they may decide to use a mixture of inputs that are more variable than other firms. For example, if the inputs they use are capital and labor, then they may choose more labor than they would have otherwise. This may incur a short run cost (they may not be using the optimal ratio of inputs to meet current demand), but if demand changes, they can more rapidly and cheaply adjust, thereby gaining higher future profits. Thus, their supply would also be more elastic. (Class of 2008: 8/10)

129. An increase in the supply of skilled labor will generate biased technological change favoring skilled labor by increasing the incentive of firms to find technologies that efficiently utilize skilled labor. (Winter 2009 Midterm)

UNCERTAIN - Consider a firm that uses both skilled and unskilled labor. If there is a fixed amount of skilled plus unskilled labor in the economy, an increase in the supply of skilled

labor would cause a decrease in the supply of unskilled labor. If for the firms' production function skilled labor and unskilled labor were complements, the firm may prefer to seek to more efficiently convert each time-unit of unskilled labor into effective units of skilled labor. In this case, increasing the productivity of unskilled labor would be more important, because it would become relatively scarcer and more costly. If the firm could produce a technology that would make skilled labor and unskilled labor more substitutable, they may, however, do that. (Class of 2008: 8/10)

130. The fact that large firms pay higher wages than small firms suggests that the supply of labor is upward sloping at the firm level. (Core 2005)

## **2.5 Change in the Factor Price [Need a severe revision. This part appears very frequently in recent years.]**

131. A per unit tax on an input used by a competitive industry will lower industry profits. (Core 2001)

FALSE - If some factors are fixed, then the marginal share of the remaining factors will exceed their average share (with say constant returns in all factors). This will cause marginal cost to rise more than average cost when the price of the input goes up. To the extent that buyers pay most of the tax (as they will if the demand for output is very inelastic), price will increase more than average cost and hence profits will increase. (T.A.) [I don't fully understand it.]

132. An increase in the price of an input to a competitive industry will often increase the profits of firms in that industry when output demand is relatively inelastic and some factors are fixed. (Final 2002)

TRUE - See the above question.

133. A union of coal miners that raises the wage rate of miners will lower the profits of mining companies in the short run if this is a competitive industry. (Core 2001)

FALSE - See the above question.

134. Payroll taxes that finance social security and other social services raise the costs of labor, encourage capital/labor substitution, and reduce employment opportunities. (Core 1997)

FALSE - See the above question. It may increase the industry profit, and hence the statement is not necessarily true.

135. A rise in the price of an input will reduce the profits of a monopolist but may actually increase the profits of a competitive industry. (Final 2001)

FALSE - The latter part is true. (See the above question.) For the monopolistic profit, it depends on the demand function. Depict a monopolistic pricing figure, and move the marginal cost curve upward. The profit may increase or decrease based on the shape of the demand curve. (Mo) [Very unclear. Please advise.]

136. A rise in the wage rate of employees may raise the profits of firms in a competitive industry in the short run—before the amount of capital adjusts—but not in a monopolistic industry either in the short or long run. (Core 2007)

TRUE - The first part of the statement is true. If some factors are fixed, then the marginal share of the remaining factors will exceed their average share (with say constant returns in all factors). This will cause marginal cost to rise more than average cost when the price of the input goes up. To the extent that buyers pay most of the tax (as they will if the demand for output is very inelastic), price will increase more than average cost and hence profits will increase. Another way to see this is that increase in wage means marginal cost has increased, which would tend to shift the supply curve upward. Depending on how inelastic the demand curve is, this could cause price to increase a lot while quantity decreases by a tiny bit. In this case, it is possible for profit to increase in the short run. The second part of the statement is also true. This can be seen by drawing a graph. (Class of 2008)

137. An increase in wage rates of employees who work in a competitive industry may raise the profits of the firms in this industry, but cannot raise profits if they work for a monopolist. (Core 1999)

FALSE - See the above question.

138. A maximum price control on an input used in industry X will lower the market price of X. (Core 2001)

FALSE (Solution 1) A maximum price increases the shadow price of the input which is what really matters for the producers. Hence the price of the final output tends to increase. (A student) (Solution 2) A price control will decrease the input price, but also reduce the input supply. Since the input supply is reduced, the output of X will decrease, and thereby the supply curve of X moves to the left. Then the price of X actually increases! (Mo)

139. Crude oil is a necessary input into the production of gasoline. A maximum price placed on crude oil that is below its market price will lower the market price of gasoline by the amount that is positively related to the share of oil in gasoline costs. (Final 1999)

FALSE - See the above question.

140. Under the conditions of factor price equalization, a 10% tax on labor in a small country will reduce the real wage by 10% and have no effect on the price of capital or the mix of production in that country. (Core 2002)

FALSE - Assume the economy is in the equilibrium, i.e., the real wages of country A and the outside world are the same. As the 10% tax has been initiated in a country A, the workers in country will move to other countries since they can earn higher wages there. Hence the labor supply in country A decreases until the real wage there goes back to the world economy level! (Therefore the only difference is that the labor supply in country A has been decreased.) Decreased labor supply in country A in the equilibrium will create two effects: (1) the capital-labor usage (K/L) in the production will increase (at least in the short run). (2) At the same time, it will also decrease the demand for capital, and hence the capital price decreases in the country. Since the capital price is smaller in this country than in the outside world, the capital will go out of the country until the capital price goes back to the worldwide level. Therefore, in the long run, wage rate and capital price will go back to the old level, but the capital-labor usage is not guaranteed to be unchanged. (Mo) [Unclear.]

NOTE: I AM VERY UNSURE OF THIS. Factor Price Equalization says that so long as the assumptions hold and the solution is interior, in equilibrium the prices of non-traded factors of production have to be equal across countries if the production technologies are identical. Thus, if we assume that workers cannot move between countries, we still know that their price must be equal across the two places. Similarly, even if capital is immobile, it must command the same price after the change as well. This means that the tax incidence falls mostly on the worker's in the small country; their wage falls. This could either increase or decrease their labor supply by the standard story. In the end, this change in factor prices will affect what the production mix of all firms in the world equally, and would also affect the world price of capital (by a very very small amount). (Class of 2008)

141. For a competitive industry with constant returns to scale, a tax on labor will raise the price of output more in the short run than in the long run if capital is fixed in the short run but variable in the long run. (Winter 2009 Midterm)

UNCERTAIN - Consider the market for labor. Since labor is variable in the short run, we always have  $P = w/MP_L$ , where  $w$  is the full wage paid by the firms. We see here that a tax  $T$  must lower the amount of labor demanded by firms and that we must have a higher wage (including tax) paid for labor. This decrease in labor, in the long run, will have an effect on capital. If capital and labor are complements, then capital will fall, but if substitutes, capital will rise. Either way, however, the industry will be using an efficient mix of labor and capital on the long run. Thus, it is uncertain whether the price of output will rise more in the

short run, since it will depend on the marginal productivity of labor and the substitutability between labor and capital. (Omitted graph simply showed that tax  $T$  drove wedge between wage faced by firms and workers) (Class of 2008: 8/10)

## 2.6 Change in the Factor Price: Inferior Factor

Note: A factor is inferior if the demand for it decreases when the output increases. This is equivalent to the following condition: "...if the marginal cost decreases when its factor price increases."

142. If a factor is inferior, then the factor demand may increase as the factor price increases.

FALSE - To begin with, consider a normal factor:

- Substitution effect: less input
- Scale effect: higher marginal cost  $\rightarrow$  less output  $\rightarrow$  less input

Now consider an inferior factor:

- Substitution effect: less input
- Scale effect: lower marginal cost  $\rightarrow$  more output  $\rightarrow$  less input (since it is inferior)

143. If the price of an inferior factor decreases and the output increases at the same time, then the firm should use more of that factor.

FALSE - By definition of an inferior good, if the price of an inferior factor decreases,

- Substitution effect: more input
- Scale effect: higher marginal cost  $\rightarrow$  less output  $\rightarrow$  more input (since it is inferior)

On the other hand, if the output increases,

- More output  $\rightarrow$  less input (since it is inferior)

Hence it is ambiguous. (Mo)

144. An increase in the price of an inferior factor will raise industry profits. (Final 2000)

UNCERTAIN - The scale effect implies we will have a lower marginal cost. This will move the average cost curve down and to the right [Can you prove this?], and thereby the firms are willing to produce more outputs in a reduced price. Whether the firms get profits or not depends on the demand elasticity. For example, if demand is elastic, then the reduced price will increase the quantity demanded more than the proportion of price decrease, and hence the industry profit will be raised in the short run. (Mo) [Unclear.]

145. A rise in the cost of an inferior input will lower profits in a competitive market. (Core 2002)  
 UNCERTAIN - See the above question.

## 2.7 Economics of Technical Change/Productivity Growth

A summary:  $\Delta X$  denotes a percent change in  $X$ , and  $S_X$  denotes a cost share of factor  $X$ .

- (1) labor productivity:  $\frac{Y}{L}$ , growth in labor productivity:  $\Delta Y - \Delta L$   
 (2) marginal labor productivity:  $\frac{W}{P}$ , growth in marginal labor productivity:  $\Delta W - \Delta P$   
 (3) total factor productivity growth:  $\Delta Y - S_L \Delta L - S_K \Delta K$  (Hint:  $Y = AL^{S_L} K^{S_K}$ )  
 (4) total factor productivity growth (alternative):  $S_L \Delta w + S_K \Delta r - \Delta P$

146. Output prices will tend to grow faster in the sectors with higher rates of TFP (total factor productivity) growth. (GSB Final 1999)

FALSE - All else equal, output prices should grow slowest in the sectors with the highest rates of TFP growth. This is straightforward from (4).

147. You have two plants (A & B) that produce the same output using labor and capital. In plant A, labor and capital usages are each growing at 4% per year while output is growing at 5% per year. In plant B, capital usage is growing at 5% per year while labor usage is growing at 3% per year and output is growing at 6% per year. Based on this evidence, we can conclude that total factor productivity is growing faster in Plant B. (GSB Final 1999)

TRUE - From (3), we have  $\Delta \text{TFP} = \Delta Y - S_L \Delta L - S_K \Delta K$ . Hence

$$\text{Plant A : } \Delta \text{TFP} = 5\% - S_L^A(4\%) - S_K^A(4\%) = 1\%$$

$$\text{Plant B : } \Delta \text{TFP} = 6\% - S_L^B(3\%) - S_K^B(5\%) = 1\% + S_L^B(2\%) > 1\%$$

148. If wage rates are increasing faster than the rental price of capital goods, then we would expect labor usage to be falling relative to capital usage and output prices to be rising more slowly for capital intensive goods (i.e. those goods where capital's share is high). (GSB Final 1999)

TRUE - As the price of labor rises relative to the price of capital, firms should substitute capital for labor. We also know from (4) that  $\Delta \text{TFP} = S_L \Delta w + S_K \Delta r - \Delta P$ , i.e.,  $\Delta P = S_L \Delta w + S_K \Delta r - \Delta \text{TFP}$ . Hence holding the growth in TFP constant, goods with a higher share of capital (and hence a lower share of labor) will tend to increase in price more slowly. (Kevin Murphy)

149. With constant returns to scale, the rate of growth of labor productivity will exceed the rate of growth of total factor productivity when the capital output ratio is rising. (Core 2001)

TRUE - Since  $\Delta K - \Delta Y > 0$ , the total factor productivity growth from (3) is

$$\Delta Y - S_L \Delta L - S_K \Delta K < (1 - S_K) \Delta Y - S_L \Delta L = S_L (\Delta Y - \Delta L).$$

Since  $0 < S_L < 1$ , this is less than the growth in labor productivity from (1),  $\Delta Y - \Delta L$ . (Mo)

150. With constant returns to scale, labor productivity will grow faster than total factor productivity if the real returns to capital stays constant due to capital being elastically supplied. (Core 2003)

TRUE - Since the real returns to capital stays constant, we have  $\Delta r = 0$ . From (4), we have  $\Delta \text{TFP} = S_L \Delta w - \Delta P$ , which is the growth rate of the total factor productivity. On the other hand, the growth rate of the labor productivity can be measured by  $\Delta w - \Delta p$ . (We know that if labor share is constant, marginal product of labor and average product of labor grow at same rate). Since  $S_L < 1$ , it must be that  $\Delta \text{TFP} < \Delta w - \Delta p$ . (Class of 2008)

151. The fact that the fraction of the labor force employed in the manufactured sector has declined over the past 5 decades must be due to the relatively slow growth of productivity in the manufacturing sector. (GSB Final 2000)

FALSE - This may in fact due to the rapid increase in manufacturing relative to the productivity in other sectors (e.g. services) coupled with inelastic demand for manufactured goods. It could also be due to the income elasticity of demand for manufactures being less than 1. (Kevin Murphy)

152. An increase in the rate of technical progress in the capital goods producing sector could increase the rental cost of capital goods in the short run. (Fall 2008 Final)

TRUE - If agents expect the cost of new capital goods will go down in the future due to more efficient technology, then the resale value next period of capital purchased today declines. The rental price equation shows that  $R$  increases when the resale value declines, so it is possible that a higher rate of technical progress increases rental cost in the short run. (Class of 2008: 6/10)

TRUE - The rental rate of capital goods depends on the rate the capital goods depreciates, the current price of the good and the future price of the good. Assuming the increased rate of technical progress decreased the future price of the goods, then the rental rate will increase, because the resale value will be lower, so they will have to charge even more to break even. (Class of 2008: 6/10)

153. If preferences are homothetic and productivity grows at constant but different rates in different sectors of the economy (e.g. productivity grows faster in manufacturing than services) how will the growth rate of the overall economy change over time? (Fall 2007 Final—This was not a T/F/U Question)

Productivity is growing at a constant rate in both manufacturing and services, though it is higher in the former than in the latter. Over time, the productivity growth rate of the overall economy will increase. As productivity increases faster in manufacturing, it means that we will get more output for the same amount of inputs. Therefore, the prices in that sector will start dropping relative to prices in the services sector. The demand response depends on the elasticity of demand. If demand is very elastic, it might increase such that the demand for manufactured goods will outweigh the increase in productivity. In such a case, more resources will be employed in that sector. This will cause the overall growth rate of the industry to increase even more. However, if demand is inelastic, less capital and labor will be used in that sector, implying that the growth rate will be lower. (Class of 2007: 8/9)

154. Technological progress that allows each firm in a competitive industry to produce twice as much output from any given level of inputs will reduce prices in the industry more in the long run than in the short run (assuming capital is fixed in the short run) as long as output demand is elastic. (Core 2007)

FALSE - Both demand and supply tend to be more elastic in the long-run than in the short-run.

155. With constant returns to scale, the rate of growth of labor productivity will exceed the rate of growth of TFP as long as the capital labor ratio is rising. (Core 2006)

TRUE - Rearranging the equation (3), we get that

$$\Delta \text{TFP} = (\Delta Y - \Delta L) - S_K(\Delta K - \Delta L)$$

So, in order for the rate of growth of labor productivity to exceed the rate of growth of TFP,  $(\Delta K - \Delta L)$  must be positive. (Class of 2008)

## 2.8 Relationship between Capital and Labor

156. Suppose two countries A and B. They have the same CRS aggregate production functions, and each country has a fixed capital stock. Initially A has lower wages than B, and no immigration is allowed. If B wants to maximize the per capita income of its natives, it should allow unlimited immigration from A. (Core 2008)

FALSE - Clearly, when immigration is allowed, people from country A will immigrate to country B thereby increasing the labor supply in B while decreasing the labor supply in A. Hence the wage in B has to decrease and wage in A has to increase until the wages in two countries are equalized. So, in country B,  $d \ln L > 0$  and  $d \ln w < 0$ . Here, I am going to assume that per capita income the question wants is  $Y/L$ . From the four magic equations, we know that

$$d \ln Y = s_K d \ln K + s_L d \ln L$$

Since capital is fixed, it must be that  $d \ln K = 0$ . So, substituting  $s_L = 1 - s_K$ , we get

$$d \ln Y - d \ln L = -s_K d \ln L$$

The left-hand side clearly negative, which means per capita income has decreased due to the unlimited immigration from A. This occurs because each country has a fixed capital stock, and it was assumed that capital does not flow like labor does between the two countries. (Class of 2008)

157. Suppose two countries that have the same aggregate CRS production function. The amount of capital is the same in both countries, and capital is immobile across countries and it is fixed in supply. Country A has less labor than B. Country A can either allow unlimited immigration from Country B or it can charge a fee to immigrants from B. In both cases, the average income of natives in A rises, but this average income rises more if A charges immigrants a fee that maximizes the revenue collected from the immigrants. (Winter 2008 Midterm)

UNCERTAIN - Charging a fee on immigrants have two opposite effects:

- 1) It transfers some income from immigrants to natives in A, which raises the income of natives in A.
- 2) It discourages immigration from B to A, which tends to lower the income of natives in A, compared with unlimited immigration.

Whether the overall effect on average income of natives in A depends on the relative strengths of the two effects, which in turn would depend on the elasticity of supply for labor. If labor supply is inelastic, then it's more likely to improve the income of A natives by charging an immigration fee. (Class of 2007: 8/10)

158. For a competitive industry with two factors (labor and capital) and constant returns to scale, an increase in output demand will increase the usage of labor more in the short run (when

capital is fixed) than in the long run (when capital is freely variable) as long as the elasticity of substitution is greater than the elasticity of output demand. (Fall 2008 Final)

TRUE - In the short run, the increase in output demand will increase the output price and hence supply, which—given that K is fixed to the industry—can only be achieved by increasing L. In the short run, this increases production cost per unit since the capital to labor ratio is no longer optimal. Implicitly, the price of capital rises. In the long run, when K is adjustable, the firms will employ more K. Essentially, the fact that K becomes flexible implies then that the shadow price of capital decreases. Then we know that

$$\epsilon_{LR} = s_K(\sigma + \epsilon_D), \text{ where } \sigma > 0, \epsilon_D < 0$$

Hence, if  $\sigma > |\epsilon_D|$ , we have  $\epsilon_{LR} > 0$  which means that L decreases in response to a decrease in R. Thus we can conclude that since the shadow price of capital falls in the long run, L increases more in the short than in the long run. (Class of 2008: 7/10)

159. If each firm in an industry uses labor and capital in fixed proportions then there will be no substitution between labor and capital at the industry level. (Core 2004)

FALSE - The statement would be true when all firms have the exact same fixed proportions. In general, some firms will be capital-intensive, while other firms are labor-intensive. In this case, when relative input prices change such that the cost of capital decreases relative to cost of labor, then capital-intensive firms will tend to produce more and use more capital, while labor-intensive firms will tend to produce less and use less labor. Overall, the economy would appear as if labor is being substituted for more capital usage, even though each firm has a fixed proportion between the two inputs. (Class of 2008)

## 2.9 Monopoly and Antitrust

160. A decrease in market share for the dominant firm in an industry is an indication that the market has become more competitive.

FALSE - It depends on why the share has changed. If the firm has a smaller share because it is restricting output, then in fact the market has become less competitive. If it is because new firms have entered or other forces, then maybe it has become more competitive. (Kevin Murphy)

161. If the Justice Department allows two firm with market shares of 20% and 30% to merge, we should be more concerned if the combined share of the merged firm is 60% in two years rather than 45%.

FALSE - See the above question. Here the major concern is that the merged firm would restrict output.

162. In the 1950s, an antitrust suit against the single manufacturer of cellophane was correctly dismissed because the cellophane accounted for only a modest share of the market for flexible wrapping materials, even though the price of cellophane was very high. (Core 2000)

FALSE - See the above question. Don't only look at the "share"!

163. It would be welfare enhancing to subsidize firms that would compete against an existing monopolist. (Final 2002)

FALSE - On the one hand, it can be efficiency enhancing if the greater level of competition induces the monopolist to charge lower prices and expand its output. On the other hand, to the extent that we simply divert sales from the monopolist or induce the monopolist to charge higher prices, (which can happen,) efficiency will be reduced (i.e. monopoly sales are already too low). (T.A.)

## 2.10 Monopolistic Pricing of Complementary Goods

164. If a monopolist produces two products, say computers and software, he would never sell one of them below its marginal cost if all consumers are identical and he does not price discriminate. (Core 1999)

FALSE - If the two products are complements, the monopolist can sell one product below the marginal cost so that it would increase the demand for the other products. Hence it would be the case where they sell a good at  $P < MC$  if the demand is elastic (and the share is small,) but instead they sell the other at  $P > MC$  if the demand is inelastic (and the share is large.)<sup>3</sup> (Mo)

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<sup>3</sup>To see this mathematically, assume the demand functions of the Computer and the Software are given by:

$$\begin{aligned}D_C &= D_C(P_C) \\D_S &= D_S(P_S, P_C)\end{aligned}$$

where  $\frac{\partial D_S}{\partial P_C} < 0$  (If the price of C increases, the demand for S decreases) and where we disregard the effect of  $P_S$  on  $D_C$  for simplicity. (This is a reasonable assumption since we assume that C is more elastic.) The inverse demand functions are accordingly defined as:

$$\begin{aligned}P_C &= P_C(X_C) \\P_S &= P_S(X_S, X_C) \text{ where } \frac{\partial P_S}{\partial X_C} > 0 \text{ (If I sell C more, I can charge a higher price for S.)}\end{aligned}$$

And if a monopolist has fixed marginal costs for both goods, he maximizes

$$P_C(X_C)X_C - c_C X_C + P_S(X_S, X_C)X_S - c_S X_S$$

165. A tax imposed on one of two goods produced by a monopolist can cause the price of the untaxed good to fall. (Core 1995)

TRUE - Start from the above question. If the two produces are complements, the profit-maximizing monopolist can sell one (more elastic) product C below the marginal cost so that it would increase the demand for the other product S. In this case the price for S is higher than the marginal cost. Now because of a tax, the price of C is “forced” to increase, and hence using C is less effective to increase the demand for S. Therefore, the firm will find a new profit maximizing point. Since the price for S has been higher due to the above effect, now it can be a little decreased since such an effect plays a smaller role here.<sup>4</sup> (Mo)

166. Since Microsoft is charging a price for Windows that is (according to some estimates) about 5 times lower than what the first order conditions for monopoly producer imply, we conclude that Microsoft does not have a monopoly in the market for operating systems. (Core 2000)

FALSE - See the above question. Microsoft, a monopolist, sells not only Windows (the operating system) but also its complementary good MS Office. Hence it will be the case where they sell a good (Windows) at  $P < MC$  if the demand is elastic (and the share is small,) but instead they sell the other (MS Office) at  $P > MC$  if the demand is inelastic (and the share is large.) (Furthermore, a potential entry of new firms may also reduce the price of Windows.)

167. Suppose a monopolist of good A has constant marginal and average costs. He also sells another product B that is competitively produced and produced at constant cost. There is no gain to the monopolist from tying together the sales of A and B. (Final 2000)

FALSE - (Solution 1) It may be useful for a monopolist to tie the sales of A and B if this can help him discriminate among the population (assuming she doesn't have perfect information). Suppose there are two groups: group I likes B, not a lot A, group II likes A, not a lot B. If there are a lot of group I consumers, then the monopolist can offer the “packages”. (A student) [This solution got 5 out of possible 8 points.] (Solution 2) There is a gain to the monopolist if the two goods are complements. In particular, let us provide an example. Suppose goods

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The first order conditions are

$$P_S(X_S, X_C) \left(1 + \frac{1}{\epsilon_S}\right) = c_S \left(\leftarrow \frac{\partial P_S(X_S, X_C)}{\partial X_S}(X_S) + P_S(X_S, X_C) = c_S\right) \quad (2)$$

$$P_C(X_C) \left(1 + \frac{1}{\epsilon_S}\right) = c_C - \frac{\partial P_S(X_S, X_C)}{\partial X_C}(X_S) < c_C \quad (3)$$

Noticing that  $\frac{1}{\epsilon_S}$  is negative, we see that  $P_S > c_S$ . Furthermore, if the magnitude of  $\frac{\partial P_S(X_S, X_C)}{\partial X_C}(X_S)$  is sufficiently large, it can happen that  $P_C < c_C$ .

<sup>4</sup>Mathematically, this question is related to the above conclusion. From the expression (3) in the above, a tax on C will increase  $P_C(X_C)$ , and hence decrease  $\frac{\partial P_S(X_S, X_C)}{\partial X_C}(X_S)$ . Then from the expression (2),  $P_S(X_S, X_C)$  will be increased in response.

A and B are perfect complements like left and right shoes. Also, suppose in the equilibrium, the output  $q$  of A are supplied by the monopolist and the same output  $q$  of B is supplied in the competitive industry where the monopolist of A supplies just the output  $q^* < q$  in this market. Since the good B industry is competitive, the monopolist of A cannot gain any profit in the market of B. If this monopolist offers the packages, then she can have a higher market power in B: that is, the market of B can be transformed to the monopolistic industry. If the monopolist sets the price of the packages to maximize her profit, then this profit may be higher than before. (Mo)

168. A monopolist of product X can raise its profits by forcing consumers to also buy a complementary product to X from the monopoly rather than from the competitive producers. (Core 2001)

TRUE - See the above question.

169. (Intel case) Suppose computer makers in a competitive industry buy one Pentium processor (I) and one other essential component per computer (G). If the monopoly producers of I and G behaved independently, they would each chose the optimal royalty rates per unit of their products,  $r^1$  and  $r^2$ . If they act jointly, they could choose a combined rate,  $r^*$ . Then  $r^* < r^1 + r^2$ . (Final 1999)

FALSE - The key thing to understand is that the two goods are perfect complements, just like left and right shoes. In this case, the same amount X of each good will be sold in the market. For simplicity, consider two non-cooperative firms where both have fixed marginal costs. In the equilibrium, we can imagine the following:

(1) Firm 1 is optimized at X but firm 2 wants to increase X. (Remember again - two firms should sell the same amount!) Firm 2 has nothing to do with this situation, because firm 1 is already optimized and will never want to increase X. However, if the two firms cooperate, e.g., maximize the total profit and divide it properly, and if it is more profitable for both firms, they will increase X to a higher level. Since the quantity supplied increases, the prices (royalty rates) will decrease, i.e.,  $r^* < r^1 + r^2$ .

(2) Both firms are optimized at X. Even if they cooperate, X is still optimizing. (Why? Profit function 1 is maximized at X. The same for profit function 2. Hence the sum of two functions are maximized at X.) Hence  $r^* = r^1 + r^2$ .

(3) Firm 1 is optimized at X but firm 2 wants to decrease X. This never happens in the equilibrium. Firm 2 can always decrease X, for example, to X'. Then at the equilibrium X', firm 1 will want to increase it, and the situation goes back to (1).

Therefore, we have  $r^* \leq r^1 + r^2$ . (Mo)

170. Eliminating the current subsidy to producing ethanol from corn could reduce the profits of corn farmers by more than the lost subsidy. (Fall 2007 Final)

TRUE - Eliminating the subsidy would decrease ethanol production, which in turn would decrease the demand for corn. Suppose the subsidy is important enough that eliminating it drives the ethanol producers out of business. Then if their corn purchases were worth more than the subsidy, and the supply of corn is elastic, then the decrease in revenues to the corn farmers could be greater than the size of the subsidy. (Class of 2007: 7/9)

TRUE - The key is that corn is also used in the feed market. The subsidy in the ethanol market raises the price received by the sellers and lowers the price received by the buyers. In just one market, it must be true that the seller's gain is less than the overall cost of the subsidy. The demand for corn in ethanol shifts out as a result of the subsidy. Thus, the aggregate demand for corn also shifts out, which will raise the market price for corn received by the sellers. In effect, they are also getting a subsidy in the feed market. If the demand for ethanol is elastic the subsidy will shift demand a lot (and cost relatively little) while if the market for feed is very inelastic, the gain in the market will be large. Thus, the farmers could be getting a larger gain than the amount of the subsidy, so taking it away could cause them to lose more as well. (Class of 2008)

## 2.11 Effect of Taxes on Monopoly

171. How would switching from a per unit tax of \$1 to fixed percentage tax set at 15% of revenues affect the output of a monopolist that currently charges \$10 per unit for its output? (Fall 2007 Final—This was not a T/F/U Question)

I assume, for the sake of simplicity that the monopolist faces constant marginal cost. The monopolist will price at marginal cost equal to marginal revenue. So the new equilibrium price and quantity will depend on whether or not the new tax adds a greater than \$1/unit tax. This in turn will depend on the elasticity of demand (which will affect the slope of the marginal revenue curve). If demand is inelastic, the 15% tax will lead to a larger increase in marginal cost and hence a restriction in output. If it is less than \$1 it will lead to an increase in output. (Class of 2007: 4/9)

172. A per unit tax on the output produced by a monopolist would reduce monopoly profits by more than the revenue collected by the government. (Core 2007)

TRUE - After the tax, it must be the case that

$$Q^* = \arg \max_Q QP(Q) - C(Q)$$

So,

$$Q^*P(Q^*) - C(Q^*) > Q_1P(Q_1) - C(Q_1) = \underbrace{Q_1P(Q_1) - (C(Q_1) + \tau Q_1)}_{\equiv \pi(Q_1) \text{ after-tax}} + \tau Q_1$$

## 2.12 Price Discrimination

173. There is more price discrimination on services than on manufactured goods because the demand for services is less elastic.

FALSE - The reason it is easier to price discriminate is most likely the differences in the probability of resale and the greater ease of identifying the buyer in many service transactions (i.e., you often know whom you are selling to and the product often cannot be easily resold). Doctor services are a good example. (Kevin Murphy)

174. The rise of the internet will lead to a more price discrimination. (Andrew Sellgren)

UNCERTAIN - Price discrimination is defined to be charging one person (or group) differently from another. The Internet provides firms with more information with which they could price discriminate. For example, websites can make offers tailored to individual consumers, as Amazon.com has done, i.e., the internet facilitates first-degree price discrimination. On the other hand, we know that price discrimination is impossible (i) in perfectly competitive markets and (ii) whenever resale is possible. The internet is likely to decrease startup costs and increase the number of suppliers able to serve any given customer, so it will make price discrimination less tenable. Auction websites like Ebay make resale of goods quite a bit simpler, also undermining price discrimination. Either effect could dominate. (Andrew Sellgren)

175. Consider a luxury good consumed by both the rich and middle classes, but in larger quantities by the rich. A price discriminating monopolist of that good would charge a higher price to rich consumers because the compensated price elasticity of demand for that good is smaller for the rich than the middle classes. (Final 1999)

FALSE - In price discrimination, different customers are charged different prices for the same product due to differences in (uncompensated) price elasticity of demand. With this, the supplier should consider the income effect: the higher price for rich people means, by the income effect, their income falls more than the middle class consumers. Hence this might affect the sales of the good because it is a luxury. (A student) [Need to check.]

Clearer answer. Price discrimination charges different consumers differently based on their (uncompensated) price elasticity of demand. The fact that the good is a luxury tells us that

its income elasticity is greater than 1, but this does not tell us which of the two groups has a greater price elasticity. If the rich are more price elastic than the middle class then it might be optimal to charge them less if price discrimination is possible (not sure). (Class of 2008)

### 2.13 Monopolistic Choice of Product Quality

176. A monopolist always chooses the socially optimal product quality and uses price to extract the maximum surplus from customers. (Core 1996)

FALSE - (1) Since a monopolist maximizes her profit, she sees a marginal consumer to decide a product quality. However, the social planner will decide quality for an average consumer since she cares about the consumer surplus. Hence a monopolist's quality choice is not socially optimal. (2) A monopolist can extract the maximum surplus through the first-degree price discrimination. But this rarely happens in the real world.

177. A monopolist produces the socially optimal quality of a good so long as all consumers have the same preferences for quality. (Core 1997)

TRUE - Refer to the above question. Since all consumers have the same preferences for quality, the marginal consumer and the average consumer have the same quality preferences.

178. A monopolist producer of light bulbs will design them so that they will have to be replaced more frequently than competitive produces would. (Core 1994)

FALSE - This question is equivalent to "A monopolist will not produce the socially optimal quality of a good". Refer to the above question. Unlike the social planner, a monopolist will look at the marginal consumers. Her quality choice may be higher or lower than the socially optimal quality. In particular, if all consumers have the same preferences for quality, then the quality chosen by a monopolist will be efficient. (Mo)

### 2.14 Cartel

179. A cartel is easier to maintain if there are a few purchasers that are large rather than many purchasers that are small. (Andrew Sellgren)

UNCERTAIN - A cartel is a collusive arrangement amongst a small number of producers, where they agree to restrict competition amongst themselves in order to increase profit. Stigler's article "A theory of oligopoly" is relevant to this question. In that article, Stigler's model predicts the contrary: cartels are harder to maintain when there are only a few purchasers, each of whom makes large purchases. The reason is that this increases the incentive

to each member of the cartel to undercut the other members. This hinges on Stigler's assumption that the probability of detecting a price cut is independent of the size of the sale. This means that price cuts give more bang for a given risk when dealing with large purchasers. On the other hand, common sense tells us that monitoring costs are likely to be larger when dealing with many small purchasers. If so, the cartel would not be as effective at monitoring small purchasers, so the cartel would be harder to maintain in that case, so the statement would be true. (Andrew Sellgren)

180. Suppose a cartel of all firms in an industry sets a profit-maximizing "trigger" price such that all members act as Cournot competitors if market price falls below that price. This trigger price would be a higher fraction of the pure monopoly price when there are fewer firms in the cartel. (Core 1996)

TRUE - According to Becker's study, the cartel is more unstable when there are more firms there. This is because there is larger incentive to cheat, which is  $(\pi C - \frac{\pi}{n})$  as the number of firms in the cartel,  $n$ , increases. Hence when there are more firms in the cartel, it is unstable and it may be transformed to the Cournot oligopoly. (A student) [I cannot understand the question itself. A student's solution is very highly related to the previous question.]

## 2.15 Merger and Vertical Integration of the Monopolistic Firms

181. A merger that is anticompetitive will generally raise the stock market value of the merging firms but lower the market value of other competing firms.

FALSE - In general, an anticompetitive merger that increases market power will generally increase the market value of competing firms since they benefit from higher price supported by the more dominant firm. (Kevin Murphy)

182. Mergers that increase prices are socially inefficient.

FALSE - Mergers that increase price will generally reduce consumer welfare but overall efficiency may increase if firm profits rise sufficiently. There are the types of cases where the consumer welfare and overall welfare criteria diverge. (Kevin Murphy)

183. The fact that other firms in the same industry do not object to a merger between firm A and firm B suggests that such a merger is pro-competitive based on both economic efficiency and consumer benefit grounds. (GSB Final 2000)

FALSE - Most likely it is anti-competitive on consumer benefit ground since the fact that other firms are not complaining would suggest that they expect prices to rise. It could still be

pro-competitive on efficiency ground if the cost savings generated by the merger more than offset the loss from increased market power. (Kevin Murphy)

184. A firm that has a monopoly over aluminum will not want to vertically integrate into a downstream market (e.g. produce products made with aluminum) unless it has a comparative advantage at producing those products. (Core 2001)

FALSE - If there is also a monopoly in the production of, say, aluminum cans, there is a double mark-up. Both firms could be made better off if they integrate even though there is no comparative advantage. [Note: Need to add some material on the vertical integration. See Kevin Murphy's note.]

## 2.16 Network Effect and Market Power

A summary: The network effect means that a good or service is such that the value of the good or service to a potential customer is dependent on the number of customers already owning that good or using that service. One consequence of a network effect is that the purchase of a good by one individual indirectly benefits others who own the good - for example, by purchasing a telephone, a person makes other people's telephones more useful.

185. If one firm is the sole supplier of a good with important network economies, then that firm will have significant market power. (Final 2002)

FALSE - With network effects, inducing one individual to switch products will increase the willingness of others to switch as well. This will often make demand more elastic and thereby make the market more competitive. While this force can lead to extreme market shares, it need not lead to high levels of market power. Indeed, in many ways, the high market shares flow from the high elasticity of aggregate responses predicted by the theory. (T.A.)

186. A good with important network economies for its customers would have an elastic aggregate price response even though the individual consumer responses were price inelastic. (Core 2002)

TRUE - See the above question.

187. If Microsoft has monopoly power in computer operating systems due to network externalities, it might add to its monopoly profits by giving away free its internet browser. (Core 1998)

TRUE - With network effects, inducing one individual to switch products will increase the willingness of others to switch as well; Giving away free its internet browser will attract more people to the MS Windows (i.e., a complementary good), and thereby it will increase the

market demand of the MS Windows. This might increase its monopoly profits if the profit derived by the increased demand of MS Windows is larger than the profit abandoned by making the internet browser free. (Mo) [Not 100% sure.]

### **2.17 Monopolistic Behavior of the Labor Union**

188. A contract that gives a union that supplies labor to a competitive industry a fixed percentage of industry sales will be able to make both union members and the firms in the industry better off than would a contract that sets a fixed wage per hour. (Final 2002)

UNCERTAIN - The sharing arrangement can help in many ways. It can eliminate inefficient capital/labor substitution. It can facilitate the monopolization of the industry (it is a kind of horizontal agreement that might be illegal without the unions involvement). The sharing arrangement can also be less efficient to the extent that it reduces the firm's incentives to provide other inputs (e.g. capital). (T.A.) [I don't understand.]

189. A union of identical members would set a wage rate per hour that would maximize the total earnings of union members. (Fall 2007 Final)

UNCERTAIN - A union of identical members will maximize their joint utility, which is not necessarily the same as earning maximization. If the members do not value leisure, then utility maximization and earnings maximization are the same, and answer would be "true". However, if the union also bargains over the hours worked, then the resulting wage rate per hour need not be the one which maximizes total earnings. (Class of 2007: 8/9)

### **2.18 Rent Seeking Behavior of a Monopolist**

190. In the United States today, one must have a license to operate a television station. To get such a license, one must apply to the FCC and convince them that the proposed television station would serve the public interest. It would be more efficient to require payment for television-station licenses, awarding those licenses to the highest bidder. (Andrew Sellgren)

TRUE - As firms compete to become the monopolist, they expend resources on excessive advertising, duplication of research and development, lobbying, etc. All these activities are "rent seeking" that confer little economic benefit to society, so this sort of behavior is inefficient. Free entry into the competition to become the monopolist means that the expected economic profit must be zero, so the cost of the required rent seeking must equal the expected profit from becoming the monopolist. For the problem at hand, applicants will expend resources trying to convince the FCC that the license proposal would be in the best interests of society. Applicants might use expensive studies or expert witnesses, or they might try to bribe or

lobby the FCC. All this activity would be inefficient. On the other hand, if the license is awarded to the highest bidder, the payment for the license is a transfer from the monopolist to the government, and the government can put those resources to productive use, such as by returning them to tax payers. (Andrew Sellgren)

191. The high concentration of earnings among a few individuals in sports, music and related professions encourages rent-seeking (socially excessive entry) that is remedied by licensing. (Core 1998)

FALSE and TRUE - The first thing is whether this is rent seeking or not. This is not rent seeking if high earning is due to the ability. But this may be rent seeking: For example, a singer whose ability is not best can be a star due to the investment of the entertainment company. Then, a want-to-be-a singer can lobby to the entertainment company to choose her when the company wants to find someone who it will invest. The second thing is whether we can remedy it by licensing: See the above question. If it is rent-seeking, a licensing to the highest bidder can be a solution. (Mo)

## 2.19 Advertising

192. The incentive to advertise by a firm is greater, the more inelastic is the demand for its product. (Final 2001)

UNCERTAIN - Suppose advertising increases its demand, i.e., moves the demand curve to the right. Both price and output in the equilibrium are higher when the demand is inelastic, i.e., the profit is higher. Now consider another model: suppose advertising increases consumers' willingness-to-pay, i.e., moves the demand curve to top. Both price and output in the equilibrium are higher when the demand is elastic. Hence we cannot simply accept the statement. (Mo) [Unsure.]

193. If advertising of a monopolized good is directed to marginal consumers, it is likely to raise the equilibrium price of the advertised good if that good has a constant marginal cost of production. (Core 1997)

UNCERTAIN - It is more likely to increase the demand. By the figure, we can show that the equilibrium price can actually decrease. [Very unsure.]

194. A monopolist spends too little on advertising from the viewpoint of social efficiency if a further increase in its advertising raises the consumption of the monopolized good. (Core 1996)

FALSE - Suppose there is a further increase in the advertising. First of all, we are not sure whether the consumer surplus increases or not in the new equilibrium - it depends on the

shape of the demand curve. (Check with the graph.) Furthermore, this raises the demand and actually decreases a monopolist's profit (since she already set her optimal advertising level). Hence, a further increase in the advertising is not guaranteed to be an improvement. (Mo) [Not sure.]

195. If advertising by Coca Cola raises the demand for Pepsi Cola, then higher advertising by Coca Cola would reduce advertising by Pepsi Cola. (Final 2002)

FALSE - These are two completely different concepts. More advertising by Coca Cola raising the demand for Pepsi says that Coca Cola advertising and Pepsi are complements. This will raise Pepsi's advertising if it raises the marginal return to advertising for Pepsi (Allowing all other factors to adjust as well). (T.A.)

196. Coca Cola and Pepsi Cola compete against each other in the sale of soft drinks. Each chooses an optimal price and level of advertising. It is possible that their equilibrium advertising does not change their equilibrium quantities sold. If so, they would make greater profit if they could agree not to advertise at all, and then social welfare would also rise. (Final 1998)

FALSE - If the advertisement is included in the total cost, then both equilibria have the same properties. (Mo) [Very Unclear. Please advise.]

197. A cooperative advertising campaign by a competitive industry financed by a per-unit fee on output set to cover the costs of advertising would generate the level of advertising that maximizes equilibrium industry sales. (Fall 2007 Final)

This is true if the objective is to maximize total industry profit: with upward-sloping supply curve, increased sales are equivalent to increased profits: the graph shows that profits stay unchanged if sales stay unchanged. However, the cooperative might have an additional objective to not lower any firm's profit, which would affect the equilibrium sales level. (A graph was provided where both supply & demand shift linearly by same amount (leads to  $q$  staying the same)) (Class of 2007: 8/9)

198. A monopolist advertises its product X in order to lower the elasticity of demand for X. (Spring 2008 Midterm)

FALSE - Monopolist prices good at the elastic region of the demand curve,  $|\epsilon_D| > 1$ . Advertisement is aimed to attract marginal consumer, who is indifferent between buying and not buying the product. Thus this shifts the demand curve up in levels, advertising does not necessarily change the elasticity. (Class of 2007: 7/10)

## 2.20 Investment Decision using the Present Value

199. Assume that I have two choices for capital equipment that provide the same level of production capacity. Equipment of type 1 costs \$100,000 and will produce output for 5 years. After 5 years it will be worthless and will need to be replaced. Equipment of type 2 costs \$150,000 and will produce the same level of output for 10 years after which time it too will be worthless. If it will cost \$50,000 to purchase a new machine of type 1 in 5 years, I would be better off buying the type 1 equipment than the type 2 equipment today. (GSB Final 1999)

TRUE - You can get your productive capacity for 10 years either by buying a machine of type 2 now for \$150,000 or two machines of type 1, one now and the other in five years. This second plan would cost me \$100,000 now and \$50,000 in five years. With a positive interest rate, I would always prefer to pay \$100,000 now and \$50,000 in five years than \$150,000 today. (Kevin Murphy)

200. Suppose the annual benefits of a wilderness area are given by a random walk and that an irreversible project, that destroys the area, would have a sure return of  $c$  per year once started. Under risk neutrality the project will be started if  $c > w_t$ , where  $w_t$  are the current benefits from the wilderness area. (Core 1992)

TRUE - The discounted return of the project is  $c + \beta c + \beta^2 c + \dots = \frac{c}{1-\beta}$ . Since  $w_t$  follows a random walk, we can assume that  $w_t = E_t(w_{t+1}) = E_t(w_{t+2}) = \dots$  and hence the discounted expected benefit of a wilderness area is  $w_t + \beta E_t(w_{t+1}) + \beta^2 E_t(w_{t+2}) + \dots = \frac{w_t}{1-\beta}$ . If the former is larger than the latter, i.e., if  $c > w_t$ , then the project is justified. Since the utility function is risk neutral, we arrive to the same conclusion even if we use the utility instead of using monetary benefits. (Mo)

201. An increase in interest rate volatility, holding the expected interest rate constant, would increase the net present value of projects and hence increase investment. (Core 1995)

FALSE - First, it is true that the net present value would increase. Consider two distribution function  $F(r)$  and  $G(r)$  where  $F(r)$  has a higher variance but the mean is the same. In this case, we have  $\int \frac{1}{(1+r)^t} dF(r) > \int \frac{1}{(1+r)^t} dG(r)$  for natural number  $t$ . Therefore, considering the present value of projects which gives  $NB^t$  for each period  $t$ :

$$\frac{NB^1}{1+r} + \dots + \frac{NB^T}{(1+r)^T}$$

we see that the one under  $F(r)$  is higher than under  $G(r)$ . However, even though the net present value increases, this is due to the increased volatility of interest rate, not due to the increased “actual” benefit of the program. So, if there are several investment programs, this will not change the order of profitability among the programs. (Mo)

202. If a retailer is holding inventories of goods that he sells, he must be expecting the retail price of these goods to be rising over time because the inventories are costly to hold. (Fall 2008 Final)

FALSE - This is not necessarily true. Take the case of cattles. Let's say it costs  $C$  to hold onto a cattle one more period,  $g$  is the natural growth rate of cattle, and  $r$  is the interest rate. In this case, cattle farmer is indifferent between killing his cattle now or in the next period when

$$P_t = \frac{P_{t+1}(1+g)}{1+r} - C$$

Even if  $C > 0$  and  $P_{t+1} < P_t$ , if the growth rate of the cattle is really big, it could be that  $P_t < \frac{P_{t+1}(1+g)}{1+r} - C$ , which means the farmer holds on to the inventory. Therefore, in cases in which the inventory are such that they will reproduce amongst themselves explosively, a retailer might choose not to sell the good even though he doesn't expect the price of these goods to be rising over time. (Class of 2008: 7/10)

FALSE - Suppose the demand for the retailer's services is quite variable and that customers do not like showing up and not being served because there is no stock. Then, to prevent customers from fleeing to other retailers, a store may well stock excess inventories to guard against this kind of event. Similarly, uncertainty about when and how much they would be resupplied from the wholesale markets could lead them to do this. (Class of 2008: 8/10)

## 2.21 Division of Labor

203. If the division of labor is limited by the extent of the market, then perfect competition must not exist. (Core 1994)

FALSE - The perfect competition consists of the following assumptions: (1) There are many firms each selling an identical product. (2) There are many buyers. (3) There are no restrictions on entry to the industry. (4) Firms in the industry have no advantage over potential new entrants. (5) Firms and buyers have complete information about the market. So the division of labor does not affect any of these assumptions. In fact, Stigler (1951) argued "If the division of labor is limited by the extent of the market, then monopoly must not exist." He said, "So long as the further division of labor offers lower costs for larger outputs, entrepreneurs will gain by combining or expanding and driving out rivals." See <http://www.jstor.org/view/00223808/di950816/95p0167a/0>. (Mo)

## 2.22 Durable Good/Rental Rates and Prices

A Summary: The rental rate and the price are related by the following equalities:

$$R_t = P_t - \frac{P_{t+1}(1-\delta)}{(1+r)}$$

$$P_t = R_t + R_{t+1} \frac{(1-\delta)}{(1+r)} + R_{t+2} \frac{(1-\delta)^2}{(1+r)^2} + \dots$$

The dynamics can be represented by:

- (1) Investment market equilibrium:  $I_t = I(P_t)$
- (2) Stock-flow equation:  $S_t = (1-\delta)S_{t-1} + I_t$
- (3) Rental market equilibrium:  $S_t = D(R_t)$
- (4) Pricing equation:  $P_t = R_t + R_{t+1} \frac{(1-\delta)}{(1+r)} + R_{t+2} \frac{(1-\delta)^2}{(1+r)^2} + \dots$

It will be very useful to remember the dynamics in this order. That is, (1) investment determined  $\rightarrow$  (2) stock determined  $\rightarrow$  (3) rent determined  $\rightarrow$  (4) price determined.

204. Rent control can reduce the demand for new housing even if the prices of new housing are not controlled. (Core 1997)

TRUE - The rent control will decrease the discounted rents of the housing owners. Hence the demand for housing will be reduced. (As a result, the price of housing will decrease. Recall that in the equilibrium, we have  $P_t = R_t + R_{t+1} \frac{(1-\delta)}{(1+r)} + R_{t+2} \frac{(1-\delta)^2}{(1+r)^2} + \dots$ ) (Mo)

205. All else equal, the current rental rate will be higher when computer prices are declining more rapidly. (GSB Final 2000)

TRUE - The rental rate for computer equipment is higher the faster prices are depreciating since the declining capital price represents another form of depreciation. The statement is straightforward from  $R_t = P_t - \frac{P_{t+1}(1-\delta)}{(1+r)}$ .

206. If the market rental rate for new computers is \$800 per year and the purchase price for new computers is \$2,000, then individuals expect the price of computers to decline over time if the market interest rate is 5% and physical depreciation is 25% per year. (Final 1998)

TRUE - Since  $R_t = P_t - \frac{P_{t+1}(1-\delta)}{(1+r)}$ , we have

$$P_{t+1} = (P_t - R_t) \frac{(1+r)}{(1-\delta)} = (2000 - 800) \frac{1.05}{0.75} = 1680$$

Hence the price of computers is expected to decline.

207. Higher future demand for computing would imply lower prices of computing today. (Fall 2007 Final)

This is true if computing is considered as a capital service. Computing power depends on processors, servers, etc. Then in the future, the rental rate of these services would increase. Now the price of \*computers\* can be represented as the total discounted future flow of rent income,  $P = R(r + \delta) + \dot{P}$ . With rents up in the future, the price of computers today rises, making investment in computers, processors, etc, more attractive since  $I = I(P)$  is a function of price. An expansion in the stock of capital (computers) today (well it would have started yesterday, when it was known that future demand increases), would lead to greater supply of computing at any rent, thus to a lower rental rate of computing. (Class of 2007: 9/9)

208. An increase in the property tax rate will increase the rental price of housing (inclusive of the property tax) in both the short run and the long run. (GSB Final 1999)

FALSE - In the very short run, the rental price would be unchanged since the supply would not be changed (all of the tax would be born by sellers). Thereafter, the supply of housing would fall gradually causing rental prices to rise until they reach their highest level in the new steady state. (Kevin Murphy) That is, the investment decreases (from (1)), the stock decreases over time (from (2)), and hence the rental price goes up (from (3)).

209. An increase in the property tax rate will decrease the price paid for new houses more in the short run than the long run. (GSB Final 1999)

TRUE - An increase in the property tax will reduce the demand and hence reduce the price of housing. This decreases the investment (from (1)), decreases the stock of housing (from (2)), and hence the price of housing will rebound.

210. A subsidy to new housing construction will reduce the rental price of housing more in the short run than in the long run.

FALSE - A subsidy to new housing construction will do nothing to the rental price of housing in the very short run since neither the stock of housing nor the demand for housing is affected. The subsidy will increase new construction however and gradually increase the stock which will push down rents over time. (Kevin Murphy)

211. A reduction in the cost of producing new houses will reduce rental rates more than prices in the short run and prices more than rental rates in the long run. (GSB Final 2000)

FALSE - In the very short run, the rental rates remain unchanged since the stock of housing is unchanged. But a reduction in the cost will increase the investment (from (1)), increase the stock of housing (from (2)), and decrease the future rental rates (from (3)). By (4), the

housing price of today decreases. This means that a reduction in the cost of producing new houses reduces prices more than the rental rates in the short run. In the long run, prices and rents decline by the same percentage.

212. An expected future increase in demand for a good can lower price today. (Core 1999)

TRUE - For example, consider a housing market. An expected future increase in demand will increase the investment (from (1)). This will increase the stock over time (from (2)), and will decrease the rental price over time (from (3)). But then, by (4), the price of housing today decreases.

Alternate answer: Based on Murphy's Lecture, this is FALSE. Consider the housing market. In the new high demand state rental rates are higher. Discounting to today, this means the price is higher. The higher price will move up investment which increases the stock of housing over time. This will have the short run effect of lowering rental rates. Since  $P_t$  is the present value of future rental flows, it might appear that the price movement could go down. However, this is impossible, since then investment would not be rising over time to meet the higher demand (recall that investment is a function of the current price only). (Class of 2008)

213. Higher interest rates will lead to both higher rental rates on houses and higher housing prices. (Final 2000)

FALSE - Suppose the economy is in a steady state. In our dynamics, the higher interest rate will first affect (4). This will lower the price. This will decrease the investment (by (1)), decrease the stock (by (2)), and increase the rental rate (by (3)). The increased rental rate will make the price rebound by (4), and by this dynamics, the economy will find a new steady state in the long run. At least in the short run, higher interest rates will lead to lower housing prices. Of course, the rental rate will not be changed in the short run. Hence the statement is false. (Mo)

214. If the government announces in 1996 that it will begin an investment subsidy in 1998, then capital rental rates will be higher than they otherwise would have been between 1996 and 1998; moreover, capital rental rates should be rising and capital prices should falling over this period. (Final 2001)

FALSE - First statement ("Capital rental rates will be higher than they otherwise would have been between 1996 and 1998."): After the announcement, some individuals will postpone their investment until 1998. That is, the investments between 1996 and 1998 will be lower than they otherwise would be. If the economy used to be in the steady state, the stock of capital will become lower (by (2)) and hence the rental rates should be higher (by (3)) than they otherwise would have been. Therefore, the first statement is true. Second statement ("capital

rental rates should be rising and capital prices should falling over this period.”): Over this period, the lower investment will lower the rental rates by the same argument. Hence capital rental rates should be rising. However, after 1998, the investment is increasing (by (1)), hence the stock of capital is increasing (by (2)), and the rental rates are decreasing (by (3)). This means that the rental rates is increasing between 1996 and 1998 but is decreasing after 1998 to the new steady state. By (4), it is not clear whether the capital prices are increasing or decreasing between 1996 and 1998. (Mo)

215. If we learn today that there will be a subsidy to housing construction starting in five years, then housing prices will fall today and rental pices will begin to increase. (Winter 2009 Midterm)

A subsidy in construction of housing is equal to a shift in the supply side, the investment in construction. Thus we know that the long run rental rate will decrease, but a higher stock of housing will be present in the new steady state. Using the formula relating prices and rental rates:  $p_t = R_t + R_{t+1} \frac{(1-\delta)}{(1+r)} + R_{t+2} \frac{(1-\delta)^2}{(1+r)^2} + \dots$  we know that prices will fall in the short run and so also the investment will slow down (it's cheaper to wait for the subsidy in 5 years). This will further decrease the short run supply of houses and rental rates will increase in the short run. When the subsidy will come into effect, investment will start kicking in, prices will start going down and also the rental rate will decrease to the new steady state. (Class of 2008: 7/10)

216. Suppose a durable good X and a non-durable good Y have the same income elasticity, price elasticity and supply elasticity. If all consumers experienced a permanent decline of 5% in their income, then the price of Y falls more than that of X both in the short run and in the long run.

FALSE - Since the income, price and supply elasticities are all the same, the steady state (or long run) effects will be the same for both the durable and the non-durable. In the short run, the consumption of the durable falls more and hence prices (both rental and capital) fall more. (Hence production of the durable responds more in the short run than production of the non-durable will. This helps explain why durable goods production is more volatile over the business cycle.) (Kevin Murphy)

217. A fall in the cost of producing a durable good will reduce the capital price of that good more in the long run than the short run. In addition, in the short run capital prices will fall more in percentage terms than will rental prices. (Core 2008)

TRUE - A fall in the cost of producing does not immediately impact the stock of durable good nor the demand for it. So, the rental prices will not change in the short-run. However, the

fall in the cost of producing means investment will increase. This means the capital price will decrease. And as stock increase toward its new steady-state level, the rental rate decreases. And this means the capital price will decrease even further due to equation (4). (Class of 2008)

TRUE - A reduction in the cost of the durable good will move the supply curve out so the new steady state will have a larger stock and a lower rental rate. Thus, current prices will fall (discounted sum of rental rates) and investment will increase (the returns are higher so the investment curve has shifted out). In the very short run the stock of the good is unchanged, so the rental rate does not fall at all. During the transition the rental rate falls to its new equilibrium. Thus, since price is the discounted sum of rental rates, the price will be lower in the long run steady state than in the transition. Further, since rental rates are determined by the stock, in the short run the prices must be lower in percentage terms than the rental rates. (Class of 2008)

## 2.23 Exhaustible Resources

218. Since the relative price of coal has never increased at the rate of interest, coal cannot be an exhaustible resource. (Core 1994)

FALSE - An individual firm maximizes  $\sum \frac{(P_t - C_t)q_t}{(1+r)^t}$  subject to  $\sum q_t = S_0$  and  $q_t \geq 0$  where  $S_0$  is the total amount of resources and  $q_t$  is the amount produced in period  $t$ . The first order condition yields  $\frac{(P_t - C_t)}{(1+r)^t} = \lambda$ , which implies  $\frac{(P_{t+1} - C_{t+1})}{P_t - C_t} = 1 + r$ . Therefore, if there is technological progress and hence the cost  $C$  decreases over time, then the price would fall over time. Another possibility is the new discovery of exhaustible resources which makes the price lower.

219. A monopolist of an exhaustible resource and a competitive industry for this resource would have the same prices at all times. (Fall 2007 Final)

UNCERTAIN - This will depend on elasticity of demand. However, if the elasticity of demand is constant over time, then both types of industries will generate the same prices. The Hotelling model of exhaustible resources implies:

for competitive industry:  $\frac{P_j}{P_i} = (1 + r)^{j-i}$

for monopolist:  $\frac{P_j \left(1 - \frac{1}{\epsilon_j}\right)}{P_i \left(1 - \frac{1}{\epsilon_i}\right)} = (1 + r)^{j-i}$

Thus, if  $\epsilon_j = \epsilon_i$ , i.e., if elasticities of demand at time  $j, i$  are the same, then the monopolist's prices are the same as competitive prices. (Class of 2007: 7/9)

220. Assume that extraction costs to a firm that owns oil deposits is a function only of the stock of its oil that remains in the ground. This function remains constant over time. Suppose these costs per marginal unit of oil extracted rises at an increasing rate as the remaining stock falls. Then even if oil prices were expected to be constant over time, the firm would spread out its extraction of oil over time. (Winter 2009 Midterm)

FALSE - If the firm extracted all of the oil today they would gain  $SP_0 - TC^*$ . If they extracted the oil tomorrow the present value would be  $(SP_0 - TC^*)$ . Furthermore, there is no incentive on the cost side to extract the oil tomorrow because the cost only depends on the amount remaining in the ground. Therefore, the marginal cost of extraction is unaffected by time and they would extract all of the oil today, up to the point where marginal cost equals the price. Note:  $TC^*$  is the total cost of the oil that is beneficial to extract, i.e. up to the point where  $P = MC$ . (Class of 2008: 8/10)

### 3 OTHER TOPICS

#### 3.1 Incentive, Copyright, and Patent

221. Consumers would be better off if they don't have to pay authors to copy copyrighted works. (Andrew Sellgren)

UNCERTAIN - If a consumer cares only about existing works, then that consumer will be better off. According to the law of demand, the decrease in price (to zero) will cause an increase in the consumer's consumption of existing works, while payments for them will decrease to zero, so the consumer will have more of everything (works and money), which means the consumer will be better off. On the other hand, if authors are no longer compensated for their works, then they will produce less (the law of supply), so there will be fewer (if any) new works for people to enjoy. Hence, if a consumer cares about new works, this consumer will be worse off. (Andrew Sellgren)

222. Allowing pharmaceutical companies to charge monopoly prices for drugs they develop is inefficient. (Andrew Sellgren)

UNCERTAIN - Making drugs (nearly) free would be efficient in the sense that, all else equal, efficiency requires the price to equal the marginal cost to produce an extra dose, which is very low. On the other hand, making drugs free would mean that pharmaceutical companies would have no incentive to make new drugs, so no new drugs would be created, and many people would be worse off. (Andrew Sellgren)

223. If prices for brand name prescription drugs increase when cheaper generic equivalents become available, the firms are not profit maximizing.

FALSE - Here the question again relates to the elasticity of demand. While the introduction of generic equivalents reduces the level of demand for the branded drug, often significantly, the introduction of the generic often leaves the branded drug manufacturer with the least price sensitive customers. This can lower the elasticity of demand and lead the firm to charge higher rather than lower prices. (Kevin Murphy)

224. Patent laws on new drugs are typically for 17 years in America. Yet strong competition from patented chemically-equivalent entities often emerges after 8-10 years. This implies that in such cases, patent life could be reduced to 10 years from 17 years without much affecting the incentive to invest in finding new drugs. (Core 2003)

FALSE - Well, this means the patent life is reduced from 17 years but we cannot say that it is reduced to 10 years because the patented firm still have a positive profit (although it is

less than it would be without chemically-equivalent entities), as we have seen in the previous question, even after chemically-equivalent entities emerges. See the above question for detail. (Of course, the incentive to invest in finding new drugs will be affected anyway.) (Mo)

225. Publishers typically give authors a royalty rate (i.e. a share of sales revenue) rather than only a lump-sum payment because publishers are risk averse. (Final 2002)

FALSE - The sharing arrangement on revenues probably has more to do with the marginal incentives it provides to authors and the publisher to promote and improve the work. Deviating from a 100% share for one party has only a second order effect on the efficiency of that party's efforts but a first order effect on the incentives of the other party. (T.A.)

226. Incentives are efficiently aligned between workers and management if workers are paid a fixed fee for a specified amount of output rather than by an hourly wage rate for an unspecified amount of output. (Core 1998)

FALSE - We need to consider the incentives and risk-sharing together. This gives more incentives, but also makes consumption more risky: that is, if the project ends up being hard, the worker needs to do a lot of works, and if not, he needs a little work. Hence we cannot say the incentives are "efficiently aligned" without considering the risk sharing. (A student)

227. The ability to make digital copies of music recordings will not reduce the revenues accruing to producers of music since they can increase the price of their recordings to capture the value of the copies made using those recordings. (Core 2003)

FALSE? - [Sometimes it would be impossible to capture the value of copies and that is what is currently happening in the real world. In fact, this question appeared as a long Core question a few years ago. When I was solving that question, I concluded that it is possible to capture the value of copies. Maybe it depends on how we design a model. I am not sure how to answer this question correctly. Please advise.] (Mo)

The key is that when there are copies the initial producer loses control of the supply. The producer collects the market value, which is given by quantity\*marginal value. Losing control of supply can affect this quantity a lot. The revenue to the producer is increasing over some range of supply and then decreasing. Ordinarily a firm would position itself to be at the maximum of this function. When the firm cannot control supply after releasing the product, they set a higher price and a quantity to the left of the maximum. They can set this price such that they get the integral of the revenue function weighted by the speed with which market quantity changes. If copying is cheap and rapid, they move over the "hump" very fast and collect little market value. If demand is very elastic and or copying is very slow they can still capture most of the consumer surplus. (Class of 2008)

(The following four questions are based on the long answer question of Final 2002.)

228. One way to encourage individuals to create new products is to give them exclusive property rights to produce those products for some period of time through legal arrangements such as copyrights and patents. An individual that comes up with a new product can patent the particular design for that product, but others often follow quickly with legal “copycat” products. Often these “copycat” products are created through “reverse engineering” where individuals purchase a unit of the original product and study it in order to produce a “copycat” product. Assume that it takes a fixed period of time,  $t$ , for individuals to create a copycat product with or without using reverse engineering, but that it costs more to create a copycat product if one does not use reverse engineering. Then, it will be efficient to prevent such reverse engineering. (Final 2002)

FALSE - It depends. (1) Preventing such reverse engineering might be efficient since it will increase the incentive to invest in creating such products (it is like increasing the effective patent life). (2) On the other hand, if people are going to create copycat products anyway, we are just forcing them to do it in an inefficient way. In that case we might as well allow them to do it since given the assumption, the effective patent length will be the same either way. (T.A.)

229. Sometimes it would be better to allow individuals to sell the rights to reverse engineer (i.e. set two prices one for reverse engineering and one for consumption) rather than simply outlaw reverse engineering. (Final 2002)

TRUE - In this case, if people are going to do it anyway, he can sell the rights and prevent the deadweight loss of them having to incur the higher cost or reinvention. (T.A.)

230. One way to prevent the production of copycat products is to keep the production methods secret. This forces would-be copiers to engage in independent invention (i.e. invent their own production method or rediscover the original method on their own). Such secrecy tends to provide more protection to the “right” products from a social point of view. (Final 2002)

TRUE - To the extent that it is easy to keep things secret, the key effect would be to force individuals to reinvent the product. To the extent that it is costly to reinvent products that were costly to invent in the first place, this will tend to give more property rights to those products that cost more to produce. This can lead to protection of some of the “right” products. In addition, the incentive to reinvent will be greater for those products with more demand, which also goes in the right direction (i.e. we need less protection since the inventor collects more per period).

231. The incentive to keep production methods secret is lower for producers in a small open economy than in a closed economy assuming that the potential flow of information in each country is limited to other firms in that country. Furthermore, firms might voluntarily share their information in some cases in a small open economy. (Final 2002)

TRUE - There would be more incentive to share in the open economy case since there is really no cost of letting your competitors have access to your knowledge (other than factor market price effects) since the output price is determined on the world market. In fact, if access to knowledge makes them more productive and that is complementary with their learning more, you might even gain. This gives you a positive incentive to share in the open economy case. In contrast, in the closed economy, you will be reluctant to share since the price of output will fall as their costs fall. (T.A.)

232. It may be desirable to allow patent holders (like drug companies) to price discriminate even if it would not be desirable to allow companies to price discriminate when faced with the same demand and cost conditions. (Core 2004)

TRUE - There is a lot of fixed cost involved in R&D of a new drug, and guaranteed monopoly profit provides firms with incentives to undergo such high-cost R&D. Otherwise, all firms will try to copycat other firms' innovation, and there will be no innovation in the society. (Class of 2008)

233. Assume the developer of a new good, like the drug lipitor, receives a temporary monopoly through a patent for T years. If the R&D industry is perfectly competitive, then in equilibrium patents are not desirable. The reason is that the expected real cost of finding a new good that can be patented is equal to the discounted monopoly profits from the good, which equals consumer benefits from the drug. (Winter 2009 Midterm)

234. If firms in an industry could collude R%D spending then it would be in their interest to collude to reduce spending below the levels that would be chosen by individual firms. (Core 2005)

UNCERTAIN - If the patent law allows the firm with the patent to enjoy monopoly profits, and if it takes certain fixed amount of R%D to come up with new innovation worthy of patent, it wouldn't necessarily be the case that firms would like to decrease R%D, if that means they won't be able to come up with new innovations. What they really want to do in this case is to collude so that each firm spends on R%D of different innovations such that each firm will have a patent of its own and enjoy monopoly profits. (Class of 2008)

235. An increase in the size of the market for new goods—perhaps because aggregate income

rose—would reduce the optimal patent length given to discoverers of new goods by a social planner. (Core 2005)

UNCERTAIN - Patent holder enjoys monopoly profit. The increase in the size of the market (interpreted as an outward shift of the demand curve) will certainly increase the profit the patent holder would receive at any given time. However, due to this outward shift of the demand, the deadweight loss may also increase. Therefore, overall optimality can be ambiguous. (Class of 2008)

### 3.2 Externality/Learning by Doing

236. There is an externality if educated employees in a firm increase the productivity of other employees both in the same firm and in the firm that supplies machinery to this firm. (Core 2000)

FALSE - There is an externality if the individual is not monetarily compensated. (1) If the more educated people are compensated by their wages, then this is only a spillover but not an externality. (2) However, if the firm that supplies machinery to this firm does not monetarily compensate, then there exist an externality. (A student)

237. Suppose a new product is developed that is produced competitively with a production technology that has learning by doing at the firm level. Assume that the price falls over time, and rich households consume the product earlier than poor consumers. By consuming earlier, the rich provide a real external benefit to the poor households. (Final 2001)

FALSE - This is not a real externality. It is true that the poor households can consume the product due to rich people's early consumption, but this mechanism is realized through the price mechanism. Notice that the rich people are "compensated", in any sense, with a lower price. It is called a real externality only if the rich people are never compensated. (Mo)

238. If earnings of a high school graduate in a country increases when the number of college graduates increases, college graduates provide an external benefit to high school graduates that they do not take account of in the decision to get a college education which leads to too little private incentive to earn a college degree. (Core 2003)

FALSE - Again, this is not a real externality. It is true that since more people go to college, the labor supply of high school graduates decreases, and hence lower-skilled wages increases. But this is realized through the price mechanism. Notice that the college graduates are "compensated", in any sense, with a higher wage. (Mo)

239. If the amount of petroleum in the world is limited and is necessary for production, then a family having additional children imposes real externalities on other families by reducing the petroleum stock per person, even when all oil reserves are privately owned, and the petroleum industry is competitive. (Core 1998)

FALSE - This is not a real externality. It is true that other families can consume less petroleum due to a family's having additional children, but this mechanism is realized through the price mechanism. If the stock of petroleum is fixed and there is no technological progress, the price of petroleum is supposed to increase over time; since now the demand increases due to additional children, the price will increase more than it is supposed to. (See the related topic: Exhaustible Resources.) Notice that the family with additional children is also "suffered" with a higher petroleum price. So they are, in any sense, compensated. (Mo)

240. Suppose competitive industry A, long the sole user of a factor F, finds that its costs rise due to the emergence of competitive industry B, which employs large quantities of factor F. This is an instance of an externality, imposed by B upon A, for which governmental tax policy to provide appropriate incentives would be appropriate. (Core 1992)

FALSE - Similar to the above question. It happens with market mechanism, and industry B is "compensated", in any sense, due to a higher factor price. (Mo)

241. Since a positive externality is conferred on people who happen to find goods that are lost by others, owners of goods spend too much time and money to avoid losing them. (Core 1998)

FALSE - The value of a good may be different between the individuals; for example, the wedding ring or the laptop computer values high for the current owner and values lower for the winner who happens to find them. Then it is socially inefficient for the owner to lose it and for the winner to find it. Hence spending much time and money to avoid losing them is not necessarily inefficient. (A student)

242. Since shopping mall owners typically offer to rent the same space at different rents to different businesses, they are price-discriminating monopolists. (Core 1998)

FALSE - If some businesses can attract more consumers to the shopping mall (and thereby increase the profit of the mall through the positive externality), then the owner can offer a better condition to these businesses. In this case, it has nothing to do with price discrimination in monopoly because (1) they don't discriminate the price using the demand elasticities, and because (2) it can happen even though the shopping mall is not monopolized. (Mo)

243. The negative externalities of a claim's staking land rush - whoever gets to a piece of land first becomes the owner of the land - in allocating previously unoccupied land would be entirely eliminated by using an auction market instead. (Core 1995)

TRUE? - All I can say is that auction will be at least “more” efficient. Without the auction, the land is allocated without considering the benefit of the land to each potential owner. By the auction, the person with the highest benefit will own the land. (Mo) [There may be something wrong with the term “entirely eliminated”. Someone may argue that there will be some ‘strategic behavior’ in auction. That is, if we administrate the first-order sealed bid auction, the agents will not bid their true values. In my opinion, the allocation is still efficient because the highest valuation will win the auction. Maybe the answer is related to “who gets the money”. If someone, say the government, gets all the money that the bidders pay, that means the lands should be already occupied by that person. Then still the externality remains. Please advise.]

244. If a college-educated employee raises the productivity of other workers in the same firm in which he works, he is providing them with a positive externality. (Fall 2008 Final)

UNCERTAIN - It really depends on whether this college-educated employee is being compensated for his role in raising the productivity of other firms. If he is not properly compensated, then he is providing them with a positive externality, since he’s undertaking something that comes at his own expense, yet benefits accrue to everyone. If he is in fact compensated for his role in raising the productivity of others, then this is not a positive externality; instead, it’s a spillover. (Class of 2008: 8/10)

245. In a learning by doing industry where all firms in the industry benefit fully from the learning by other firms, those firms that enter the industry later would have an advantage since their costs would be lowered by the prior costly learning of older firms. (Fall 2007 Final)

FALSE - Assume we have a competitive industry. If the learning-by-doing benefits only the firm that does the research and development, they could charge below marginal cost in the beginning and then recoup those losses later. However, in the case when the knowledge produced by the firm benefits everyone, that strategy would not be an option. Therefore, the firms would always charge at marginal cost. Thus, new firms that enter the industry will charge marginal cost, just like the old firms. Therefore, they would not have an advantage since all firms will be pricing at marginal cost. (Class of 2007: 9/9)

### 3.3 Coase Theorem

246. Freeing of slaves will not affect hours worked by the freed labor compared to the hours they worked as slaves if the Coase theorem applies to the equilibrium with slaves as well as the equilibrium with free labor. (Final 2000)

FALSE - The Coase theorem says that if transaction is carried out without costs, the outcome is efficient (that is, the social marginal benefit equals the social marginal cost) whoever is the owner of legal right of property. Notice that it does not say the outcome itself remains the same. If a slave is freed, then the legal right of the slave moves to the slave himself. The Coase theorem guarantees that the allocation is still efficient, but not that the two allocations are the same. As far as this example goes, if a slave is freed, then he will get a higher wage rate, and so his marginal cost of work (opportunity cost of leisure) will increase assuming that leisure is normal. Hence he may reduce hours worked.

247. The Coase theorem implies that even for slaves, the equilibrium number of hours worked has the property that the money value to slaves of the disutility to them from an additional hour of work would be no greater than the value of that hour to the slave owners. (Final 1998)

FALSE - See the above question. It would be greater.

248. The Coase theorem implies that whether rookie professional basketball players are assigned to the teams by a rule - such that teams with worse records in previous years gain exclusive rights to sign the best rookies - or whether teams can bid for rookies does not affect which teams the rookies end up playing for, or the incomes of rookies. (Core 1998)

FALSE - See the above question for the implication of the Coase theorem. The player will get a higher income under the bidding system, and his marginal cost of work (opportunity cost of leisure) is higher assuming that leisure is normal. Hence he may reduce hours worked.

249. If a slave owner and a slave bargained to an efficient outcome regarding the slave's hours of work, then the hours worked by the slave would not change when the slave was freed. (Fall 2007 Final)

This question refers to the Coase Theorem which states that outcomes will be efficient irrespective of the distribution property. This Theorem however breaks down in cases of asymmetric information and income effects. It also does not state that the income distribution is independent from property rights. This is especially poignant in the present case, where the slave has no income. He does not have any bargaining power vis-a-vis his owner, since he has nothing to offer. Therefore he could not make a transfer to his owner in order to compensate him for a reduction in the hours worked by the slave. Therefore once the slave is freed, supposedly he will earn wages and can determine his hours worked. Another reason why he would probably reduce them is the income effect - if leisure is normal he will consume more. Finally, there is a principal-agent structure here that makes the true effort spent by the slave impossible to monitor. When the slave is free, pay can be a function of the outcome and incentives will be realigned. (Class of 2007: 8/9)

### 3.4 Residential Location

250. When the wages of city dwellers increase, economic theory says that they should move to the suburbs. (Andrew Sellgren)

UNCERTAIN - The framework of Becker's "A Theory of the Allocation of Time" can help to make sense of this question. When wages go up, there are both income and substitution effects:

- Income effect: "Full income" has increased, so the income effects will induce the agent to consume more of all normal goods. We would expect living space to be a normal good, so this would induce the agent to move to the suburbs, where there is more space. [It assumes that the price of living space has the same price regardless of the location. - I don't think that is good.] On the other hand, living in the city might be a normal good in its own right. One reason it might be normal is that cultural events, etc., are desirable. Another reason is that leisure is a normal good, and living in the city allows more leisure, since city dwellers spend less time commuting. Accordingly, income effects could push the agent either way.
- Substitution effect: On the substitution side, the increase in wage has made the opportunity cost of the agent's time more valuable. This means that living in the suburbs has become relatively more costly, because of long commute times, so the agent would substitute towards living in the city.

(Andrew Sellgren)

251. Assume that all workers commute to a central city. The total cost of commuting for each consumer is  $D \cdot W$ , where  $D$  is the distance traveled to work and  $W$  is the individual's wage rate. Assume that wages differ among consumers, but that everyone consumes the same quantity of land. In equilibrium, high wage consumers will commute shorter distances to work, and the relationship between land prices and the distance to the central city will be convex. (Final 2002)

TRUE - An individual maximizes

$$U(X, L)$$

subject to

$$X = A + w(T - t - L) - R(t)$$

Where  $X$  is her consumption (whose price is normalized to 1),  $L$  is her labor input,  $A$  is her asset holding,  $w$  is her wage rate,  $T$  is the time available,  $t$  is the commuting time from his

housing to the working place, and  $R(t)$  is the rent for a location of commuting time  $t$ . The first order conditions are

$$\begin{aligned} [L] : \frac{\partial U}{\partial L} &= -\lambda w \\ [X] : \frac{\partial U}{\partial X} &= -\lambda \\ [t] : w &= R'(t) \end{aligned}$$

The last equation tells us that the optimal location will be independent of preferences and will be determined by the wage. [Until here is Mo's solution. The justification continues with the T.A.'s solution from here.] Each person will live where the marginal savings from commuting an extra hour is equal to the hourly wage. Those with the lowest wage will therefore be willing to travel the farthest. Since the slope of the rent gradient will be equal to the wage of the person living there, the slope must fall (in absolute value) with distance. This makes the equilibrium rent gradient convex. (T.A.) [Can we say it in a better way?]

252. Suppose all workers commute to a central city business district. The total cost of commuting is equal to the value of the time spent commuting, which is proportional to the product of the wage of the commuter and the distance commuted. Wage rates differ, but everyone wants the same quantity of land. Then higher wage persons live closer to the center, and the relation between land prices and distance commuted is convex. (Core 2002)

TRUE - See the above question.

253. Real wages appear to be higher in larger than in smaller cities in most, if not all, countries. This is because the division of labor and efficiency of production is greater in large cities. (Core 2003)

FALSE - This is more likely due to the residential location we have discussed so far. See the question above.

### 3.5 Economics of Education and Human Capital

254. Both foregone earnings and tuition and other fees affect the cost of a college education. Even students who must themselves finance all their costs would only care about the sum of these costs, not their breakdown into foregone earnings and fees. (Winter 2009 Midterm)

FALSE - One difference between human capital and physical capital is that it may be difficult to borrow against human capital. Therefore, students who must finance college will care whether they would have to forgo earnings or pay for fees for which they may potentially need to take out loans to finance. If the fees are sufficiently high, they may face a borrowing

limit and would not be able to attend. However, if most of the cost was forgone earnings they could still attend. (Class of 2008)

255. Suppose it costs \$200,000 in present value to raise a child to age 19. The government is considering whether to provide \$15,000 to subsidize the college education of 18 year olds in order to increase fertility and the number of children that are sent to college. An economist argues that this subsidy is too small relative to the \$200,000 cost to either appreciably affect fertility or the number of children sent to college. (Core 2008)

UNCERTAIN - It's hard to tell for sure without detailed breakdown of \$200,000. Also, what matters is the utility of \$200,000 compared to a utility of having a child. For example, regardless of whether the child goes to college or not, it costs \$200,000 to raise a child to age 19. So, when the parents are making a decision to have the child or not, the parents weigh between utility of \$0 plus having no child versus utility of minus \$200,000 plus a child. Suppose that for the parents, having a child who attends college gives more utility to them than having a child who only graduated high school. Then, even if it were the case that  $U(0 + \text{no child}) > U(-\$200,000 + \text{a child})$ , with the added subsidy of \$15,000 and the prospect of a child that's attending college, this added bonus could certainly make  $U(0 + \text{no child}) < U(-\$200,000 + \$15,000 + \text{a child who attends college})$ , in which case the subsidy is not small relative to the \$200,000 cost. It really depends on what the utility function looks like. (Also, one could argue that a child is like an investment, and that having a college educated child will generate big cash flow after the child graduates from college, such that the initial cost will be more than recuperated.) (Class of 2008)

UNCERTAIN - (shorter answer) It is likely to have a small effect on the decision of new parents to have a kid since the 15,000 bonus comes 18 years in the future so its present value is small (about 5000) so the savings are not that great. This would shift some people on the margin into having a kid, but not that many. It could have a much larger effect on college attendance for those facing the decision. The two costs of college are the fees and forgone time. The fees are pretty large, and if young folks are credit constrained the bonus could lift many more into college. (Class of 2008)

256. Suppose that having smart students at a school helps the test performance of the less able students, but not the scores of more able students. The willingness to pay by parents for their child to go to a school depends only on the resulting test scores of their child. All schools have  $n$  students, there are  $S$  schools, and the cost of each school are independent of student ability. There are  $nS$  students to be allocated among these schools. It would be most efficient—that is, maximize aggregate test scores—to have smart and not so smart students mixed together in same schools, but a decentralized school system without government direction could not

achieve the sorting that maximizes aggregate efficiency. (Core 2008)

UNCERTAIN - Couldn't students' parents enter into a private contract amongst themselves? Since parents' willingness to pay depends on the test score, they could arrange a private contract with parents of a smart kid such that I will pay to the parents of the smart kid if that smart kid attends the same school as my kid, if it is guaranteed that my child's scores will rise as a result of attending the same school as the smart kid. As a result, the parents of a smart kid will enter into several contracts with parents whose kids are less able than theirs, and if enough monetary compensation has been received, will opt to let their smart kid attend the school with those less able children rather than sending their kid to a school that has even smarter kid attending. This question seems to draw at the question of externality vs. spillover, but the question is so open-ended that it is hard to address the issue without knowing how exactly the score would improve by attending school with a smarter kid. (Class of 2008)

257. The fact that more educated people work more hours than less educated people implies that education raises market productivity more than household productivity. (Core 2008)

FALSE - The educated people working more hours than less educated people has mainly to do with the fact that the educated people (which I will label as college graduates) receive higher wage than less educated people (which I will call high school graduates). Household production requires time spent to produce that commodity, and a higher wage means that the cost of spending time in household production is higher for the college graduates. Hence, college graduates will tend to substitute time spent in household towards time spent working and earning market wage. Even if education raises household productivity more than the market productivity, if the wage difference is sufficiently large and household production tends to be very time-intensive, the college graduates will spend more hours working than the high school graduates.

### **3.6 Economics of Aging**

258. Social security promises each retired person a fixed income for the rest of their lives. This helps explain why life expectancy has increased over time among retired persons. (Core 2004)

FALSE - This is a classic case where correlation does not imply causation. It could precisely be that life expectancy has increased (due to stuff like better knowledge about diseases and medicine), and as a result, people demanded for social security. It's also possible they are unrelated. Also, early on, having a transfer (since they did not pay in most of their working lives) meant that their expected standard of living was higher than anticipated. This could

lead to people taking more care than the otherwise would have to live a long time. Now, that argument is more tenuous unless people are boundedly rational and need help being forced to save. (Class of 2008)

259. Consumption of many individuals declines at age 65 after they stop working. This is evidence of insufficient saving to provide for consumption in old age. (Core 2008)

FALSE - This statement does not take into account the price effect. For retirees, they no longer earn wages, which means the opportunity cost of leisure has decreased a lot. Therefore, leisure has become incredibly cheaper compared to consumption goods, so they substitute leisure for consumption. This can be seen in the actual world where we see retirees play lot of golf or work in the garden, etc. This is clearly not because they have insufficient saving. (Also, the income effect is such that leisure and consumption both decrease. So, combining the income effect and substitution effect, consumption definitely decreases, while leisure would increase if the usual case of substitution effect being stronger than the income effect holds true.) (Class of 2008)

260. The recent rise in gasoline prices should cause people who are now reaching age 65 to retire later than they otherwise would since they are not effectively poorer than they otherwise would have been. (Core 2008)

UNCERTAIN - It really depends on how much and why this person consumes gasoline. If the major reason why this person consumed gasoline was because he had to drive to work everyday, and if he had been spending most of his gasoline on commuting to work, then the rise in gasoline price would actually spur him to retire early and reduce the amount of driving altogether. Provided that he already had enough savings to live adequately after retiring and that gasoline consumption would not occupy a significant share of his budget after his retirement, the rise in gasoline prices may make him to retire even earlier than he would have. However, this is contingent on the fact that only the gasoline prices rise. If the prices of all other goods also rise as a result of the rising gas prices, then it could force him to retire later than he would have liked if he thinks the new higher price level will drain his savings quicker than he anticipated. (Class of 2008)

### 3.7 Miscellaneous

261. If owners of sports teams care about the winning percentage of their teams, then we would expect a positive equilibrium relationship between expenditures on player salaries and winning percentage. (Core 2008)

FALSE? - Although the expenditures on player salaries are not the only thing that an owner can do in his effort to increase the winning percentage of his team, he would tend to spend a lot if he cares a lot about winning. But it's not always the case that the care for winning percentage directly translates to his team actually having a high winning percentage. Also, since the budget of the team is limited, the owner has other options that could potentially increase the winning percentage. For example, having better facility and/or amicable relationship between teammates and the coach may be more important factor in determining the winning percentage than the expenditures on player salaries. Salaries are definitely a part of a various proxy that can measure the success of the team, but in my opinion, there exists better proxies than salaries. Just look at New England Patriots. (Class of 2008)

FALSE - Suppose for now that all team owners have the same budgets and care about winning the same, but may have other idiosyncratic tastes. Then, in equilibrium there will be a price for "winning percentage". How much teams spend on winning percentage would be a function of how this is related to all the other goods...one can't say that it is positive. Even if teams have different budgets, the same idea goes through.

Simple example. Suppose that teams have utility given by  $U_i = \alpha_i \ln w + c$  where  $w$  is winning and  $c$  is other stuff. Let the price of  $w$  be 1, the price of  $c$  be  $p$ , and the total budget  $M$ . Then, simple maximization shows that  $w^* = \alpha_i p$  and  $c$  soaks up all the residual variation in spending. If all teams have  $\alpha_i$  the same but different  $M$ 's, then there is no equilibrium relationship between the two. One can also cook up examples where the relationship is negative. (Class of 2008)

262. If spouses are very altruistic to one another so that they maximize the sum of their utilities, and each has the same utility function over consumption and leisure, then differences in wages and hours across spouses will reflect Hicks income compensated labor supply elasticities since the two spouses will effectively have the same real income. (Core 2006)

FALSE - Just having read the problem, I'd say the answer is false for two reasons. First, they don't have the same effective real income. The real income of the family is  $(w_1 + w_2)T$  where  $T$  is the full time endowment of each person. When the question says they "effectively have the same real income", it's assuming that full consumption for each person will be  $(w_1 + w_2)\frac{T}{2}$ , which won't be the case. If you were to write out the family's maximization problem, you'd see that the two have the same shadow price of consumption, but the one with the higher wage has a higher shadow price of leisure. The second reason it's false is because even if they had the same real income, this would provide the Marshallian labor supply elasticity. A measure of the Hicksian elasticity would require that each have achieve the same utility, not income, which by the way, also won't be the case since again the one with the higher wage

has the higher cost of leisure (and the same cost of consumption). (Answer provided by one of the Teaching Assistants in Fall 2008)

263. In irrigating land to grow crops, either water can be just spilled over the land, or the water can be run through pipe irrigation systems. The recovery rate of used water to the seller is much higher with the pipe system. This implies that the same uniform price of water to farmers with different irrigation systems that measures the marginal cost of producing the water is not efficient. (Core 2004)

UNCERTAIN - Certainly, it seems inefficient since farmers with irrigation system that has better recovery rate is forced to pay the same as farmers with worse irrigation system, which effectively subsidizes farmers with bad system by making farmers with good system pay more than they actually should. However, there is a cost involved for a water seller to go around and determine exactly which farmer has which irrigation system. Of course, this cost would be paid for by the farmers. If this cost is higher than the efficiency gain farmers would enjoy from distinguishing who has which system, then the original pricing scheme is “efficient” as it is. (Class of 2008)

264. If there are only two types of weather hot and cold and each location differs in the fraction of hot and cold days and individual preferences are separable across days then preferences over locations will be monotone (one way or the other) in the number of cold days per year. (Core 2004)

UNCERTAIN - If individual preferences are not only separable but stable across days, and the utility of location only depends on weather strictly, then the statement above would be true. If utility of location depends not only on weather, but also on stuff like whether it has a mountain or a beach, then the statement above will not necessarily be true. (Class of 2008)

265. The NBA imposes a “cliff” tax of \$10 million dollars on teams that spend more than a certain level on player salaries (that level was set at roughly \$62 million for the 2004-05 season so that any team that spends more than \$62 million on player salaries must pay a tax of \$10 million to the league). Lowering the level at which this tax is imposed from \$62 million to \$52 million will reduce (or at least not increase) spending on salaries by individual teams. (Core 2005)

FALSE - Many teams that were under the \$52 to \$62 million range in salary would be strictly be worse off due to the new policy and will let go some of its players. With new players in the free agent market, the teams that were above the \$62 million range or were under the \$52 million range may choose to the new free agents that have been released from their old team. (Class of 2008)

266. Suppose police are stopping some cars to inspect whether they are carrying persons who might engage in terrorism, and that they can identify cars as containing either one of two groups, A and B, where they know that the B's are twice as likely to be potential terrorists as A's. Then, if they want to maximize the expected number of terrorists found—given the total number of cars stopped—the probability of stopping a car with B's should be twice the probability of stopping one with A's. (Core 2005)

FALSE - They should only stop cars with B's. (Class of 2008)