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

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Expanded and Modified by Entering Class of 2008

Further Updated by Entering Class of 2011,

2013 Price Theory TA's, and

Entering Class of 2013

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1   Disclaimers

"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 fifteen weeks 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, 1992–2003. Price Theory I Final Examination, 1998–2002. GSB Material of Prof Kevin Murphy, 1999–2002.

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 Entering 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.

2013 TA's: We have added the highest-scoring answers from our class' final and midterm, as well as any other recent questions that were available to us. We have revised the answers to all of the

past questions, including replacing the ones we felt were incoherent or incorrect.

Class of 2013 writes: We migrate the encyclopedia to the cloud (`https://piazza.com/class/ht36091iw1s271`), add the highest-scoring answers from our class' final and midterm as well as the TAs' answers, and address ambiguities in past questions and answers. All remaining errors are our past generations' fault. Jk. We are thankful to have benefited from their insights and hope future generations continue to build on this tradition.

2   Advice

True/False/Uncertain questions can be a great tool for learning. To make your study efforts more effective, we suggest that you. . .

- **DO** try to rephrase the question in your own words or reformulate it in more precise language

- **DO** realize that 90% of these claims are (or could be) "uncertain"—you get points for making reasonable assumptions and providing a correct and thoughtful analysis given your assumptions

- **DO** practice similar T/F problems in Gary Becker's book *Economic Theory*

- **DO** practice composing an answer in 10 minutes or less

- **DO** reflect on your analysis:

  - compare the pattern of your analysis to your answers to other questions
  - try to summarize the underlying idea in a short sentence
  - consider how your assumptions affected the answer
  - consider related questions and how you would adapt your analysis to answer them

- **DO NOT** think of the claim as a mathematical statement to be proved or disproved—provide explanations, not proofs

- **DO NOT** answer "uncertain" and simply enumerate all the ambiguities or potential cases—breadth is not a substitute for depth

3 Household Theory

3.1 Elasticity: The Concepts

3.1.1. <mark>The share of income spent on necessities declines with the level of income. Therefore, all necessities are inferior goods</mark>.

F – "The share of income spent declines with level of income" simply means the income elasticity η is less than 1. This is the definition of a necessity. It does not mean $\eta < 0$, which would make a good inferior.

To see more formally what the question is saying, differentiate the share with respect to income:

$$\frac{\partial s_x}{\partial M} = \frac{\partial \frac{px}{M}}{\partial M}$$
$$= \frac{p}{M}\frac{\partial x}{\partial M} - \frac{px}{M^2}$$

If this is less than zero, then

$$\frac{p}{M}\frac{\partial x}{\partial M} - \frac{px}{M^2} < 0$$
$$\Rightarrow \frac{\partial x}{\partial M}\frac{M}{x} < 1$$
$$\Rightarrow \eta_x < 1$$

Thus, the first sentence of the question simply defines necessities, but we know that not all necessities are inferior. (All inferior goods, however, are necessities.) (2013 TA)

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

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

3.1.3. <mark>The market demand for a good is more inelastic the greater the elasticity of supply of goods for which it is a substitute.</mark> (Core 1998)

F – Demand curves do not account for conditions of supply. Rather, the elasticity of demand is determined by the consumers' preferences and elasticity of substitution between two goods. The elasticity of supply impacts the equilibrium point, and the degree of response to changes in price, but does affect the elasticity of demand per se. (2013 TA)

> You may be tempted to argue along these lines (for ease of exposition, we'll ignore income effects): The primary effects of an increase in the price of Good 1 are a decrease in the quantity demanded of Good 1 and an outward shift in demand for its substitute (Good 2). If the supply of Good 2 is very elastic, this will only lead to small increase in the price of Good 2. Then the secondary effect on the consumption of Good 1 will only partially offset the initial decrease. Hence, the elasticity of demand is more elastic the greater the elasticity of supply of its substitutes, right? Wrong! Price elasticities are defined as the effect of a change in price holding all other prices constant. Consequently, the elasticity of supply should not factor into the analysis. (2013 TA)

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

F – See 3.1.3.

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

U – To get overall demand of a good, we horizontally add individual demand curves. When individuals have different points of entry into the market, then the market demand gets a "kink" every time a new consumer enters. This makes the market demand curve more elastic than it would be for an individual. However, if all consumers are identical, the market demand curve is exactly proportional to that for any given individual; thus, more demanders will not change the elasticity. See Becker's *Economic Theory*, Lecture 8. (2013 TA)

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

F – Consider a person on the extensive margin for a good: they will buy one unit of a good at the given price, but if the price rises they will exit the market altogether. This person has perfectly elastic demand at this price. Meanwhile, a wealthier person may decrease consumption on some infra-marginal units of the good but will continue consuming; thus, their elasticity is lower.

Another way to consider the problem is to note that at sufficiently low incomes, any good will be normal. Yet some goods will become inferior at higher incomes. Picture an Engel curve with a good on the horizontal axis and money on the vertical axis. Take two people with the same level of consumption of the good at a given price, except one person is wealthy and the other is poor (these would correspond to two intersection points of an Engel curve with a given vertical line). If the price rises, the poor person has both a negative substitution effect and a negative income effect while the rich person has a negative substitution effect and a positive income effect. If the substitution effects are equal, the poor person reduces consumption by more than the rich person. Hence, the poor person has more elastic demand. (2013 TA)

The intuition behind this statement is that there are more (or better) substitutes available to the rich than to the poor. While this may be correct in some cases, we demonstrated that including the extensive margin and/or income effects in our analysis is sufficient to provide a counterexample.

3.1.7. 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)

U – See 3.1.6.

3.1.8. 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)

F – Consider this formulation of Marshall's Laws in the case of a constant returns to scale production function:

$$\epsilon_{ii} = \underbrace{s_i \epsilon^D}_{\text{scale effect}} - \underbrace{\sum_{j \neq i} s_j \sigma_{ij}}_{\text{substitution effect}}$$

where ϵ_{ii} is the own-price input elasticity of input i, s_i is the share of production costs accruing to input i, ϵ^D is the demand elasticity of the output, and σ_{ij} is the elasticity of substitution between inputs i and j. Since $\sigma_{ij} \geq 0$, we must have $\epsilon_{ii} \leq s_i \epsilon^D$. But this does not imply that the input

demand is more elastic than output demand. The verity of the statement depends on the cost-share of input i and the relative magnitudes of the elasticity of demand and elasticities of substitution. If the elasticity of output demand is larger than the elasticities of substitution, then the statement is more likely to be true for large inputs (s_i greater than s_j). If the elasticity of output demand is less than the elasticities of subsitution, then the statement is more likely to be true for small inputs. (2013 TA)

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

F – This *can* be true. A simple example of a utility function would be $U(x, y, z) = \sqrt{x} + \sqrt{y} + \sqrt{z}$ so that if p_z increases, the consumption of x and y both increase. But it is not always true. Consider the utility function $U(x, y, z) = \min\{x + y, y + z\}$. Then y is a substitute for both x and z but x is a complement for z. (2013 TA)

> Sometimes the truth of a claim about elasticities depends on whether the price change is compensated—for example, if x is a Hicks subsitute (complement) for y, then y is a Hicks substitute (complement) for x; but the same is not true for Marshallian elasticities. The supposed transitive property of substitution is not one of those cases.

3.1.10. 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)

F – Using the Slutsky equation, we know that

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

So, summing this across all goods we get

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

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

3.2 Elasticity: Real-World Examples

3.2.1. <mark>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)</mark>

T – 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)

3.2.2. <mark>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)</mark>

F – Assume that the income of the employing households increases as per capita income grows. Take as given that the income elasticity of demand for maids and other domestic help is positive. Then the income effect will tend to increase the demand for maids. However, as a country develops, we expect the relative wages to change as well as income. Therefore, we have to consider the price elasticity, too. If the wages of maids and other domestic help increase relative to the cost of the employer's household time, then the price effect could more than compensate for the income effect. If "importance" is measured by the quantity demanded or (more likely) the expenditure share of the household budget, then importance may decrease as a country develops. (2013 TA)

> Notice that the fact that the wages of maids increases is not sufficient to argue that the price effect will reduce the demand for maids. If the wages of the employing households increase by more, then it is possible that price effect and income effect will reinforce each other.

3.2.3. <mark>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)</mark>

U – Consider the maids' labor supply decision. The statement claims that it is possible for

the increases in wages and income to exactly offset and leave the labor supply curve unchanged. Recognizing the importance of *relative* wages, we find that this is plausible (see above). Thus, this is not a nonsensical question and we may proceed with our analysis.

If everyone's income increases, then the demand for servants will increase. Holding supply constant, this unambiguously increases the number of servants. In this case, the statement is true.

Alternatively, suppose that aggregate income increases through a large increase in the incomes of the lower and middle classes accompanied by a decrease in the incomes of the upper class. If only the upper class employs servants, then demand will decrease. In this case, the statement is false. (2013 TA)

The aggregate income elasticity is usually defined as the relative change in demand when everyone's income increases by 1%. The truth of the above claim is uncertain because it does not specify how income will increase.

3.2.4. 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)

U – First, let's make sense of the fact that market demand is inelastic (at the current price) in an industry that we might expect to be monopolistic. Define the short run as the time it takes for a new shipment of drugs to reach the consumers. We will assume that the demand for illegal drugs is inelastic in the short run, but elastic in the long run. We think this is reasonable (a) because monopolistic drug dealers (or profit-maximizing drug cartels) will not produce at an inelastic portion of the long run demand curve and (b) because Becker and Murphy's rational addiction model says it is likely to be more elastic in the long run.

Suppose that the drug suppliers produce a quantity of drugs such that the long run marginal revenue equals marginal cost. If 10% of those drugs are seized and destroyed, then the short-run price increases by at least 10% because short run demand is inelastic. Consequently, short run profits will increase.

On the other hand, a decrease in quantity in the short run could reduce demand in the long run and lead to a decrease in profits. If the supplier is a monopolist, then profits will definitely decrease in the long run because we assumed that they were producing at the long-run optimum: any deviation from this plan must yield less profit. If the market is oligopolistic, then it is possible profits could increase. How might this happen? Well, suppose that the suppliers would benefit from restricting output through some collusive agreement, but cannot profitably enforce such an arrangement. If an intervention unexpectedly destroys 10% of each of their outputs, then it does not matter that they could not effectively collude. (2013 TA)

> There is almost no limit to how developed and complex your answer could be. For these kinds of questions, it is most important that your answer
>
> 1. demonstrates that you understand the claim and its ambiguities, 2. makes reasonable assumptions, and 3. provides a thoughtful analysis.

~~3.2.5.~~ 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)

F – 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. 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)

3.2.6. 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)

T – 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)

F – While the above answer is mainly correct, it does not address the question of whether a person would consume more gasoline than before. It is not possible that the consumers would actually consume more gallons of gasoline. That amount of gas would have been cheaper before, but the consumer did not choose to buy that quantity. Thus, despite the fact that they might drive more miles, they will still use less gas than before. Any other possibility would imply that they are getting higher utility at a consumption bundle that was feasible before, which is not rational. (2013 TA)

> Because we are holding other prices and income constant, this statement claims that gasoline is a Giffen good in the long run (i.e. when consumers can adjust their cars). You should be very skeptical of Giffen goods. You should be even *more* skeptical of Giffen goods in the *long run* because demands tend to be more elastic in the long run, which implies a larger substitution effect. (Recall that the fabled Giffen goods are inferior goods with a relatively small substitution effect.)

3.2.7. 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)

F – 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)

F – We agree with the above answer but object to the use the word "necessity" because this term is generally reserved for goods whose income elasticity is less than one. The above argument about price elasticities is not tied to any statement about income elasticities. (2013 TA)

3.3 Demand and Supply

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

F – A price ceiling in the wholesale market will effectively transfer surplus from consumers to retailers. The wholesale market must sell at a lower price than before, so the supply is lower. Retailers buy from wholesalers at this lower price, but can resell at a higher price because the price ceiling creates a shortage. In fact, because of the shortage, the retail price will be higher than it used to be. Thus, retailers are not selling at marginal cost, and they are extracting surplus from the consumers. (2013 TA)

3.3.2. 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)

F – 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.

T/U – 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)

3.3.3. **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)**

T – Refer to Professor Becker's social multiplier theory, but here's a brief sketch. Suppose individual j's demand function for good 1 can be written $x_1^j(\mathbf{p}, I^j, X_1)$, where I^j is j's income and $X_1 = \sum_{i=1}^{N} x_1^i$. Then

$$\frac{dX_1}{dp_1} = \sum_{i=1}^{N} \frac{dx_1^i}{dp_1} + \sum_{i=1}^{N} \frac{dx_1^i}{dX_1} \frac{dX_1}{dp_1}$$

$$\Rightarrow \frac{dX_1}{dp_1} = \frac{\sum_{i=1}^{N} \frac{dx_1^i}{dp_1}}{1 - \sum_{i=1}^{N} \frac{dx_1^i}{dX_1}}$$

The social multiplier is

$$m = \frac{1}{1 - \sum_{i=1}^{N} \frac{dx_1^i}{dX_1}}$$

When $m < 0$ the demand curve is upward sloping. (Class of 2008)

3.3.4. **Suppose there are l identical leaders (L) and f identical followers (F) consuming a fashion good X, where $l < f$. If given the price of X, the demand for X by the L's falls when the consumption of X by the F's rises, but the demand by the F's rises when the consumption of X by the L's rises, then the demand for X by L would fall when the**

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(KES) Why did they tell us that $l < f$?

U – There is a positive price effect on consumption by both leaders and followers when the price of X falls. At the same time the fashion sensitivities of the two groups have a stabilizing effect on demand: the leaders demand less because the followers are consuming more, while the followers demand more because leaders will consume more. Ultimately, the sign of the effect on demand by leaders is ambiguous. It depends on the relative price sensitivities of the two groups and the fashion sensitivity of the leaders. Consumption by leaders is more likely to rise when they are more price sensitive than the followers and when their fashion elasticity is small. (2013 TA)

More formally, we can linearize the system of equations that defines the market equilibrium:

$$l \cdot X_L^i(p, X_F) = X_L$$
$$f \cdot X_F^i(p, X_L) = X_F$$

becomes

$$\varepsilon_{L,p}\Delta p + \varepsilon_{L,F}\Delta X_F = \Delta X_L$$
$$\varepsilon_{F,p}\Delta p + \varepsilon_{F,L}\Delta X_L = \Delta X_F.$$

Then, solving for $\Delta X_L/\Delta p$, we get

$$\frac{\Delta X_L}{\Delta p} = \frac{\varepsilon_{L,p} + \varepsilon_{L,F}\varepsilon_{F,p}}{1 - \varepsilon_{F,L}\varepsilon_{L,F}}.$$

The sign of the numerator depends on the terms mentioned above, and the denominator is always positive. In fact, the denominator is always greater than one; hence, the fashion effects are stabilizing.

3.3.5. **Suppose that the utility of consumers of good X are affected by other consumers of X, so that they consume more when aggregate consumption of X is greater. Consumers have the same preferences but they differ in incomes and all their incomes increase over**

T – When computing income elasticity of X at a point in time, we are essentially computing the effect of an individual's income on consumption of X, holding aggregate consumption constant. When computing income elasticity of X based on average income changes over time, we are essentially computing the effect of aggregate income on aggregate consumption (since average is aggregate / number of individuals),

In the latter case, because aggregate consumption varies, the "social multiplier" effect will be observed and will magnify the effect of income changing (whether X is normal or inferior). Since the social multiplier effect moves in the same direction as the income effect (holding aggregate consumption fixed), the latter method of computing income elasticity will be greater in absolute value. (Class of 2006, 9/10).

~~3.3.6.~~ **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)**

F – 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 consumers prefer the one with the largest amount of X. In this case, it is possible that consumers would over-consume. 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)

The last sentence didn't make sense to me at first glance. I think this answer is trying to distinguish $\frac{\partial^2 U}{\partial x_i \partial X}$ from $\frac{\partial U}{\partial x_i}$. This is a relevant point because the former may be positive while the latter is negative. (2013 TA)

True/Uncertain – The degree of supply elasticity depends on the relative share of fixed and variable costs in producing the good. When demand is more variable, suppliers will try to reduce as much fixed cost in their production and use more variable inputs. If the share of fixed cost is 0 to begin

with for all producers, supply elasticity will not change. The larger the shift toward more variable input due to higher variability in demand, the more elastic the supply will become. This is remindful of our problem set on agents choosing to be either well-rounded or specialized. More variable demand → More well-rounded producers → More elastic supply in each period. (Class of 2013, 7/10)

3.4   Deadweight Loss

~~3.4.1.~~ 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)

F – 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)

3.4.2.   Suppose that a successor to the Kyoto agreement requires that by 2025, every economy must cut its greenhouse gas emissions by 20%. This will increase the emissions of these gases in 2012. (Final 2011)

U – We know that in 2025, demand for substitutes to greenhouse-gas producing technologies will increase. Suppose these technologies do not yet exist. If development of such technology requires current greenhouse-gas technology, emissions could rise. On the other hand, if such technology is already available, they may not.

Similarly, if greenhouse gas technologies are involved in making a durable good, investment will increase now (before prices rise in 2025 due to limited emissions), so emissions will temporarily rise. (Class of 2011 - 9/10)

3.4.3.   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)

F – 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. (Mo)

~~3.4.4.~~ If labor supply is perfectly inelastic (both compensated and uncompensated), then a tax on labor income will not generate any deadweight loss. (2008 Midterm)

U – 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)

U – First, we will acknowledge that there is no deadweight loss if all forms of compensation are treated symmetrically. Now we will proceed to the more interesting (and more realistic) case:

Although the supply of labor won't change, the actual compensation for labor has multiple forms. We can model income as taxable income and non-taxable income. Before a labor-income tax, these were perfect substitutes. Under the marginal tax rate τ, the cost of one dollar of non-taxable income is $1 - \tau$ dollars of taxable income. So, even if revenues are not spent in a distortionary manner, there is still a tax wedge: anything that reduces taxable income has some deadweight loss because it is traded off at relative price $1 - \tau$. (Note that this analysis also applies to tax-exempt consumption, not just tax-exempt income. See work by Feldstein for more explicit analysis.)

One could argue that consumption of non-taxable income (such as health care) might generate positive externalities. In this case, the tax on labor income could be socially beneficial. However, it is certainly distortionary. (2013 TA)

3.4.5. A new law which mandates that employers provide health insurance to all workers will help workers that do not currently have employer-provided health insurance but will make those that do currently have it worse-off. (Core 2013)

F – This is a scenario where we need to look at the total benefits being offered. Companies can offer a lower wage in exchange for health benefits (or any other job perks). Therefore, those workers who do not currently have insurance may have to accept a lower wage, or different hours, in exchange for health benefits. The profit-maximizing firm will provide a compensation package that minimizes the average cost of each unit of labor. While some workers may be benefit from or be indifferent to the policy, there are likely others for whom the new regulations will be strictly worse. (2013 TA)

3.4.6. 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)

F – 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 systems were 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)

3.4.7. *** A carbon tax (taxing each ton of CO_2 emitted) would likely raise the profits of some fossil fuel producers if those fuels differed in the CO_2 emission per unit of energy produced, and if the demand for energy is relatively inelastic. (Core 2013)

A carbon tax leads to an increase in the market price for energy while the quantity demanded is not significantly reduced because demand is inelastic. The size of the price increase is greater the higher the rate of CO_2 emissions (tons/unit of energy) of the marginal generators.

Suppose the marginal generators are relatively clean. Then the inframarginal dirty generators' profits will decrease because the price increases by less than their tax. Even though the inelastic consumers will bear most of the tax burden of the marginal generators, their profits will also tend to decrease since the after-tax price will not increase in a competitive market. The marginal generators could earn higher profits if the tax causes the dirty generators to become the marginal suppliers.

Otherwise, if the marginal generators are the heavy emitters, the inframarginal generators will earn higher profits because the market price increases by more than their tax bill per unit of energy.

3.5 Substitutes and Complements in Production and Consumption

3.5.1. 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)

F – 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)

3.5.2. 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)

T – 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)

3.5.3. Local governments may be willing to subsidize capital investments in manufacturing as a means of raising local labor demand even when labor and capital are gross substitutes for the manufacturing industry as a whole. (Core 2012)

T – A subsidy for capital investments by local manufacturing firms will increase the effective return on capital for local manufacturers. By definition, if labor and capital are gross substitutes for the local manufacturing industry, the decrease in the price of capital will reduce demand for labor. However, it does not necessarily follow that labor and capital are gross subsitutes in the local market if they are gross substitutes in the industry as a whole. To illustrate this point, consider the extreme possibility that each firm uses a Leonteif technology (in which labor and capital are gross complements) with different proportions. The isoquants for the industry will be the lower envelope of each firm's. The shape of the industry's isoquant will depend on the distribution of Leonteif coefficients, and so factors may be gross substitutes at the industry level. (2013 TA)

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

T – 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)

3.5.5. 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)

T – 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)

~~3.5.6.~~ **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)**

T – 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)

~~3.5.7.~~ **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)**

T – 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)

3.5.8. 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)

U – Totally differentiating $\frac{dX_{cream}}{dP_{coffee}}$ we get

$$\frac{dX_{cream}}{dP_{coffee}} = \frac{\partial X_{cream}}{\partial P_{coffee}} + \frac{\partial X_{cream}}{\partial P_{tea}} \frac{\partial P_{tea}}{\partial X_{tea}} \frac{\partial X_{tea}}{\partial P_{coffee}}$$

The first term is the direct effect (negative), and the second term is the indirect effect (negative $\times$ negative $\times$ positive = positive). (Here we are assuming tea is not a Giffen good). Hence, we cannot tell what the sign of the LHS is.

As an extreme instance illuminating the equation above, suppose coffee and tea are perfect substitutes (because, say, I really just care about caffeine) and one cup of either is sufficient to jump-start my morning. If the price of coffee goes below that of tea, I will switch from tea to coffee. Then my consumption of cream will definitely drop.

3.5.9. ==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. (Final 2008)==

U – 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)

3.5.10. ==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)==

T – 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.

U – Before the consumer learns anything about computers, I think two different computer-based products will tend to be complements. This is because the price of each product makes the whole bundle of "computer use" more or less expensive, and people on the extensive margin care about that. But someone who has already learned how to use the products will treat them as substitutes; they are on the intensive margin, and can re-optimize their inputs into "computer usage" in response to changes in prices.

This question highlights the distinction between the usual definition of complements and substitutes (negative versus positive cross elasticity) and what we will call *technological complements* and *technological substitutes*. By technological complements (or substitutes), we mean that the marginal utility (or marginal product) of one consumption good (or input) is increasing (or decreasing) in the quantity of the other good. The connection between these concepts is not as clear as you might hope...

Suppose the budget constrainst is not linear, perhaps because there is a cost of investment in computer skills that is independent of one's intensity of usage. An increase in the price of on-line music may reduce investment in computer skills and thereby increase the shadow price of digital photography. The demand for digital photography may fall and the two products will be complements in consumption even if they are substitutes in the utility function.

3.5.11. The introduction of a popular video game will reduce the demand for other video games if people who own game consoles view different games as substitutes for each other. (Final 2013)

U – Among people who own console, yes (substitution effect). Among people who do not own the console, they can be technological complements (scale effect). (Class of 2013 TA)

To elaborate, the introduction of the popular video game will induce more people to purchase the console on which the game runs (scale effect). Then, the shadows price of owning other games that run on the same console drops. Let's focus on the new console owners. Since people are spending extra money on the popular game, income effect will decrease the demand for other video games. But since the price of owning other games is now lower, people will substitute in expenditures from other areas (not necessarily video games for the same console) to buy more of the other games. If the substitution effect is high enough, the overall demand for other games will increase. If the console induces strong network effects for playing other games, the demand increase for other video games will be even further reinforced. (Class of 2013)

3.6 Long- versus Short-Run

3.6.1. ==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)

T – 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)

3.6.2. ==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)==

T – 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)

3.6.3. **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)**

T – 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)

3.6.4. ~~3.6.4.~~ **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)**

F – 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)

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

T – 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)

(KES) If demand is strictly downward sloping, I don't think it is possible for a demand increase to lead to an equilibrium where all the beef is slaughtered. I'm basing this on the phase diagram I drew in H-P space. The P-dot locus is a horizontal line at P=C*(g-r) and the H-dot locus is H=D(P)/g. An increase in demand shifts the H-dot locus to the right. So I think that if there was a stable equilibrium before, there should be one after the demand shift.

(JVM) I agree with your point. I deleted my answer after rethinking it. But how could we improve the given answer to better than 6/10?

(KES) I don't know. I think it was an unusually straight forward question and this was a correct answer.

3.6.6. **A technology improvement which increases the reproductive rate of livestock will (all else equal) reduce the price of livestock in the long-run but can increase the price of livestock in the short-run. (Midterm 2012)**

(JVM) (KES) I don't think long-run herd size necessarily increases. I got $gH^* = D(P^*)$ and

$P^* = C/(g - r)$, so $H^* = D(c/(g - r))/g$.

T – The technology improvement is a supply shock, which will ultimately increase the equilibrium quantity of beef and decrease the equilibrium price. If demand is inelastic, then the long-run herd size will decrease because the small increase in demand for beef can be sustained by a smaller herd.

On the other hand, if demand is elastic, the steady-state herd size may increase. In order to reach the long-run steady-state, farmers may have to reduce quantity today. This would drive up prices in the short-run. (2013 TA)

3.7 Rational Agents and Utility Maximization

3.7.1. 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)

F – 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.

3.7.2. Suppose some persons donate blood out of altruistic reasons and others donate blood because they are paid to do so. An exogenous increase in the price paid for blood would increase the total amount of donated blood by less than the increase in the amount donated by those paid to do so. (Core 2012)

T – See above. The statement implies that the net increase in supply is less than we would expect if we simply moved along the supply curve of aid donors. Why? Because some volunteer donors would stop donating.

> (JVM) The key here is to determine the true variables in the utility function. If peope got utility from the act of donating blood, they would be even more excited to do it once they started getting paid. Since this is not the behavior we observe, we have to rethink what is the "good" in their utility. Volunteer donors may not actually get utility from the process of donating (after all, it's time-consuming and uncomfortable). Rather, they care about the fact that the blood bank has enough blood to help those in need. (2013 TA)

3.7.3. 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)

U – 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)

3.7.4. ==When consumers overestimate the value received from a good and as a result purchase more of that good than they otherwise would, the loss to the consumer will be smaller when supply is inelastic since inelastic supply limits the degree of overconsumption. (Core 2013)==

(JVM) F – With inelastic supply, small changes in quantity result in large changes in price (this is why we observe more price volatility for inelastically supplied goods). This will cause larger loss to the consumer than under elastic supply. One way to visualize the loss to the consumer on a supply/demand graph is to draw a vertical line at the "optimal" quantity (where the consumer *should have* bought) and a vertical line at the "miscalculated" quantity (where the consumer *actually* bought). The loss to the consumer can be seen to be larger when supply is less elastic. (2013 TA)

(KES) I don't understand the graphical explanation. The way I thought about it, the individual's price-quantity indifference curve has zero slope at the optimal demand. If supply is perfectly elastic, then a small change in quantity will only lead to a small change in quantity and the consumer will stay very close to his maximum utility level. If supply is very inelastic, an increase in quantity will lead to a large increase in price and the consumer will move almost orthogonally to his indifference curves.

3.7.5. ==Improvements in the quality of life (that raise the utility of each life year) will raise the willingness to pay for life extension (i.e. the value of a life year). (Core 2012)==

(JVM) U – What matters for demand is marginal utility, not the level of utility. After all, utility is really an ordinal and not a cardinal concept. Marginal utility matters because in equilibrium the consumer will set the marginal utilities (normalized by price) equal to each other: $\frac{MU_1}{p_1} = \frac{MU_2}{p_2} = \ldots$. Therefore, if these quality improvements shift the utility curve but do not change its curvature, there

will be no change in willingness to pay. However, if curvature changes, then the marginal utility is affected. In that case, we might observe a change in willingness to pay. (2013 TA)

(KES) Specifically, if utility is additively separable across periods and concave in each period, then increasing utility each year will reduce marginal utility in each year of life. This will increase the marginal rate of substitution between utility today and utility during an additional period of life. The willingness to pay will therefore increase. Intuitively, you would like to optimally "spend" that additional utility by spreading it across your current lifetime *and* by extending your lifespan.

3.7.6. 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)

F – 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." 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)

T – 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)

3.7.7. Suppose 2 candidates, A and B, are running for office, and the candidate with the larger number of votes wins. Under these conditions, we should not observe voting by married couples where one spouse prefers A and the other prefers B, since voting takes time. (Final 2011)

U – If married couples could (nearly costlessly) bargain with each other to not vote when they preferred different candidates, then we might not observe married couples voting for different candidates. However, if they cannot observe if their partner breaks the agreement, then both spouses would have an incentive to break the agreement and vote. So a non-voting equilibrium depends on

bargaining costs and monitoring costs. (Class of 2011 - 9/10)

3.7.8. 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)

F – 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)

3.7.9. 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)

F – 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)

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

F – 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)

3.8 Preferences

3.8.1. The "Law of Demand" is a direct implication of diminishing marginal utility. (Andrew Sellgren)

F – We don't even need utility to get the law of demand. Even without the utility framework, budget/scarcity constraints always exist. We need people to spend their whole income. To see that

$\frac{dx_i}{dp_i} < 0$ for any good i, differentiate the budget constraint, assuming we change p_1:

$$\sum_i p_i x_i = M$$

$$x_1 + \sum_i p_i \frac{dx_i}{dp_1} = \frac{dM}{dp_1}$$

Real income compensation (keeping buying power the same) implies $x_1 = \frac{dM}{dp_1}$, so that in uncompensated terms,

$$\sum_i p_i \frac{dx_i}{dp_1} = 0$$

Mathematically, we could have $\frac{dx_i}{dp_1} = 0 \ \forall i$, but economically we cannot because it would mean that the bundle costs more than the income. Therefore, at least one good must have $\frac{dx_i}{dp_1} < 0$. To see that $\frac{dx_1}{dp_1}$ in particular must be negative, we don't need a utility model. We need a behavioral model that says a person consumes where there is more available. For instance, a model of random dollar allocation would do this: if people spend each dollar at random, then they will get the same amount of each good in terms of dollar value, but will get less of the expensive goods in terms of quantity. See Becker's *Economic Theory*, Lecture 5. (2013 TA)

3.8.2. If an agent prefers lottery L to lottery L' and lottery L to lottery L'', but prefers a compound lottery that gives 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)

T – Denote the compound lottery $\tilde{L} = a[L'] + (1 - a)[L'']$. Then in terms of preferences, $\tilde{L} > L$ and $L > L' > L''$ (since the preferences don't obey the standard axioms, we can't compare certainty equivalents). The agent is willing to pay a positive amount to switch from L to $\tilde{L}$. But then he is willing to pay to change the $(1 - a)L''$ term of $\tilde{L}$ into $(1 - a)L'$, effectively trading $\tilde{L}$ for L'. But then he is again willing to pay to switch from L' to L. The agent has paid a positive amount of money to go from L to L. (2013 TA)

3.8.3. 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)

F – 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, she values it more than the market price.) Then she will refuse the offer of $200, but she wouldn't pay $200 for a "normal" bottle of wine. No axiom is violated. (Mo)

3.8.4. 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)

T – Homothetic preferences imply that the MRS between any two goods depends only on relative price, not income. Therefore, if a consumer demands x when her income is M, she should demand αx when her income is αM, assuming prices haven't changed. Assume homotheticity and derive a contradiction:

Denote p_{90} and p_{00} the price vectors in 1990 and 2000. Denote x_{90} and x_{00} the bundles demanded in 1990 and 2000. Suppose the price vector is fixed at p_{90}. If the agent demands x_{90} when income is $20000, she should demand $\frac{3}{2}x_{90}$ when income is $30000. Since x_{00} costs less than $30000 under prices p_{90}, we must have $u(x_{00}) u(\frac{3}{2}x_{90})$. This contradicts the statement above; the preferences cannot be homothetic. (2013 TA)

3.8.5. 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)

F – 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 $p_1 \cdot x_1 = M_1$ and $p_2 \cdot x_2 = M_2$. 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)

3.9 Income and Substitution Effects

3.9.1. <mark>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.</mark> **(Core 2003)**

T – The good is normal. Hence if the price of this good increases: 1. Income effect: consume less for this good 2. Substitution effect: consume less for this good since the price increases That is, a consumer will consume less. (Mo)

Side note: Even if the good is NOT a normal good, consumption will still go down, as long as the good is not Giffen. (2013 TA)

3.9.2. <mark>In a world with N goods, a uniform percentage increase in the price of $N/2$ of these goods will reduce spending on these goods if all goods are normal for all consumers.</mark> **(Final 2011)**

U – The income *share* of each good need not change, even if the *quantity* of each good drops. Consider the Cobb-Douglas utility function, for which the income share of each good is fixed. For instance, $U(x_1, x_2) = x_1^{1/2} x_2^{1/2}$ implies the consumer will spend half of his money on each good, regardless of the price. Perfect complements provide a more extreme example, in which the spending rises. If $U(x_1, x_2) = \min\{x_1, x_2\}$ then the consumer buys $\frac{m}{p_1 + p_2}$ of each good. The share of good one rises if $\frac{p_1}{p_1 + p_2}$ is increasing in p_1, i.e. if $p_1 < p_2$, even though the quantity of the good is diminishing. (2013 TA)

> The broader point is that price and income elasticities relate quantities to prices, not shares to prices. Do not be misled into thinking that normality or inferiority is important to your answer just because the statement mentions it.

~~3.9.3.~~ **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)

U – See previous question (Giffen goods would be the case in which this is false).

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

U – 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)

3.9.5. <mark>**An increase in the real rate of interest will lead to a fall in housing prices. This fall in prices will be greater in the short-run than in the long-run. (Final 2011)**</mark>

T – Recall price of a durable is its discounted stream of rents, or: $P_t = R_t + P_{t+1}\frac{1-\delta}{1+r}$ thus, if interest rates increase, prices decrease.

Since price has decreased, investment decreases and the stock of housing will slowly adjust downward to a new lower steady-state stock. As the stock of houses decreases rent will increase, causing prices to rise some in the long run. Thus, fall in prices is greater in the short run. (Class of 2011 - 9/10)

F – Recall $P_t = \sum_{j=0}^{\infty} R_{t+j} \left[\frac{1-\delta}{1+r}\right]^j$. Hence, a rise in interest rates lowers prices today, i.e., in the short run. Investment therefore declines. But that leads to a decline in the housing stock, which also leads to a rise in the rental rates R_{t+j} in the long run. Hence, in the long-run, you can see a "rebound" in prices. (Class of 2011 - 8.5/10)

3.9.6. <mark>**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)**</mark>

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

1. Income effect: consume more. 2. Substitution effect: consume more today since current consumption becomes relatively cheaper.

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

1. Income effect: consume less. 2. Substitution effect: consume more today.

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

T – I disagree with the net-saver answer above. A fall in interest rates will tend to make people save less, or borrow more. A simple framework is a two-good world (period 1 goods, period 2 goods). Relative price is $\frac{1}{1+r}$. If r falls, the relative price increases; good 2 becomes relatively more expensive.

Thus, people shift consumption to good 1. Net borrowers are basically net sellers of good 2; net savers are net buyers of good 2. When the price of a good rises, a net seller will not become a buyer of that good, and a net buyer will buy less. (2013 TA)

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

T – See previous question.

3.9.8. 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.

T – 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. They consume less housing in California since:

1. Income effect: negative 2. Substitution effect: negative

For those leaving California (assuming they own the house), the increase in price makes them better off. Hence

1. Income effect: positive 2. Substitution effect: negative

Thus those leaving California benefit more from a rise in house prices.

3.9.9. 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)

(JVM) F – The introduction of dishwashers and vacuum cleaners made household production more efficient, meaning it was possible to spend more time in the labor force than before. However, children and household labor may be complementary goods, while both of them are substitutes for market labor. So it should not be surprising that when labor participation went up, fertility went down.

(KES) We could also consider the income effect of these labor saving products. Since dishwashers and vacuum cleaners increase the productivity of labor in the household, the full income of the household will increase. It is possible, and empirical evidence suggests, that fertility goes down and investment in the human capital of children goes up as income rises. Thus, both the substitution

effect and income effect could lead to a decline in fertility. (2013 TA)

~~3.9.10.~~ As labor productivity increases over time, we would expect wages and average hours of work to increase. (GSB Final 1999)

U – Assume leisure is normal. We should expect wages to rise (price of leisure increases), but hours of work could either fall or rise since two effects are to the opposite directions:

1. Income effect: consume more leisure 2. Substitution effect: consume less leisure

(Kevin Murphy)

~~3.9.11.~~ With two goods and stable preferences, relative prices and relative consumption of the two goods always move in opposite directions. (Final 1998)

F – A counterexample: Suppose the price of X increases while the price of Y remains the same, which implies $\frac{p_X}{p_Y}$ increases:

1. Income effect: consume X less, consume Y less 2. Substitution effect: consume X less if it is normal

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

One may also illustrate what Mo said by drawing a picture with a budget line that pivots inward, to show that even as a budget line gets steeper, $\frac{X}{Y}$ may get larger as well. The *levels* of X and Y may decrease, but the *ratio* can increase. (2013 TA's)

3.9.12. 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)

F – 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)

U – 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)

3.9.13. 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)

U – 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)

~~3.9.14~~. **A rise in the price of housing will make those that own their own home better off. (Core 2004)**

(JVM) U – The endowment effect makes a homeowner wealthier. However, if someone is a net buyer of a good, then they can be worse-off when the price rises due to substitution/income effects. This would be the case if the person were "consuming" more than just the home he/she owns. (2013 TA)

3.10 Labor Income Taxes

3.10.1. 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)

F/U – 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:

1. Income effect: since they have become better off, they work less 2. Substitution effect: since the wage rate has decreased, the price of leisure has decreased; they consumer 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:

1. Income effect: since they have become worse off, they work more 2. Substitution effect: the wage rate decreased, 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)

3.10.2. A reduction on 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 revenue fixed will increase labor supply. (Final 2000)

(JVM) U – Only a subset of goods are taxed. People who do not buy the newly-taxed goods will experience only an effective wage increase, and their labor supply may go up or down, as usual. But let's consider the aggregate labor supply by examining the average consumer, who pays the same amount in consumption tax as he did in income taxes (since the taxes are revenue-equivalent). Depending on what types of goods were taxed, the average consumer's labor supply could go up or down. If the taxed goods are complements to leisure, he will substitute away from those goods and from leisure; but if the taxed goods are substitutes to leisure, he will substitute towards leisure and its complementary goods. (2013 TA)

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

T – Remember the slope of the consumer's budget set is $\frac{w}{p}$. A 10% increase in p will result in slope of $1/1.1 = 90.9\%$ of the original. A 10% wage tax will give a slope of 90% of the original. To first-order, both the taxes distort the budget set in the same way, so they will have approximately the same effect on consumption and labor.

On the other hand, those who are not working will certainly not change their behavior in response to a labor income tax, while a consumption tax will distort their budget set and result in less consumption. (2013 TA)

3.10.4. A reduction in the tax rate on earnings for low wage workers will raise pre-tax wages for these workers. (Final 2013)

False/Uncertain –
1. The Basics: Think about the labor demand and supply curves intersecting without any government intervention. The distance between the supply and demand curves to the left of the intersection point is the tax wedge. When the tax wedge decreases, quantity moves to the right closer to the intersection point. Since the demand curve is downward sloping, the pre-tax wage decreases for

these workers.

2. But is the supply curve really stationary? Even before we ask that, is this a compensated supply curve? If the tax reduction is coming from reduction in services for low income workers, then the supply curve is fully compensated. But if the reduction is coming from paying for roads, then higher income guys now have to pay more. In the latter case, maybe the labor supply curve shifts out for low wage workers since now they are getting a fuller return on effort than before. Then the pre-tax wage drops even further.

3. But maybe lower tax on earnings increases human capital investment. If more people are going to school rather than working, then the labor supply curve may shift inward in the short-run and raise the pre-tax wage. This may be a bit less likely than scenario 2, since the reduction in the tax rate on earnings is only for low wage workers. (Class of 2013 TA, Class of 2013)

3.11 Marginal vs. Average Consumers

3.11.0. Section summary: One key thing to remember seems to be that we should look at the willingness to pay of the average consumer when 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 consumer, not the average one. (This is the Spence Distortion: see the related section, Monopolistic Choice of Product

3.11.1. <mark>**Selling overhead bin space for carry-on baggage to passengers is efficient if different airline passengers have different values of time**</mark>**. (Core 2000)**

U – Assuming there is not enough overhead bin space for everyone, and that the only reason people want overhead bins is so to save time (and not because of e.g. the risk of lost luggage), then efficiency would imply that bins should go to those people with the highest value of time. Then creating a market for overhead bin space would be more efficient than no market. However, if airlines set monopoly prices for the overhead bins, instead of the competitive price, then there is some deadweight loss and full efficiency is not achieved. (2013 TA)

~~3.11.2.~~ **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)**

F – It is true that housing prices will be higher in rich neighborhoods, since rich families' willingness to pay is higher. However, efficient allocation will only result under assortative matching. Suppose families contribute to some jointly-produced good (education?), with wealth as an input. If the cross-derivative of the production function is positive, then it is efficient to segregate by income. However, we might think that the cross-derivative is negative: students benefit from diversity if students from different socioeconomic backgrounds have positive spillover effects. Then it would be efficient to have more mixing of families. (2013 TA)

3.11.3. Suppose a labor market where 25% of all equally productive workers are members of a minority group B, while others are members of the majority W. All workers supply 1 unit of labor. Assume that firms have identical production functions, and that 80% of firms dislike hiring B, while the other 20% are indifferent between B and W. Then equilibrium in this market would have the wage B's less than that of W's since the "marginal" firm discriminates, and the 20% of non-discriminators only hire B's. (Final 2011)

U – Assuming that disliking means that the 80% will not hire somebody from B, then all B's will be in the 20% that does not discriminate. If all B's get hired in that 20% (which might happen with C.R.S. and elastic K), then those firms would pay the marginal product, equating wages between W and B. However, if some B's remain unemployed (inelastic K for example), then $w_B < w_W$ since B's cannot look for jobs in the bigger 80% sector. (Class of 2011 - 9/10)

U – Suppose the industry had CRS production with Leiontief production technology where one unit of labor and one unit of capital are combined to make one final good. Then the 20% firms would hire all of the Bs and produce more than 20% of the total output, but the marginal productivity of Bs and As would be equal and they would receive the same wages. (Class of 2011 - 8/10)

3.11.4. If the wage bill is held fixed for different soccer teams in the same professional league, then we 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)

F – I am interpreting "the wage bill is held fixed" to mean that the total salary of each team is the same for each team. The question seems to be asking whether $MPL_{black} > MPL_{white}$ even if wages are equal. Because there are non-pecuniary rewards to playing, we can't necessarily say that this is true. For instance, if there are complementarities in production (i.e. players like to play together with

people of the same race) then the team doesn't necessarily need to pay black players more when they have a large contingent, because the players reap psychic benefits from having other blacks on the team. (2013 TA)

3.12 Choice Under Uncertainty

3.12.1. 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)

F – 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)

3.12.2. 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. Utility 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 the 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.

F – There are two major reasons why an individual will spend resources on improving their chances of survival. One is to increase their resources. Because the market provides full and fair annuities, the value of the resources available to the individual is equal to their full income, i.e. the present value of their expected wealth if they work the maximum amount of time in both periods. Thus, this motive alone will incentivize the individual to maximize the present value of his full income net of health spending.

The other reason to increase h derives from the curvature of the utility function: spending resources on consumption and leisure today adds marginal utility, but spending resources on extending the lifespan adds average utility. When utility is concave, marginal utility in the current period is less than average utility in later periods and so the individual has an additional incentive to increase chances of survival. Therefore, the individual's spending on health will be greater than the wealth-maximizing spending level. (2013 TA)

Hold prices and wages constant, normalize the price of consumption to one. Let T be the time endowment in each period and r be the interest rate. The individual must solve

$$\max_{c,l,h} u(c_1, l_l) + S(h)\beta u(c_2, l_2) \quad \text{subject to } h + c_1 + wl_1 + \frac{S(h)}{1+r}(c_2 + wl_2) = wT + \frac{S(h)wT}{1+r},$$

where the RHS of the constraint is the expected present value of the individual's full income. This is the appropriate budget constraint because there is full and fair annuity insurance. The present value of full income (net of health spending) is maximized where $S'(h)wT/(1+r) = 1$. On the other hand, the FOCs for h and c_2 imply that the consumer will choose h such that

$$\frac{S'(h)wT}{1+r} = \frac{S'(h)}{1+r}\left(wl_2 + c_2 - \frac{u(c_2, l_2)}{u_c(c_2, l_2)}\right).$$

If utility is homogenous of degree one in consumption and leisure, then the two conditions coincide with each other and the individual will simultaneously maximize expected wealth and utility (use Euler's homogenous function theorem and the FOCs for c_2 and l_2 to show this). Otherwise, the individual will not choose h to maximize their expected wealth. For details, see Becker's "Health as Human Capital: Synthesis and Extensions" (2007), specifically section 2.2.

3.12.3. 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)

T – Assume risk aversion. The two bonds have exactly the same expected payout. However, one bond pays with certainty, and the other is a gamble. Investors are willing to pay the certainty equivalent (CE) of a gamble; with risk-aversion, this is always less than the expected payout:

$$CE(g) < E(g), \forall g \Leftrightarrow \text{agent risk averse.}$$

3.12.4. 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)

T – 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 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)

3.12.5. 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)

F – 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, which they hand over to the lottery. Then both of them will agree to the above lottery since $\frac{100}{2} + \frac{0}{2} = 50$ (expected utility under lottery) ¿ 25 (utility from not participating). This result holds with many people economy.) The resulting extremely unequal income distribution is the same as the social planner's. (Mo)

3.12.6. 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)

T – 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)

3.12.7. 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.

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

$$(1 - p)U(G) + pU(B) \text{ vs. } U(G - C)$$

The consumer will buy insurance whenever LHS<RHS. Sure enough, LHS decreases in p. But when C is high enough, however (for example, if $C > G - B$) it will not be optimal to buy insurance even if $p = 1$. (Class of 2008)

3.12.8. Assume that firms have the ability to cheat customers by providing them with only 90% of the quantity claimed to be in a package and that consumers cannot detect whether they are being short-changed. Assume some firms are "honest" (and provide consumers with only 90% of the quantity claimed). Consumers will be better off when at least some of the honest firms survive in equilibrium. (Final 2013)

Hint: What does it mean "consumers can't tell"? Main idea: price has to be the same per box no matter whom you buy it from. Profit maximizing firms produce at MC=P because of competition. (Class of 2013 TA)

False – The beauty of this question lies in recognizing that if the honest firms weren't being so honest, they would drive out inefficient producers and consumers would end up in a better equilibrium where they end up getting what they paid for. 1. Since consumers cannot detect fraud, it must be the case that there is only one price per box in this market. 2. Competitive firms must be making 0 profit in equilibrium, so P = MC. 3. Since some firms are selling 100% per box while others are selling 90% per box, but all firms must be making 0 profit in equilibrium, it must be the case that those selling 90% per box are the less efficient firms (requiring MC=P to produce 90%).

For simplicity and clarity, suppose consumers in this market solve,

$\max_Q \ s \cdot \log(Q) + (1 - s) \cdot \log(0.9Q) - Q,$

where s is the share of honest firms in this market and price P is normalized to 1. Then equilibrium utility is given by,

$U^* = (1 - s) \cdot \log(0.9) - 1,$

which is increasing in s. So consumers are better off when $s > 0$ than when $s = 0$, right? Wrong! If the honest firms weren't being so honest and instead decided to sell only 90% just like the dishonest firms, at first they would be positive profits, then they would engage in a Bertrand competition driving down the price to 0.9 which is the honest firms' actual marginal cost for selling 90% of the quantity claimed. In the process, all the inefficient firms will be driven out. Then consumers solve,

$\max_Q \ \log(0.9Q) - 0.9Q,$

and get welfare,

$U^* = -1,$

which is exactly the same as the case where there are only honest firms selling 100% in the market. It would be as if there were no longer any fraud in the market. (Class of 2013)

3.13 Law and Economics

3.13.1. 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)

T – 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)

3.13.2. 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)

F – 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)

3.14 State-Dependent Preferences

3.14.1. 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)

(JVM) U – Let the utilities in the two states be U_H (healthy) and U_S (sick). If the person has wealth level W and p is the probability of getting sick, the person has expected utility $EU(W) = (1-p)U_H(W) + pU_S(W)$. A fair lottery would have price p per dollar of insurance. If the person could choose his level of insurance, then he would be happy to buy insurance in an amount B such that

$$U'_H(W - pB) = U'_S(W - pB + B)$$

Since $U'_H(W) < U'_S(W)$, the consumer would benefit from buying at least a little insurance; hence there is some value B at which this optimum is achieved, or he consumes at a corner where he gives up all his wealth in the healthy state.

However, if the consumer cannot choose B, it is possible that he is offered a contract that is worse than taking the gamble on getting sick, even if the contract is actuarially fair. Then the consumer wouldn't buy insurance.

3.14.2. 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)

T – See above question.

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

F – 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)

3.15   Principal-Agent Problems

3.15.1. 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)

U – [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 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 rm very severely (for example, $5 billion fine with the damages of $500 million). (Mo)

3.16   Allocation of Time

~~3.16.1~~. **Wealthy people spend more time shopping than poor people do.**

U – 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)

3.16.2. Movie theatres charge lower prices to senior citizens (over age 65) because the value of time of seniors is less than the value of time of younger movie-goers. (Final 2013)

True – Older citizens does have a lower value of time since they earn less to 0 income working, but does lower value of time imply higher elasticity? Consider that shadow prices change very slowly for millionaires. Elderlies have lower disposable income, and they are willing to put in a higher search effort, so it is likely that they do have higher elasticity. (Class of 2013 TA)

3.17 Household Production

3.17.1. ~~An~~ **increase in the rate of divorce tends to cause GDP to fall.**

F – 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)

3.17.2. **Assume a household produces commodities Z_1 and Z_2, with utility defined over these commodities. Assume the household production functions are: $Z_1 = ax_1$, $Z_2 = bx_2 g(Z_1)$ 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)**

U – 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.

3.17.3. ==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% (or example, wage rates rise by 2%, and no other sources of income) would increase real full income by 0.67 percent.== (Fall 2008 Final)

T – Let the shadow cost of the household good be π/unit. Then, since the production function is CRS, it must be that

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

where S_L is the household labor share and S_G is the goods share. So, plugging in the numbers 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)

3.17.4. If productivity of labor and capital rises by 2% in the market sector, and if at the same time productivity in the household sector of both time and goods rises by 2%, hours of work would not change because the rise in household productivity would eliminate both the substitution effect of greater market productivity toward more work, and the income effect toward reduced work. (Final 2011)

F – The increase in productivity in both sectors should eliminate the substitution effect between market and household because the marginal product of time in both sectors increases by the same amount. There is an income effect though because both the productivity of the market and the household increased, so households are richer. If leisure is a normal good, then people should substitute away from production in the market and home and toward leisure. (Class of 2011 - 7/10)

3.17.5. 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)

(JVM) F – The shadow price of household production has fallen thanks to increased productivity. This changes the opportunity set for the consumer; they can now produce just as much (or more) and also work more. We would expect labor hours to change. (2013 TA)

3.18 Rationing

3.18.1. 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)

(JVM) F – For substitutes, it's the other way around. Rationing restricts the consumer's ability to increase consumption of X. This means substitute goods become more important – in other words, X's substitutes have fewer substitutes, and so they have less elastic demand. In the extreme case of perfect substitutes, we see that rationing X will mean the consumer must buy the substitute, no matter the price.

However, complements also become less elastic, because the cap on X restrains the consumer from increasing consumption on complements. Overall, rationing lowers the own-price elasticity for every other good. (2013 TA)

3.18.2. 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)

(JVM) U – If certain types (races or genders) of people cause a negative externality by being members of a club, then charging different groups different prices could be an efficient way to eliminate the externality and yield integration. This would involve the minority groups paying a premium. They internalize the externality and the premium can be rebated to other members. However, integration will only occur if the minorities' benefits from membership are greater than the extra cost. For instance, if they are able to purchase a lot of status or social connections, or if the club's facilities are much more elaborate than the next-best option, integration may happen. If, however, those benefits are not sufficient to make up for the premium, segregation will persist. (2013 TA)

3.18.3. 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)

(JVM) F – Price mechanisms are a way to fix externalities, not create them. The college admission system likely relies on student merit because a university's production function is not about profit maximization. Rather, a school tries to produce quality scholarship, which may require a mixture of student ability that is not necessarily correlated with income.

In addition, one might argue that from a profit-maximizing standpoint, universities do better in the long-run by accepting the best, not the richest, students, because they are the ones who will later earn high salaries and endow the university in subsequent decades. (2013 TA)

3.19 Addictive Goods

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

U – 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)

3.19.2. 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)

T – 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., cigarettes), 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)

3.19.3. 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)

F – The monopolist for the cigarettes can intentionally set the price lower than the 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 at a lower level (since that will no longer increase the demand!), and will set the prices to maximize the profits this year. Since the marginal cost is constant, it will surely increase the prices. (Mo)

3.19.4. 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.

T – 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)

U – 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)

3.20   Health and Government Policy

3.20.1. 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 effects is released, the consumption should decrease for both groups.

F – 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.)

3.20.2. Suppose the government subsidies 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)

F – 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)

3.20.3. 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)

T – 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)

3.20.4. 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.

U – 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 bear 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)

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

U – See above.

3.20.6. 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.

U – See above.

3.20.7. 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)

F – 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/cost of the drugs encompasses more than just the diabetes aspect. (Class of 2008)

3.21 Crime and Punishment

3.21.1. When an increase in the number of muggers on the street leads to a reduction in the number of muggings because people stop going out at night the external cost of crime is reduced. (Final 2011)

U – It is certainly possible that the cost of crime is reduced because people are reluctant to go

outside at night. If the cost is only measured in stolen iPhones and petty cash, then this is the case. But we should also consider the opportunity cost of lost revenues to local business, decreased utility to consumers, and the likely increase in cost from more police (more muggers). If this cost outweighs the gain, then external cost actually rises. (Class of 2011 - 7/9)

F – Increasing the number of muggers drives up the probability of being mugged. Thus, the shadow price increases for any activity outside the house. Thus, individuals substitute away from such activities (e.g. going to restaurants, movies, going for midnight run) and substitute towards other activities (video games or TV). Since staying inside was always feasible, even before the increase of muggers, individuals must be strictly worse-off. But if the external cost of crime does not account for such utility loss, it may wrongly predict that costs went down. (Class of 2011 - 7/9)

3.21.2. 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)

F – The utility of a drug seller is

$$U(W) \text{ prob. } 1 - p \text{ (not caught)}$$
$$U(W - F) \text{ prob. } p \text{ (caught)}$$

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 $(1 - p)U(W) + pU(W - F)$..However, an individual will decide whether she will enter this industry by comparing this expected utility and the (reservation) utility $\overline{U}$ which can be obtained outside of this industry. Hence regardless of risk aversion, the decrease expected utility in the industry will discourage them.

In general, risk-preferrers may tend to prefer gambles to sure outcomes, but when the gamble gives slightly worse payoffs than before, it becomes less desirable compared to the sure outcome.

3.21.3. <mark>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)</mark>

(JVM) U – It depends on whether the criminal is risk-loving or risk-averse. Using the variables from the previous question, the expected fine is Fp. Suppose this is fixed at E, so that $p = \frac{E}{F}$. Note that $F \in [E, \infty)$ and we can assume $E < W$. Then the expected utility is

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

Differentiating with respect to F we get

$$\frac{E}{F^2}\left(U(W) - U(W - F)\right) - \frac{E}{F}U'(W - F)$$
$$= \frac{E}{F}\left\{\frac{U(W) - U(W - F)}{F} - U'(W - F)\right\}$$

The first term is the average slope between the utilities in each state. The second term is the slope of the tangent line at the bad state. A risk-loving criminal will have the first greater than the second (so the derivative is positive); a risk-averse criminal will have the second greater than the first (so the derivative is negative). Thus, only risk-averse criminals will be worse-off with higher fines. (2013 TA)

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

T – 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)

Also, on the demand side, price decreases (again because there is no risk of being caught), so demand may increase; cheaper supply and higher demand can definitely increase quantity, although it doesn't mean the market price will drop.

3.21.5. 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)

U – 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.)

3.21.6. 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)

F – 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)

3.21.7. Suppose crimes are punished by a probability, p of being convicted if a person commits a crime, and a fine, F, is the punishment if convicted. Starting from the same initial point, a given percentage increase in p would be more of a deterrent to committing crimes than would an equal percent increase in F. (Final 2013)

U – If criminal risk averse, increasing F will deter him more; if risk acceptant, increasing p will deter him more. Note that we can model him as solving the following problem:

$$\text{commit crime if: } \underbrace{p\,U(I-F)+(1-p)U(I)}_{\text{utility from crime (UC)}} > \underbrace{\bar{U}}_{\text{util. from not committing crime}}$$

Thus we want to reduce the LHS. Computing the elasticity of the LHS,

$$\frac{p}{U}UC'(p) = \frac{p}{U}(U(I-F)-U(I)) \lessgtr \frac{F}{U}UC'(F) = \frac{P}{U}FU'(I-F)$$

$$\Leftrightarrow -\frac{U(I)-U(I-F)}{F} \lessgtr -U'(I-F).$$

As can be seen on the graph, -U'(I-F) is more negative if criminal more risk averse. (Then I had a small graph illustrating the last inequality with income on the X-axis and utility on the Y-axis. When utility is concave, the slope at I-F is always greater than the slope of the chord.) (Class of 2013, 9/10)

3.22 Peltzman Risk Tradeoffs and the Value of Life

3.22.1. 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)

U – 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)

3.22.2. 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)

F – 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)

3.22.3. 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)

F – 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.)

3.22.4. 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)

F – 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 different marginal values of life, all less than the return of the good in life, valued at the market price. (Class of 2007: 10/10)

4 Firm Theory

4.1 Firm Behavior and Profit Maximization

4.1.1. 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.

F – 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 protable, 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)

(JVM) The existence of a large and profitable secondary market for concert tickets has caused some musicians to rethink their pricing strategies, or at least to make it more costly for people to transfer tickets to someone else. This implies that bands might be pricing a bit too low, although Pr. Murphy's main point still holds. (2013 TA)

4.1.2. 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.

F – 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)

4.1.3. 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.

F – 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)

(JVM) The basic point seems to be that "more" and "less" popular are equilibrium concepts; if the less-popular videos were free, they would become very popular. Therefore, the pricing problem is to determine which demographic to target: if we have one group of very inelastic consumers, and one group of very elastic consumers, it may be more profitable to set high prices and just serve the inelastic consumers.

4.1.4. 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)

(JVM) F – We would want to observe if firms have sales around the same time, or if sales occur randomly. The former would indicate that firms are competitive and that sales occur because of some seasonal demand cycle. The latter would make us suspect that firms have market power.

In reality, we do observe industries having sales in a regular pattern. Clothing is on sale after the holidays and when the seasons change; Halloween candy goes on sale November 1. Demand cycles can explain this: prices are high when demand is inelastic: people need to buy Christmas presents or Halloween candy. People who really need a new pair of shorts for the summer have to buy in season and pay a high price. But people who are more price-sensitive might wait until the end of the season and buy for next season. (2013 TA)

4.1.5. 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)

(KES) T – Suppose that two firms are identical before they make capital investment decisions. If there is a competitive labor market in both states of the world, then the marginal product of labor will be equated across firms, regardless. However, the marginal products of capital in each firm will generally be different and so there could be a cost-saving reallocation of labor and capital. Though infeasible, a pareto improvement may therefore be possible. The reason is not that capital is unused, per se, but that the installed capital is not used as effectively as it could be used if installed in another firm. (2013 TA)

4.1.6. 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)

F – It would rather be profit-maximizing firms that are marginal, since they are the ones that are producing at a level where marginal cost equals marginal revenue. The non-profit 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 firms have a big endowment of some sort. Hence, if demand shifts down, we would see profit-maximizing firms drop out first, given that non-profit firms have endowments that they can draw upon. (Class of 2008)

4.2 Marginal vs. Average Cost

4.2.1. <mark>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.</mark>

TRUE - The first-order conditions of the cost-minimizing problem $C(w, r, y) = \min wL + rK + \lambda(y - F(L, K))$ are $w = \lambda F_L$ and $r = \lambda F_K$. We can rewrite this as $\lambda = \frac{w}{F_L} = \frac{r}{F_K}$ where λ 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)

4.2.2. <mark>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)</mark>

(JVM) T – Elasticity is always greater in the long run. Therefore, when the supply curve shifts down (thanks to the technology shock), the price will drop and quantity will expand, but in the short-run price will still be higher than in the long-run, when capital adjusts. In is true that profit will rise in the short run because firms are enjoying the benefits of the technology shock without the competitive effects of entry. In the long run, with firm entry and capital adjustment, profit for the marginal firm will go back to 0 as with any competitive industry. (2013 TA)

4.2.3. <mark>The marginal cost of producing a product is lower in the long-run than in the short-run because there are more options for how to produce that marginal unit in the long-run.</mark> (Core 2012)

(JVM) F – The main reason marginal costs are lower in the long-run is because fixed costs can be amortized over time. Fixed factors are expensive to use over short periods, but cheap over long periods because the costs of hiring and installing, etc. are spread over a longer period. This is why industries with predicable demand cycles will adjust their variable inputs more than their fixed inputs over the cycle; the number of "options" available is constant, but some of those options are just too expensive to respond to short-term fluctuations. (2013 TA)

4.2.4. ***** A reduction in the cost of producing a capital good will reduce the price of that good more in the long-run than in the short-run but will increase production**

more in the short-run than in the long-run. (Core 2013)

4.2.5. <mark>**Knowledge that productivity growth will be higher than previously expected will lead to higher stock market valuation. (Core 2002)**</mark>

F – 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)

~~**4.2.6.**~~ **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 firm lump sum tax will reduce the number of firms and prices to consumers in the long run. (GSB Final 1999)**

F – 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)

4.2.7. 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)

F – 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)

~~4.2.8.~~ 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)

(JVM) T – Pass-through is the rate at which price changes with respect to a tax. In a competitive industry, this can never be larger than 1, since firms set $P = MC$ and the marginal cost increases by the amount of the tax; thus, the price cannot increase by more than 1-for-1 (and it will do so only if demand is perfectly inelastic). In this case, pass-through is larger than 1. This means firms must have some market power, since they are apparently not setting $P = MC$. (2013 TA)

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

T – 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 prot rates. (Class of 2008)

(JVM) T – The solution above claims that more productive firms have lower marginal costs. But in equilibrium, every firm will set output so that the marginal cost of the last unit is equal to the price. Therefore, it's really the *average* costs that are lower for the more productive firms. The profit rate as defined above is

$$\frac{\text{profits}}{\text{sales}} = \frac{(P - AC) \cdot Q}{Q} = P - AC$$

therefore, firms with lower average costs have higher profits. (2013 TA)

4.3   Returns to Scale

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

F – 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, then 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 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)

4.3.2. <mark>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)</mark>

F – It depends on whether each industry requires the same ratio K/L. See previous question.

4.4 Production Factors

4.4.1. <mark>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.</mark> (Final 1999)

(JVM) F – Decreasing returns to scale means each individual firm has upward-sloping supply. In aggregate, however, we would expect that if firms have different production functions, then the industry would have more elastic supply than any individual firm. A simple example would be to suppose Leontief production functions, which have elasticities of substitution of zero. Specifically, say one firm uses 2 units of capital and 1 unit of labor to produce one unit of a good; the other firm uses 1 unit of capital and 2 units of labor. When the price of labor rises, the labor-intensive firm cuts production more than the capital-intensive firm, so on the whole the industry uses relatively more capital than it did before. Thus, the aggregate elasticity of substitution is larger than zero. (2013 TA)

~~**4.4.2.**~~ **An automobile company has economies of scope with respect to cars and trucks because its cost of product is $k + c_1 q_c + c_2 q_t$, where q_c and q_t are its output of cars and trucks, respectively. (Final 2001)**

T – 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 $(k + c_1 q_c) + (k + c_2 q_t)$, which is greater than supplying them together. Hence by supplying two products jointly, an automobile company has economies of scope with respect to cars and trucks. (Mo)

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

T – 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)

4.4.4. 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)

U – 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)

4.4.5. 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)

(JVM) U – There are other explanations for such a differential. Differences in producton functions mean large firms may enjoy higher productivity (and their size may result from their productivity advantage). In addition, large firms may have higher capital/labor ratios, meaning that MPL is higher for such firms. Finally, large firms may attract more experienced employees, who command higher wages. (2013 TA)

4.5 Changes in Factor Prices

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

(JVM) F – Profits rise if price increases more than average cost. This could occur if output demand is inelastic (so consumers bear the tax and price is more flexible) and some factors are fixed, so that by taxing a variable input, the marginal cost increases more than the average cost. (2013 TA)

4.5.2. Firms in a competitive industry may like having a union of all its workers precisely because the union raises the wages that firms have to pay workers. (Core 2012)

(JVM) T – In a competitive industry, profits can rise if an input price increases, as long as output demand is inelastic and some factors are fixed. This could be true here. Problems would arise, however, if the union exercised monopoly power over the labor inputs and extracted rents from the industry. This is always possible when a firm monopolizes an essential input to an industry. (2013 TA)

4.5.3. 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)

T – See above question. Because they gave you "the answer," it may be best to draw a picture to prove it in this case.

4.5.4. 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)

(JVM) F – In the short run, capital is fixed and demand is inelastic (people can't switch from coal to other energy sources overnight). Thus, the union makes marginal cost rise more than average cost, and the industry can profit from this increase by passing the tax to consumers. (2013 TA)

4.5.5. 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)

(JVM) U – Based on the previous questions, we know that these payroll taxes can increase firm profits, at least in the short-run. But this does not mean they actually hire more labor. However if we look at this from Pr. Mulligan's point of view, financing social services could increase demand for labor in the industries that provide those services, which are the more labor-intensive industries. Thus, while some industries will decrease labor, the aggregate employment in the economy *could* rise.

Further, firms can substitute between different types of benefits, not just between capital/labor. So we may actually see a rise in other types of benefits, rather than a reduction in employment opportunities. (2013 TA)

4.5.6. 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)

T – A monopolist cannot be made more profitable if his costs increase, because that would imply it is operating at a point that was feasible before, but produced less profit. However, a competitive industry can increase its profit if demand is inelastic and some factors are fixed (see the answers to the other questions in this section). (2013 TA)

4.5.7. 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 2008)

See previous question.

~~4.5.8.~~ **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)**

See previous questions.

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

F – (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)

4.5.10. 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)

F – See above.

~~4.5.11.~~ 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)

F – 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)

4.5.12. 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

U – 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 τ 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. (Also had a graph which simply showed that tax τ drove wedge between wage faced by firms and workers) (Class of 2008: 8/10)

4.6 Inferior Factors

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

F – To begin with, consider a normal factor under a price increase:
1. Substitution effect: less input 2. Scale effect: higher marginal cost $\rightarrow$ less output $\rightarrow$ less input
Now consider an inferior factor:
1. Substitution effect: less input 2. Scale effect: lower marginal cost $\rightarrow$ more output $\rightarrow$ less input

4.6.2. 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.

U – By definition, if the price of an inferior factor decreases
1. Substitution effect: more input
2. Scale effect: more input
On the other hand, if output increases, input decreases (because it's inferior). Hence the overall outcome is ambiguous. (Mo)

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

4.6.4. A rise in the cost of an inferior input will lower profits in a competitive market. (Core 2002)

U – See previous question.

4.7 Technical Change and Productivity Growth

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

F – All else equal, output prices should grow slowest in the sectors with the highest rates of TFP growth. This is straightforward from the dual version of the TFP equation above.

4.7.2. 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)

T – Using the equation above, $\Delta TFP = \Delta Y - s_L \Delta L - s_K \Delta K$. This yields

$$\text{Plant A:} \Delta TFP^A = 5\% - s_L^A(4\%) - s_K^A(4\%) = 1\%$$
$$\text{Plant B:} \Delta TFP^B = 6\% - s_L^B(3\%) - s_K^B(5\%) = 1\% + s_L^B(2\%) > 1\%$$

4.7.3. 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)

T – As the price of labor rises relative to the price of capital, firms should substitute capital for labor. We also know that $\Delta P = s_L \Delta w + s_K \Delta R - \Delta TFP$. 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)

4.7.4. <mark>**In the neoclassical growth model a permanent increase in productivity caused by Hicks neutral technical progress will increase the current interest rate and reduce current consumption. (Midterm 2012)**</mark>

T – A Hicks neutral shock of the form A*F(K,L) causes the marginal productivity of labor and capital to increase. Since $\rho + \delta < F_K(K, L) = r$ the returns on investing in capital are high and consumers will choose to reduce present consumption and invest in additional capital since the interest rate is above the discount rate (Class of 2011, 5/10).

4.7.5. <mark>**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)**</mark>

T – TFP growth is $\Delta Y - s_L \Delta L - s_K \Delta K$. But since capital/output ratio is rising, $\Delta K - \Delta Y > 0$. Then $\Delta TFP < (1 - s_K)\Delta Y - s_L \Delta L = s_L(\Delta Y - \Delta L) = s_L \Delta$Labor Productivity. Since $0 < s_L < 1$, TFP is growing faster than labor productivity. (Mo)

4.7.6. <mark>**With constant returns to scale, labor productivity will grow faster than total factor productivity if the real return to capital stays constant due to capital being elastically supplied. (Core 2003)**</mark>

T – The real return to capital stays constant, so $\Delta R - \Delta P = 0$. Using the equation for TFP growth,

$$\Delta TFP = s_L \Delta w + s_K \Delta r - \Delta P = s_L \Delta w - s_L \Delta P$$

Since production is CRS and labor share is constant, MPL=APL so this equation tells us that $\Delta TFP < \Delta APL$. (2013 TA)

4.7.7. <mark>**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)**</mark>

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)

4.7.8. ~~4.7.8.~~ 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 TFU question)

Productivity is growing at a constant rate in both manufacturing and services, though it is higher in the former than in the later. 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)

4.7.9. 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)

(JVM) F – The technological progress shifts the supply curve to the right. This means that the price will have to drop in the short term to ensure equilibrium. But the short-run supply curve is less elastic than the long-run curve; therefore, the short-run curve intersects the demand curve at a *lower* price than the long-run curve. In other words, price rebounds over time as capital adjusts. (2013 TA)

4.7.10. 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)

T – Rearrange the formula for ΔTFP to get

$$\Delta TFP = \Delta Y - \Delta L - s_K(\Delta K - \Delta L)$$

So in order for the growth rate of labor productivity to exceed ΔTFP, the growth rate of K/L must be positive. (Class of 2008)

4.8   Capital and Labor

4.8.1. 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)

F – 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, $\Delta L_B > 0$ and $\Delta w_B < 0$. Here, I am going to assume that per capita income the question wants is Y/L. From the four magic equations, we know that

$$\Delta Y = s_L \Delta L + s_K \Delta K$$

Since capital is fixed, $\Delta K = 0$. Substituting $s_L = 1 - s_K$ yields

$$\Delta Y - \Delta L = -s_K \Delta L$$

The left side is 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)

4.8.2. 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

U – Charging a fee to immigrants has 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 effect, 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)

4.8.3. 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

$$\epsilon_{L,R} = s_K(\sigma + \epsilon_D)$$

where $\sigma > 0$, $\epsilon_D < 0$. Hence, if $\sigma > |\epsilon_D|$, we have $\epsilon_{L,R} > 0$ 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)

4.8.4. If each firm in an industry uses labor and capital in fixed proportions then

F – I'm assuming that "fixed proportions" means Leontief production, because otherwise there is substitutability at the firm level and if relative input prices change, the industry as a whole will also have substitution. Now if all firms have the same Leontief production function, there will be no industry-level substitution. However, if some firms are capital-intensive and some are labor-intensive, raising the price of labor will affect the marginal cost of labor-intensive firms more than capital-intensive firms. Therefore, they will cut back production more than capital-intensive firms, and it will appear in aggregate that the industry has substituted from labor to capital.

(In fact, because these firms have constant marginal costs, what will happen is that the labor-intensive firms will drop out of the market and we will just have the capital-intensive firms.) (2013 TA)

4.8.5. If the rate of time preference declines with the level of consumption then a one-time increase in productivity will reduce the level of interest rate in the long run. (Midterm 2014)

T – In the NGM case, we have $1 = \int_t^\infty \exp\{-\rho(T - t)\}\frac{u'(T)}{u'(t)}[F'(k(t)) - \delta]dT$. As productivity increases, real interest rates drop as people invest more so that current consumption drops relative to future consumption. If this rise in consumption is coupled with ρ decreasing (rate of time preference declines, people are more patient), then we would expect real interest rates to drop even further, b/c people now have even more incentive to save since they don't value current consumption as much ($\frac{u'(T)}{u'(t)}$ drops even further, r drops). Consider the extreme case where as consumption increases due to productivity growth, people become indifferent b/w consumption now and consumption in the future. Then interest rates should converge to zero in the long run. (Class of 2013, 8/10)

T – Intuitively, productivity growth s akin to marginal utility from investment increasing. In the barebone neoclassical growth model. we know the following relation must hold in steady state:

$AF'(k) - \delta = \rho(c) + \delta$,

where $AF'(k)$ denotes the value marginal product of capital. When ρ is fixed ($\rho(c) = \rho$), with productivity growth (increase in A), the economy invests more (k increases) and the real interest rate ($AF'(k) - \delta$) stays constant. If $\rho(c)$ is decreasing in c, then the real interest rate drops. (Class of 2013)

4.9 Monopoly and Antitrust

4.9.1. 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)

4.9.2. If the Justice Department allows two firms 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%.

F – See the above question. Here the major concern is that the merged firm would restrict output. Since mergers are supposed to increase efficiency, we shouldn't be worried if the new firm has a larger market share than the two firms did separately.

4.9.3. 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)

F – See previous question. Don't just consider the market share!

Note that this question refers to the US vs. DuPont case whereby a cellophane firm was deemed to *not* be a monopoly because it had many substitutes and therefore little ability to further raise its price. However, the price had *already* been raised above competitive levels, to the point at which the firm ran into substitute goods and ceased to have market power. Thus, one cannot use current price or market share to determine whether a firm is anti-competitive; it is better to use some measure of cost. (2013 TA)

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

(JVM) F – Some industries (such as utilities or public transit) have sub-additive cost functions, which means they are a "natural monopoly." It is more efficient to allow such monopolies than to encourage competition. There is another reason we may not want to encourage competition. Under competition, we know that price will equal average cost. However, if AC ¿ MC, competitive firms "overproduce" relative to the social optimum where P = MC. Since monopolists always under-produce, it is unclear whether competition or monopoly is better.

4.10 Monopolistic Competition

4.10.1. 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)

(JVM) F – Companies do this all the time. Often, one complementary good is more price inelastic than another. By selling the inelastic good above marginal cost, but pricing the elastic good below marginal cost, the monopolist can increase demand on the inelastic good. This works especially well if the goods are bundled, or if the more elastic good has many substitutes but demand for the inelastic good is contingent on owning the elastic good. For instance, you might get a free printer if you buy a laptop. Why? There are many substitute brands of printer; but the ink cartridges are specific to the printer. So by giving away a printer, the company has created an inelastic demand for its ink. (2013 TA)

4.10.2. 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 post-tax. (Mo)

4.10.3. 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)

F – 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 if Microsoft is acting to create barriers to entry.)

4.10.4. 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)

F – (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 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)

F – The answer above is unclear. The logic is as follows. By bundling, a monopolist can force consumers to choose between the monopoly/competitive good bundle, and foregoing the monopolist good to buy the competitive good from another supplier. This effectively creates a price squeeze in the competitive market, since the competitive firms will have to offer discounts to attract any buyers (assuming demand for the monopoly good is high enough that people buy the bundle). Over time, competitive firms may exit the market, and the monopolist builds market power in the competitive market as well. (2013 TA)

4.10.5. 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. It may not be true that profits will rise in the short-term, unless the demand for the monopolist good is strong enough that no one is deterred by having to buy the bundle or if the monopolist can mark up the competitive good. But over time the monopolist can build market power in the competitive market.

4.10.6. (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 choose 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)

(JVM) T – Inputs I and G are horizontal complements, the "Cournot Effect" applies: when firms act independently, they do not account for the negative externality produced by raising their price. Negative externalities mean that joint welfare (profit) would be higher if the firms lowered their individual royalty rates. This is what is meant by "double-marginalization" in complementary inputs.

If the firms act jointly, they can extract the monopolist profit from the computer industry. Firms will account for the negative externality caused by raising their prices and set $r < r_1 + r_2$. (2013 TA)

4.10.7. 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)

T – 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)

T – 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)

4.11 Monopoly Taxation

4.11.1. How would switching from a per unit tax of $1 to a 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 TFU question)

4.11.2. ~~**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)**~~

(JVM) U – The statement is true as long as pass-through is less than $\frac{1}{2}$. At larger levels of pass-through, the monopolist passes on enough of the tax burden to the consumer that its profit falls by less than the government revenue. (2013 TA)

4.12 Price Discrimination

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

F – The reason it is easier to price discriminate is most likely the difference 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)

4.12.2. 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)

4.12.3. 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)

F – 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)

4.13   Monopolistic Choice of Quality

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

F – (1) Since a monopolist maximizes her profit, she uses the 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 (this is the Spence distortion). (2) A monopolist can extract the maximum surplus through first-degree price discrimination. But this rarely happens in the real world.

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

T – 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.

4.13.3. 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)

F – 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)

4.14   Cartels

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

U – 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. 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)

4.14.2. 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)

(JVM) T – With more firms in the cartel, profits are shared among more members. There is greater incentive to undercut the price and take virtually all the profit. An equilibrium trigger price must therefore decrease with the number of firms, to ensure that the incentive to deviate remains low. In the limit as the number of firms goes to infinity, the trigger price will converge to the competitive price. (2013 TA)

4.15   Mergers and Vertical Integration

4.15.1. 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.

F – 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)

4.15.2. Mergers that increase prices are socially inefficient.

F – Mergers that increases 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)

4.15.3. ==**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)**

F Most likely it is anti-competitive on consumer benefit grounds 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 grounds if the cost savings generated by the merger more than offset the loss from increased market power. (Kevin Murphy)

4.15.4. 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)

T A monopolist of an input is able to extract monopoly profits from downstream firms: it has no incentive to merge with one of those firms because there is no added benefit. The only case in which it would vertically integrate would be if it could lower the downstream firms costs, thereby raising its own profits. (2013 TA)

4.16   Network Effects

4.16.0. Section 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 peoples telephones more useful.

4.16.1. ==**A good with important network economies for its customers would have an elastic aggregate price response even though the individual consumer responses were**==

(JVM) T – If just a few consumers substitute to other goods, the value of the good for the remaining users is lower. This can result in a cascade effect whereby many users end up leaving. This is similar to Pr. Becker's theory of restaurant pricing: an unstable equilibrium can result in high uptake of the good but also high sensitivity to price changes. (2013 TA)

U – This is not necessarily true – in fact there are good reasons to believe that more often than not this will not be the case. Consider Microsoft Office. Because virtually everyone uses the .doc and .ppt file formats that are not very compatible with other processors, Microsoft is able to keep its prices high. The reason for this is that network effects can make the substitution effect very low for necessities, such that the overall elasticity gets maintained at a low level. (Class of 2013)

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

F – See previous question.

4.16.3. 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)

T – 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)

(JVM) T – This is related to both network effects and monopoly bundling of complementary goods. By pricing the internet browser (the elastic good) below marginal cost, Microsoft increases demand for the operating system and can raise its overall profit. (2013 TA)

4.17   Labor Unions as Monopolies

4.17.1. 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)

U – The sharing arrangement can help in many ways. It can eliminate inefficient capital/labor substitution because the wage is not fixed. 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 firms incentives to provide other inputs (e.g. capital). (T.A.)

(JVM) F – Since the union is a monopolist of an input to a competitive industry, by setting the right wage it can extract monopoly profit from the downstream market for the final output. The union members can never be better-off than under this arrangement. (2013 TA)

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

U – 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)

4.17.3. Capital augmenting technological progress will increase real wages more than labor augmenting technical progress that has the same impact on TFP. (Midterm 2014)

U – Note:

$$\Delta TFP = s_L(\Delta w - \Delta L) + s_K(\Delta R - \Delta K), \quad \text{and} \quad \ln\left(\frac{w_h}{w_l}\right) = -\frac{1}{\sigma}\ln\left(\frac{L_s}{L_u}\right) + \text{"bias of tech. change"} + \cdots$$

so the direction depends on the complementarity in inputs. Suppose Leontief and we now need less capital to produce the same amount of good. Then demand for labor rises and real wages rise. On the other hand, suppose inputs are very substitutable. Then demand for labor falls and real wages are depressed. (In the long-run, though, $\Delta R - \Delta K = 0$, so all ΔTFP accrues to labor.) The picture becomes richer if we introduce different types of labor. Empirically, capital augmenting technologies have favored skilled labor, whose real income rose while that of unskilled labor fell over the past century. (Class of 2013, 8/10)

Uncertain – This depends on the substitutability of inputs in the short-run. In the long-run, all technological progress will accrue to an increase in wages. Suppose initially the economy is

characterized by the pair, $(L^* = AL, K^* = BK)=($"efficiency unit of labor", "efficiency unit of capital"). When the progress occurs,

$(\Delta L^* - \Delta K^*) = \sigma(\Delta R^* - \Delta w^*).$

In the short-run, since $\Delta L = \Delta K = 0$,

$(\Delta A - \Delta B) = \sigma(\Delta R - \Delta B - \Delta w + \Delta A),$

assuming that the technological change is neutral.

$\Rightarrow \frac{\sigma-1}{\sigma}(\Delta B - \Delta A) = (\Delta R - \Delta w).$

In the long-run,

$\Delta TFP = s_L\Delta\left(\frac{w}{P}\right) + s_K\Delta\left(\frac{R}{P}\right),$

and all ΔTFP accrues to labor since $\Delta\left(\frac{R}{P}\right)^{LR} = 0$.

Note that when σ is close to 1, the augmentation breaks down. In fact, in the real world, σ happens to be close to 1 and there is also technological bias, so this factor-augmentation type of approach may not be very convenient. (Kevin Murphy, Class of 2013 TAs, Class of 2013)

4.18 Rent-Seeking Monopolists

4.18.1. *** A monopolist would be willing to pay its consumers to restrict their purchases of substitute products and consumers would be willing to accept such payments. (Core 2012)

4.18.2. 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)

T – 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)

4.18.3. 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)

(JVM) U – Entry may seem excessive in the sense that many people spend hours or years vying for success in the entertainment industry but ultimately fail, when their skills could have been put to better use in another industry. However, this does not mean the entry is socially excessive since the profits that ultimately accrue to the "winner" (not to mention the utility people get from hearing their music or watching them play sports) could outweigh the loss from the "misallocation" of the losers' talents.

However, this is not necessarily remedied by licensing. A unique aspect of entertainment industries is that talent is a scarce resource and is not easily identified. Therefore, it may be necessary to have fierce competition between many people in order to find the one star. Licensing would imply that people have ex-ante predictions of their star power, which is not necessary true.

One solution may be to license the agents – that is, limit entry into the market for finding talent. This is effectively what happens in some countries where the government has a monopoly on finding and training Olympic athletes. However, this raises questions of efficient production of talent, which is outside the bounds of this question. (2013 TA)

4.19   Advertisting

4.19.1. A law that prevents the advertising of cigarettes will raise the profits of cigarette companies, and raise the price of cigarettes. (Core 2013)

(JVM) U – As with most advertising questions, this depends on why companies advertise. If advertising is essentially wasteful rent-seeking in the sense that companies are fighting over infra-marginal consumers by trying to develop brand loyalty, then banning advertising will likely raise producers' profits because they will spend less on rent-seeking. In this case, firms might respond by competing in price rather than ads, and we might see prices drop. However, if advertising is meant to attract consumers on the extensive margin, then their profits may drop as they are now facing a more limited market. (2013 TA)

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

(JVM) U – It depends on how advertising affects the demand curve. If ads change the willingness to pay of every consumer (marginal and inframarginal), then advertising effectively shifts out the demand curve. Inelastic demand curves will result in greater change in profit than elastic demand, so there is more incentive to advertise.

However, if advertising changes the willingess to pay of the marginal consumer, but not the inframarginal consumer, then a firm would have a greater incentive to advertise when demand is elastic. This is because small price changes will greatly affect inframarginal demand, so it may be better to increase the willingness to pay of marginal consumers at the current price. (2013 TA)

4.19.3. 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)

(JVM) U – Monopolists set price so that $MR = MC$. The equation is $P(Q) + QP'(Q) = c$. This means that $\frac{1}{\epsilon_D} = \frac{P-c}{P}$. Advertising will change the marginal consumers' willingness to pay. However, if it affects all consumers equally (so that the demand curve shifts but the elasticity does not change at any given price) the firm will have higher output but the same price. If advertising affects the marginal consumer differently from the average, the demand curve could distort so that the elasticity changes at a given price, meaning that price as well as quantity could change. (2013 TA)

4.19.4. 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)

(JVM) U – The monopolist will adjust its advertising level so that the marginal cost of an additional ad equals the marginal revenue from the ad. Even if further advertising would raise consumption, this does not mean the cost is worthwhile. For instance, if advertising affects only the marginal consumer and not the inframarginal consumers, then it is less lucrative. (2013 TA)

4.19.5. 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)

F - 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.)

4.19.6. 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)

(JVM) T – This is a case where advertisers could be competing for infra-marginal consumers (e.g. to develop brand loyalty) so that in equilibrium advertising is wasteful. That is, the firms are in a sort of prisoner's dilemma situation, and both would be better-off if they agreed not to advertise. Social welfare will likely rise unless firms raise prices to extract more rents from their inframarginal consumers. (2013 TA)

4.19.7. 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)

T – 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)

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

F – A monopolist prices good at the elastic region of the demand curve. 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)

4.19.9. Advertising for a branded good X not only increases the demand for X, but it also lowers the elasticity of demand for X at the price that had been charged for X

before the advertising began. (Fall 2013 Final)

U – If the goal of advertising is to boost the demand of inframarginal consumers (those who were willing to pay at or above the price prior to advertising), then advertising lowers the elasticity of demand for X. If the goal of advertising is to attract marginal consumers (those who were willing to pay below the price prior to advertising), then increasing the willingness to pay of the marginal consumers will increase the elasticity of demand for X. (Class of 2013 TA)

4.20 Investment and Present Value

4.20.1. 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)

T – 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)

4.20.2. 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)

T – The discounted return of the project is $c + \beta c + \beta^2 c + \ldots = \frac{c}{1-\beta}$. Since w_t follows a random walk, we can assume that $w_t = E_t(w_{t+1}) = E_t(w_{t+2}) = \ldots$ and hence the discounted expected benefit of a wilderness area is $w_t + \beta E_t(w_{t+1}) + \beta^2 E_t(w_{t+2}) = \ldots \frac{w_t}{1-\beta}$. 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)

4.20.3. * An increase in interest rate volatility, holding the expected interest rate constant, would increase the net present value of projects and hence increase invest-**

ment. (Core 1995)

4.20.4. <mark>**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)**</mark>

F – This is not necessarily true. Take the case of cattle. Let's say it costs C to hold onto a cow one more period, g is the natural growth rate of cattle, and r is the interest rate. Even if $C > 0$ and $P_{t+1} < P_t$, if the growth rate g is very large, then $P_t < P_{t+1}\frac{1+g}{1+r} - C$, 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)

F – 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)

4.21 Division of Labor

4.21.1. 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)

4.22 Durable Goods

4.22.1. <mark>Rent control can reduce the demand for new housing even if the prices of new housing are not controlled. (Core 1997)</mark>

T – 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 $P_t = \sum_{j=0}^{\infty} R_{t+j} \left(\frac{1-\delta}{1+r} \right)^j$. (Mo)

4.22.2. ******* Assume cars last 10 years and that the quality of the services provided by cars declines with age. Technological changes that make the service flow decline more slowly but do not change the cost of making new cars will make consumers of old cars (primarily the poor) better-off. (Core 2012)

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

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

4.22.4. <mark>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)</mark>

T – Since $R_t = P_t - \frac{P_{t+1}(1-\delta)}{1+r}$ we have $P_{t+1} = (P_t - r_t)\frac{1+r}{1-\delta} = (2000 - 800)\frac{1.05}{.75} = 1680$.

4.22.5. <mark>If human capital production is human capital intensive, then a permanent increase in the demand for human capital in the other (non-human capital producing) sectors could reduce the quantity supplied of human capital to those sectors in the short run. (Midterm 2007)</mark>

T – This "could" happen. The suppliers of human capital will attempt to maximize their lifetime

discounted returns to human capital and this will involve a trade-off between (1) higher returns now (a higher wag in the high-demand sector) and lower returns later (because future human capital will not be highers) and (2) lower returns now (not working in the high-demand sector) and higher returns later (because human capital will have grown, future employment in high-demand sector will be more lucrative). In equilibrium,it is possible that workers will shift out of the high demand sector in she short run in order to accumulate human capital so that later they can earn higher returns in the high demand sector. Thus, short term wages in the high-demand sector could be very high to compensate workers for lower future wages relative to those with higher human capital later. (Class of 2006, 7/10).

4.22.6. <mark>Higher future demand for computing would imply lower prices of computing today. (Fall 2007 Final)</mark>

T – 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)

4.22.7. <mark>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)</mark>

F – 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)

4.22.8. 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)

T – An increase in the property tax will reduce the demand for owning a home (not renting) and hence reduce the price of housing. This decreases the investment, which decreases the stock of housing, and hence the price of housing will rebound.

4.22.9. <mark>A subsidy to new housing construction will reduce the rental price of housing more in the short run than in the long run.</mark>

F – 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)

~~4.22.10.~~ 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)

F – 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, which will increase the stock of housing, which will decrease the future rental rates. This means 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.

4.22.11. <mark>An expected future increase in demand for a good can lower price today. (Core 1999)</mark>

F – 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)

4.22.12. <mark>Higher interest rates will lead to both higher rental rates on houses and higher housing prices. (Final 2000)</mark>

F – Suppose the economy is in a steady state. In our dynamics, the higher interest rate will first lower the price. This will decrease the investment, which will decrease the stock, which will increase the rental rate. The increased rental rate will make the price rebound a bit, and by these 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 house prices. Of course, the rental rate will not be changed in the very short

run. Hence the statement is false. (Mo)

4.22.13. <mark>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)</mark>

T – 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 and hence the rental rates should be higher 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, hence the stock of capital is increasing, and the rental rates are decreasing. This means that the rental rates is increasing between 1996 and 1998 but is decreasing after 1998 to the new steady state. The price must be decreasing over this period since otherwise investment would have risen. (Mo)

4.22.14. <mark>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 prices will begin to increase. (Midterm 2009)</mark>

T – 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 $P_t = R_t + R_{t+1}\frac{1-\delta}{1+r} + \dots$ 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)

4.22.15. <mark>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.</mark>

F – 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)

F - We think the above note has some typos. We think it should say:"Since the income, price and supply elasticities are all the same, the steady state (or long run) effects [on prices] will be the same for both the durable and the non-durable. In the short run, the price of the durable falls more (both rental and capital), and hence [investments] fall more." (Class of 2013)

4.22.16. 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)

T – 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. (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. Futher, 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)

4.22.17. An increse in the cost of feeding cattle will raise the price of beef. (Final 2013)

U – An increase in the cost of feeding cattle will depress long-run supply (stock) and raise the price of beef in the long-run. If demand inelastic, ranchers will simply shift the cost of raising cattle onto consumers by charging a higher output price. If demand elastic, then stock has to decrease in the long-run. Rather than putting in the cost, ranchers may kill more cattle in the short-run than

they had been doing before, and so the price of beef may actually fall in the short-run before rising back up again toward the new steady state price. (Class of 2013, 8.5/10)

Impact on the steady state stock of capital?

Same. Note that in the following relationship,

$$\underbrace{P_t}_{\text{tax here?}} = \sum_\tau \left[\frac{(1-\delta)}{(1+r)}\right]^\tau \underbrace{R_{t+\tau}}_{\text{tax here?}} ,$$

it doesn't matter which side we multiply by 10%. The steady state stock of capital decreases by the same amount. The difference lies in the fact that the investment tax is paid up front whereas the rental rate tax is paid over time.

Does investment tax raise less revenue in transition?

Yes. Investment drops by a lot one time. The decrease to the steady state is then borne by depreciation–but you aren't taxing what's already there. Tax on the rental rate, on the other hand, raises more revenue. (Class of 2013 TA, Class of 2013)

4.23 Exhaustible Resources

4.23.1. The US has greatly increased its production of natural gas because of fracking techniques. If US regulations prevent this increased production of gas from being exported, the US domestic price of gas will fall. Market forces will also make the international price of gas fall to US levels. (Core 2013)

(JVM) F – Domestic natural gas is perfectly substitutable with imported gas. Therefore, if the domestic gas must be sold within the US, it will displace imported gas but will sell at the international market price. The world price of gas will fall because global supply has increased, but the domestic price will not fall relative to the world price. (2013 TA)

4.23.2. The loss to consumers from a tax on natural gas usage is less if individuals are able to at least partially avoid the tax by substituting to fuel oil. (Final 2011)

U – A tax on gas will decrease demand for gas and increase demand for oil, if they are substitutes. But this will drive up the price of oil. The more inelastic the supply of oil, the greater the price increase. So the loss to the consumer may not decrease since the rise in the price of oil imposes a loss

to surplus as well.

This is further complicated by possible supply-side effects; for example, if oil and gas are produced jointly, then increasing production of oil will further increase production of gas, driving the price of gas down, so that substitution to oil is mitigated. (Class of 2011 - 9/10)

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

F – 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 $\frac{P_{t+1} - C_{t+1}}{P_t - C_t} = 1 + r$. 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.

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

U – 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 a 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 times j and i are the same, then the monopolist's prices are the same as competitive prices. (Class of 2007: 7/9)

4.23.5. 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 $\frac{SP_0 - TC}{1+r}$. 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 to-

tal cost of the oil that is beneficial to extract, i.e. up to the point where $P = MC$. (Class of 2008, 8/10)

4.23.6. If there are inventories of oil held by private companies, the future price for oil the next 3 months must be higher than the present oil price by no less than the foregone interest on these holdings over the next 3 months. (Fall 2013 Final)

U – According to Hotelling's rule, price should rise at the rate of interest: $\frac{p_{t+3}}{(1+r)^3} = p_t$. But Hotelling's rule often does not work in the real world. The two reasons we covered in class are: 1. cost of extraction is not constant; 2. there occur unexpected supply discoveries. In this question, inventory holdings are assumed. Firms need to extract more than they sell in order to hold inventories, and so if extraction costs are constant then this depresses the future price increase below the interest rate (by the marginal extraction cost times the interest rate). But if consumers like firms holding inventories then this raises the future price (by the marginal demand premium times the interest rate). Therefore, the net direction of the impact of inventory holdings on the rate at which future oil prices grow depends on the relative magnitudes of these two countervailing forces. (Class of 2013 TA)

5   Other Topics

5.1   Incentives, Copyrights, and Patents

5.1.1. Consumers would be better off if they don't have to pay authors to copy copyrighted works.

U – 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)

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

U – 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)

(JVM) F – Drugs incur huge fixed costs for research and development. They also have inelastic demand because only need them when they are sick, and then they can't go without. Pricing at marginal cost means the firm would never recoup its fixed costs, so it would be an unprofitable industry. Monopoly pricing allows firms to charge high prices (because of inelastic demand), which basically prevents market failure. (2013 TA)

5.1.3. 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)

5.1.4. 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 has 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)

5.1.5. 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)

F – 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.)

5.1.6. 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)

(JVM) F – The risk-sharing is different in each case. In the first case, the worker takes on the risk of the project being difficult. In the second case, the firm takes on that risk. Depending on information asymmetries, either one could be more efficient. (2013 TA)

5.1.7. 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)

U – 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)

5.1.8. 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)

F – 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.)

5.1.9. 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)

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

5.1.10. 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)

T – 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). (T.A.)

5.1.11. 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 ow 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)

T – 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.)

5.1.12. 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)

T – 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)

5.1.13. 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)

(JVM) F – While the costs might equal the monopoly profits, it is not true that profits equal consumer benefit. A monopolist is not able to extract all consumer surplus unless it can perfectly price-discriminate. This is particularly true for pharmaceutics, where demand is inelastic. (2013 TA)

5.1.14. 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)

U – 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)

5.1.15. 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)

U – 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)

(JVM) T – The purpose of a patent is to incentivize the expensive R&D for developing a good, so that the firm can recoup its fixed costs. If demand shifts, that means the firm will earn greater monopoly profits each period it has the patent. Therefore, the patent does not need to be in effect as long. Whether or not deadweight loss decreases is irrelevant. (2013 TA)

5.2 Externalities and Learning by Doing

5.2.1. Suppose a competitive industry with learning by doing. In particular, assume that the productivity of any firm depends partly on the aggregate output of firms in the industry in the last 5 years. Then each firm would equate its current marginal cost to market price, and the industry would under-invest in learning by doing. (Midterm 2012)

T – Given that there are many competitive firms, and it is *aggregate* output of the firms over the last 5 years, individual firms will under-invest. Each firm will choose the level of production where price equals marginal cost minus the tiny effect that unit has on 5-year industry output (which is second order and assumed = 0). Firms do not account for the benefit their production has on the other firms, and thus there is an unpriced positive externality. If firms could costlessly contract, they would all agree to produce more output. (Class of 2011 - 10 / 10)

5.2.2. If workers are learning through working on the job, they would choose to work longer hours at younger ages than at middle ages even though their hourly earnings are lower at yunger ages. (Final 2006)

U – It is true that relative to young workers in a world without learning on the job, younge workers will work more in a world with learning on the job. But comparing young and middle-aged workers is indeterminate. Learning on the job yields greater benefits when the worker is young (if the benefits do not expire over time) because the worker reaps the benefits of the learning over a longer period. But the higher wages later in life hav a price effect that (all other things equal) will lead workers to work longer hours than when their wages were lower (of course, the income effect works in the other direction). Thus, either of these effects could dominate, depending on the market. (Class of 2006, 10/10).

5.2.3. In competitive labor and product markets, firms would not provide on-the-job training that is equally useful in all firms in the same industry since the other firms in the industry would bid away these workers by offering them higher wages. (Midterm

2012)

F - Firms may offer job training, but jobs that include job-training will pay lower wages. Workers will still accept these jobs if the "total compensation" of wages and higher discounted future wages are equal to the wages at the firm with no job-training. The worker may later leave to take advantage of his new skill set, but this would not hurt the firm offering training. (Class of 2011 - 7 / 10)

5.2.4. Suppose drivers have the choice of two roads for making a given commute and those roads are subject to congestion. The introduction of a toll on one of the two roads will make some drivers worse-off. (Core 2013)

(JVM) T – We have a basic externality problem here: each additional car on the road lowers the commute time of others because it clogs the road just a little bit more. Without any tolls, we might assume that the two roads will each get crowded to the point where the commute time is equal no matter which route a driver chooses. A toll will force a trade-off between paying for a shorter commute or sitting in more traffic "for free." Those with a low value of time will likely take the free road, and those with a high value of time will take the toll road. We can also assume that the free road will now take longer than before, since there will be more cars on it. Thus, those people who choose not to pay a toll will be worse-off, because they are spending even more time in traffic than before. (2013 TA)

5.2.5. 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)

F – 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)

5.2.6. 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)

F – 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. (Mo)

5.2.7. 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)

F – 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 a sense, with a higher wage. (Mo)

5.2.8. 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)

F – 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 compensated. (Mo)

5.2.9. 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)

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

5.2.10. 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)

F – 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)

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

F – 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)

(JVM) F – I believe what Mo is trying to say is that the shopping mall owner does not behave like a price-discriminating monopolist because they do not charge rent based on a store owner's reservation value. A price-discriminating monopolist would charge each consumer their willingness to pay. However, a shopping mall owner wants to maximize profit in the presence of externalities. As Mo says, some stores will attract a wide variety of consumers ("anchor stores") and the mall may subsidize these stores with low rents. Other stores may be specialty shops, and the mall may charge high rents and extract most of their profit. Thus, the mall is price discriminating but not like a typical monopolist. (2013 TA)

5.2.12. The negative externalities of a claim-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)

F – Auctions can be efficient. But I question whether the land rush really presents any externalities. If we randomly assigned property rights, market forces would then result in an efficient allocation anyway. In other words, the pioneer who stakes out the land can later sell to the highest bidder, so the efficient allocation can result either way. (2013 TA)

5.2.13. 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)

U – 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)

5.2.14. 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)

F – 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)

5.3 Coase Theorem

5.3.1. 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)

F/U – 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 Theorem 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)

5.3.2. 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)

F – 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.

5.3.3. 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)

F – See previous question. The marginal disutility would be greater.

5.3.4. 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)

F – 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.

5.3.5. 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)

F – 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)

5.4 Residential Location

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

(JVM) F – The classic model of wages and commuting distance predicts that those with the highest wages will live in the center of the city, because their value of time is highest and their commuting time will be shortest. Rent will also decrease (at a decreasing rate) as people move further from the city center. (2013 TA)

5.4.2. Assume that all workers commute to a central city. The total cost of commuting for each consumer is $D \cdot W$, were 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)

T – An individual maximizes $U(X, L)$ subject to $X = A + w(T - D - L) - R(D)$ where X is consumption (price normalized to 1), L is labor input, A is asset holding, w is wage, T is total time available, D is commuting time (distance), and $R(D)$ is the rent at distance D. FOC's are

$$\frac{\partial U}{\partial L} = \lambda w$$
$$\frac{\partial U}{\partial X} = \lambda$$
$$w = R'(D)$$

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.)

5.4.3. 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)

T – See above question.

5.4.4. 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)

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

5.5 Education and Human Capital

5.5.1. If all individuals in the economy are identical in every way and have access to the same strictly concave technology for investing in human capital then in equilibrium all individuals will make the same human capital investment choice. (Midterm 2012)

F – Consider a world with two types of labor "high skill" and "low skill," and a worker can become high skill for monetary cost C, but is otherwise low skill. Further assume that after choosing schooling levels the workers work a single period and then die. If production requires both high and low skill workers, workers will choose to educate until $I_{HS} - C = I_{LS}$, or in other words, until the expected lifetime earnings are equal between levels of education.

Assuming that output for society is greater using a mixture of high and low skill, we demonstrate the classic example that gains from specialization drive specialization, not necessarily underlying human differences. (Class of 2011 - 8 / 10)

5.5.2. 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)

U – 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 \$5,000) 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)

5.5.3. 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 is 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)

U – 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)

5.5.4. ==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)==

F – 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.

5.5.5. If everyone gets utility from a college education, the equilibrium return on a college education is less than the interest rate. (Midterm 2014)

True – Suppose an individual lives for two periods $t \in \{0,1\}$ given wealth endowment today W_0 and she maximizes the present value of consumption plus utility from education:

$\max_E (W_0 - E) + \frac{C_1(E)}{1+r} + V(E)$.

$\Rightarrow$ foc $[E_0] : C_1'(E) = (1+r)(1 - V'(E))$.

Thus $V'(E) > 0 \Rightarrow C_1'(E) < 1 + r$: The equilibrium return from from college education is the interest rate minus the future value of direct marginal utility from education. Intuitively, people invest more in education than what the credentials can fetch on the market in terms of salary because people derive direct utility from education (e.g. think of art history majors; or you and me getting a PhD instead of making bank). (Class of 2013)

5.5.6. Faster rates of productivity growth in the sectors that employ primarily col-

lege graduates will tend to increase the return to education. (Midterm 2014)

True – Consider the relation,

$(\Delta L_s - \Delta L_u) = -\sigma(\Delta w_s - \Delta w_u) + TB_s,$

where TB_s represents technological bias toward skilled labor (which can be derived from the economy-wide production function, $F(L_u, L_s)$). Faster rates of productivity growth means $TB_s > 0$. Imagine that the labor shares are fixed initially. When the technological change hits (TB_s increases), the wage differential ($\Delta w_s - \Delta w_u$) must increase by the same amount to satisfy the relation (assuming labor shares are fixed in the short-run). Over time, the share differential (the left-hand side) will also respond and increase (e.g. more people will go to school), but it will still leave the magnitude ($\Delta w_s - \Delta w_u$) greater than before the technological change. (This last bit of reasoning is by the principle of optimality: the share differential cannot grow so large as to decrease the wage differential after the technological change, because even before the technological change the economy could employ more skilled labor but did not.) Thus faster rates of productivity growth in sectors that employ primarily college graduates will tend to increase the returns to education. (Class of 2013)

5.6   Economics of Aging

5.6.1. Suppose that consumption by an individual falls off sharply upon his retirement. This contradicts a theory based on exponential discounting since this theory implies individuals would save "enough" for retirement. This theory also implies that the reduction in consumption of different goods after retirement should depend simply on their income elasticities of demand. (Final 2011)

F – An individual consumes not only goods but also leisure. Therefore, a person may discount exponentially and save for retirement, while consuming material goods (sports cars, gourmet food) when working and leisure (vacations, cultural events, golf) when retired. The reduction in consumption is not just related to income elasticity, because the full income changes upon retirement - time becomes cheaper and goods become more expensive, so there is a price effect that also explains the consumption change. (Class of 2011 - 8/9)

F – Agents may shift towards houshold production or leisure upon retiring as the market value of their time is much lower upon entering retirement ahd they will re-optimize towards time-intensive rather than money-intensive tasks.

F – The fall in consumption might still obey rational behaviour with exponential discounting, since the individual can substitute consumption with more household production goods. This happens because wage falls, so the cost of household produced goods goes down. The second part of the

question is also false, since retirement produces substitution effects (as mentioned before, the cost of time goes down) and not only income effects. (Class of 2011 - 8/9)

5.6.2. 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)

F – 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)

5.6.3. 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)

F – This statement does not take into account the price effect. Retirees 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)

5.6.4. 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 now effectively poorer than they otherwise would have been. (Core 2008)

U – 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)

5.7   Matching

5.7.1. *** Suppose a marriage market where men and women both differ only in education, and where there is transferable utility between men and women in marriage. With a marriage market competitive equilibrium, an increase in the number of men with low education would necessarily lower the utilities from marriage of both high and low educated men, and raise the utilities from marriage of both high and low educated women. (Core 2013)

5.7.2. Suppose there is transferable utility in marriage. Divorces will increase when the divorce law changed to a system where the consent of both husbands and wives is required to receive a divorce to a system where either party can divorce without getting the approval of his or her mate. (Final 2006)

U – This result may be true if there is reason to believe that the Coase Theorem cannot apply. BUt since we assume that utility is transferable in marriage, we need only assume that couples can bargain at low cost to transfer utility, and then we will see little or no change in divorce rates after the legal change. This is because if, for example, the husband gains more from staying in marriage than the wife gains from leaving it, in an at-will divorce regime (ie, one with no consent required) he will compensate her to stay in the marriage, leading to the same outcome as in the consent-divorce regime. Likewise, if the husband gains less from staying in than the wife from leaving, the wife will compensate the husband to obtain his consent in the divorce, in a consent-divorce regime, leading to the same outcome as an at-will divorce. (Class of 2006, 10/10).

5.7.3. Suppose equilibrium in a marriage market with an equal number of men and women and monogamy. Men and women differ only in education, and there is positive assortative matching. Then the private gain to a male from increasing his education exceeds the social gain because the gain in the marriage market to the male from getting

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more education is partly at the expense of other males in the marriage market since he would move ahead in the education ranking of males. (Core 2012)

F – Because we have positive assortative matching, it is efficient for the most educated female to marry the most educated male, and so on. By increasing his education, a man *may* move ahead in the ranking (but may not). For clarity, suppose a man moves from the nth ranking to the 1st. This produces multiple social benefits. First, the top marriage is even more productive than before, because the man is now better-educated. In addition, the 2nd through n^{th} marriages are also more productive than they used to be, since each of those women is now paired with a better-educated man. The remaining marriages are unchanged. So there are actually "spillover" benefits of more education. (2013 TA)

5.7.4. * Consider a marriage market where males and females have one characteristic, years of schooling. There is transferable utility, and the martial output function is increasing in the schooling of each spouse, and the cross-derivative with respect to each spouse's schooling is positive. Then each person would invest too much in years of schooling from an overall efficiency perspective since a person's equilibrium mate depends only on his or her ranking in the schooling distribution of members of their sex. (Midterm 2012)**

5.7.5. Consider a marriage market where participants differ only in education E. Marriages produce income through a supermodular function, and income is fully transferable. Each M and F has fully separable utility over the income they receive and the education of the spouse. If the utility is increasing in the spouse's E, there would not necessarily be positive sorting in equilibrium. (Midterm 2014)

F – Let $Z = Z(M,F)$ represent a function of household production given male and female education levels M and F. If utility is increasing in the spouse's E, this will deepen the effect of supermodularity on encouraging positive assortative matching. Note that the conditions $\frac{\partial Z}{\partial M}, \frac{\partial Z}{\partial F}, \frac{\partial^2 Z}{\partial M \partial F} > 0$ of supermodularity already imply that utility is increasing in the spouse's education for those who are getting a positive surplus from their marriages. Furthermore, the spouse who has the higher bargaining power further benefits. Consider the low female and low male, with $N_m > N_f$. The female spouse could get $Z(M_l, F_l) + U(M_l) + U(F_l)$, i.e. make the low male indifferent between marrying and not marrying (whose utility is assumed 0), and bargain away the male's surplus from the female's education. (Class of 2013, 7/10)

(JVM) Grading rubric was: 4-6: False, but did not discuss impact of U(E). 6-8: False, explained well. 9-10: Mentioned the case of non-identical valuation (what could happen if some people valued education more than others?) (Class of 2013 TA)

5.8   Miscellany

5.8.1. 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)

F – 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)

5.8.2. 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)

F – 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 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)

5.8.3. * 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)**

U – 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)

5.8.4. 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)

F – Many teams that were in the $52 to $62 million range in salary would be strictly worse off due to the new policy and will let go some of its players. After all, if they agreed to pay the tax instead, they would be spending more than $62 million for the same amount of talent as before, which means they should have hired more talent in the first place. 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)

5.8.5. 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)

(JVM) F – We want to maximize the expected number of terrorists for a fixed number of cars stopped. Stopping car B yields twice the probability of finding a terrorist. Therefore, every car stopped should be B. This will surely let some terrorists get away in cars of type A, but it will yield more terrorists, on average, overall. (2013 TA)

5.8.6. Interior house temperatures in the winter should be higher in colder climates even if individuals place the same value on higher interior temperatures in both warmer and colder climates as long as individuals can increase the energy efficiency of their homes (Final 2011)

F – A household will set the interior temperature of their house so that the marginal benefit of spending another dollar on heating is equal to the marginal benefit of spending that dollar elsewhere: $\frac{\partial U}{\partial Temp} = p_{temp}\lambda$.

Heating the same house to the same interior temperature when its colder outside will be more expensive, but maybe houses in cold climates are more energy efficient. Thus. it may be cheaper to heat the hous to a warmer temperature. It is uncertain how these two effects play out. Thye *could* be warmer. but won't necessarily be warmer. (Class of 2011, 7 / 10)

A   Notes on Durable Goods

Remember these equations:

	Interpretation	Discrete Time	Continuous Time
1	Market clears	$S_t = D(R_t)$	$S_t = D(R_t)$
2	No-arbitrage condition	$R_t = P_t - \frac{P_{t+1}(1-\delta)}{1+r}$	$R_t = (r+\delta)P_t - \dot{P}_t$
3	Investment determined by price	$I_t = I(P_t)$	$I_t = I(P_t)$
4	Stock flow equation	$S_t = I_t + (1-\delta)S_{t-1}$	$\dot{S}_t = I_t - \delta S_{t-1}$

Table 1: Durable Goods Equations

Steady-state equations:

1. $\bar{S} = D(\bar{R})$

2. $\bar{R} = \bar{P}\frac{r+\delta}{1+r}$

3. $\bar{I} = I(\bar{P})$

4. $\bar{I} = \delta \bar{S}$

Rate of convergence:

- $\epsilon_D \to 0 \Rightarrow$ fast convergence (people can't do without good)

- $\epsilon_S \to \infty \Rightarrow$ fast convergence

- $\delta \to 1 \Rightarrow$ fast convergence (good doesn't decay)

- δ is the *minimum* rate of convergence, because no economic response means the economy naturally converges at rate δ