Economics 3250 Dr. Lozada
Spring 2021 Final Exam

This exam has 50 points. There are ten questions on the exam, each worth 5 points.

Put your answers to the exam on blank sheets of paper, preferably white. (They may be lined or unlined.)

You have two hours to take this test.

After the test is over, e-mail your answers to me as soon as possible.

Answer the questions using as much precision and detail as the time allows. *Correct answers which are unsupported by explanations will not be awarded points.*

More exam rules:

- Turn on your smartphone Zoom video feed so I can see you and your computer screen as you work. I understand that when you have finished your exam, you might have to close your smartphone's Zoom app in order to take pictures of your exam to send to me. If you have not been able to send me your exam by 3:35, please turn Zoom on (either on your smartphone or on your computer) so I can see you and talk to you about any technical problems which are causing the delay.
- Any time during the exam, you can call me on my landline at 801-883-0134 if you have questions. (If it's busy, I'm talking to one of your classmates; just call back a bit later.)
- Take your exam using black ink.
- Write nothing within about 1/8 inch of the edges of the paper.
- Do not put the answer to more than one question on a single sheet of paper.
- Make sure that each of your answer pages has the question number on it near the top. For example, "Qu. 3" or "Qu. 2 continued" or "Qu. 3 page 2."

- You should send me your exam in the form of a single PDF file. Arrange your answer sheets in the correct numerical order before preparing the file.
- Put your name on the first page of your exam.
- E-mail the finished PDF file to `lozada@economics.utah.edu`.

Scanning instructions over $\longrightarrow$

- Retain your original paper copy of your answers in case there are legibility problems. You may have to mail me the originals, though this is not likely.

Instructions on how to scan your exam with a smartphone.

Android

Scan a document

1. Open the Google Drive app.
2. In the bottom right, tap Add.
3. Tap Scan.
4. Take a photo of the document you'd like to scan.
   - **Adjust scan area:** Tap Crop.
   - **Take photo again:** Tap Re-scan current page.
   - **Scan another page:** Tap Add +.
5. To save the finished document, tap Done ✓.

iPhone

Step 1: Locate the Files app on your phone. That's where you can view all of your iCloud files so you're not dancing the document shuffle.

Step 2: With the app open, select the i*Cloud Drive* location.

Step 3: Swipe down on the screen and tap the three-dot *More* icon.

Step 4: Select *New Folder*, name your folder *Scan* and then tap *Done*.

Step 5: From your new *Scan* folder, swipe down again to tap the three-dot *More* button and select *Scan Documents* to activate the camera.

Step 6: Position the document on a surface and hover the phone above it until it's recognized by the Camera app. The document is highlighted in blue. Most often, the app will take the photo automatically, but there's also a shutter button in case it doesn't grab your document right away.

Step 7: Tap the *Save* button and your scan goes into the *Scan* folder, where it will be visible everywhere you can access iCloud. From there, you can tap the document to rename it.

Scanning multiple documents in sequence

Step 1: Arrange your documents in a stack so they're scanned in order, one after the other.

Step 2: After the camera shoots the first page, the app reads *Ready next scan* along the bottom. Remove the first page so it can capture the second page.

Step 3: Repeat Step 2 until you finish all scanning.

Step 4: Tap *Save* and all your scanned pages will save to a single document. A badge will indicate how many pages are included.

Don't worry about getting the scanning angle right, as the app will automatically correct the view to flatten the scan. When you view the finished scans, they will be properly aligned with a high-quality representation of the contents.

After completing your scan, there are even more options you can tweak. Just tap on the page at the bottom left and use the trash can icon to delete a page completely. The *Retake* button lets you fix a single page in a series without having to restart a multi-page scan. You can further crop or alter the document edges, use a filter, or rotate it so it looks exactly the way you want it.

Answer all of the following ten questions.

1. In Figure 1, label and thoroughly explain each one of the four features that are labelled with question marks. (This is, explain why each feature is what you say it is, and explain what each feature means.)

2. An example of the "Condorcet Paradox" is:

   - Voter 1 ranks Clinton above Bush above Perot.
   - Voter 2 ranks Perot above Clinton above Bush.
   - Voter 3 ranks Bush above Perot above Clinton.
   - Clinton vs. Bush: Clinton wins.
   - Bush vs. Perot: Bush wins.
   - Clinton vs. Perot: Perot wins.

   What does this have to do with our course?

3. Economists criticize Contingent Valuation for being vulnerable, in some situations, to respondents misrepresenting their preferences, either by overstating or by understating their Willingness (and ability) to Pay or their Willingness to Accept. How might an evolutionary biologist construct a defense of contingent valuation against these criticisms, by questioning whether respondents really are eager to misrepresent their preferences?

4. (a) Using Figure 2 below, suppose that pollution victims have the right to clean air. Explain why, according to the "Coase Theorem," output would end up at $Q = 1$.

   Also: state the assumptions needed for this argument to be true.

   (b) Using Figure 2, suppose that pollution victims have the right to clean air. Explain why, if diminished income causes pollution victims to be less willing and able to spend money on environmental quality (and so *increased* income would cause pollution victims to be *more* willing and able to spend money on environmental quality), output would end up at $Q < 1$ despite your answer to part (a).

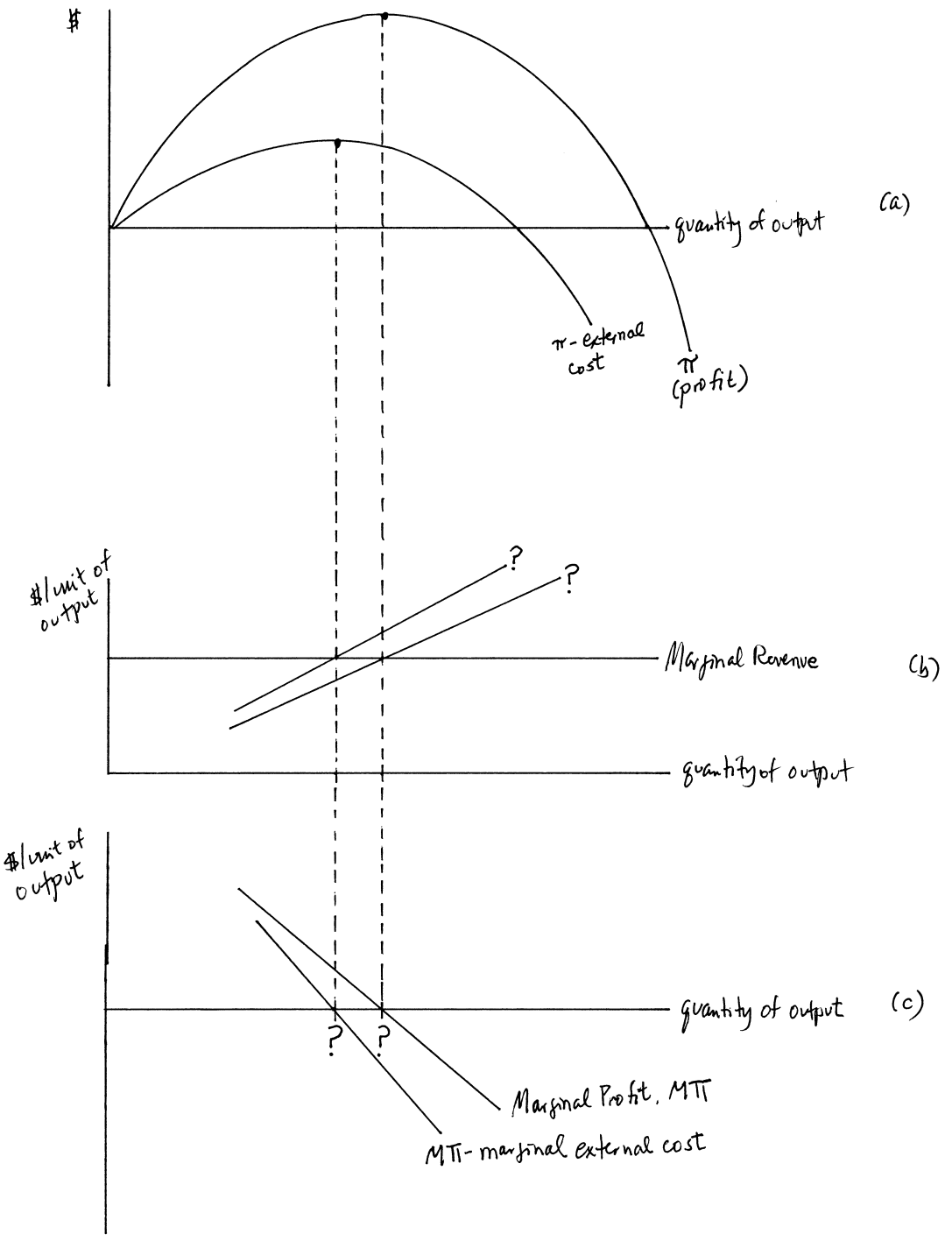

$
quantity of output
(a)
π - external cost
π (profit)
$/unit of output
?
?
Marginal Revenue
(b)
quantity of output
$/unit of output
quantity of output
(c)
?
?
Marginal Profit, MΠ
MΠ - marginal external cost

Figure 1

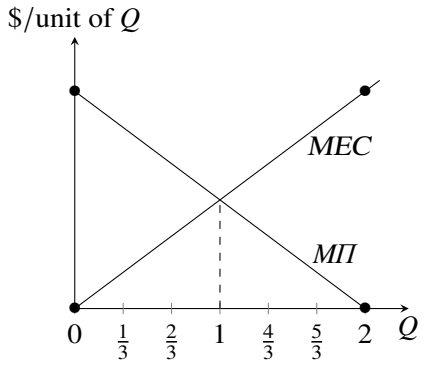


Figure 2. Marginal External Cost is *MEC*; marginal profit is *MΠ*; and the output of the commodity which causes pollution is Q.

5. Suppose:

   - an industry contains only two firms *A* and *B*;
   - each firm currently emits 10 tons of pollution;
   - Firm *A*'s marginal abatement costs are \$80/ton and Firm B's marginal abatement costs are \$100/ton;
   - the socially optimal total amount of pollution is 18 tons;
   - a "command and control" policy will require equal reduction of pollution by both firms;
   - a "tradeable permit" policy will use grandfathering.

   Using these numbers, show that a tradeable permit policy is more efficient than the command-and-control policy.

6. Illustrate the use of the McKelvey Box in the debate between "Malthusians" and "Ricardians" (also called "resource pessimists" and "resource optimists").

7. In what way might illegal dumping of garbage be a reason not to adopt a "waste disposal charge" (or "user charge") for municipal solid waste?

8. If Arctic permafrost melts, it releases methane. How could this constitute a "tipping point"? A tipping point of what? How? What is a tipping point anyway?

9. What does $2\ O_3 \xrightarrow{Cl^-} 3\ O_2$ have to do with this class? Is the solution for this problem easier or harder than the solution to global warming/climate change? Why?

10. Contrast the "Cornucopian" and "Deep Ecology" schools concerning:

    (a) how worried they are about resource scarcity, and why; and

    (b) the basis of their ethics.

Answers to Final Exam, Econ. 3250, Spring 2021

1. Refer to Figure 3.

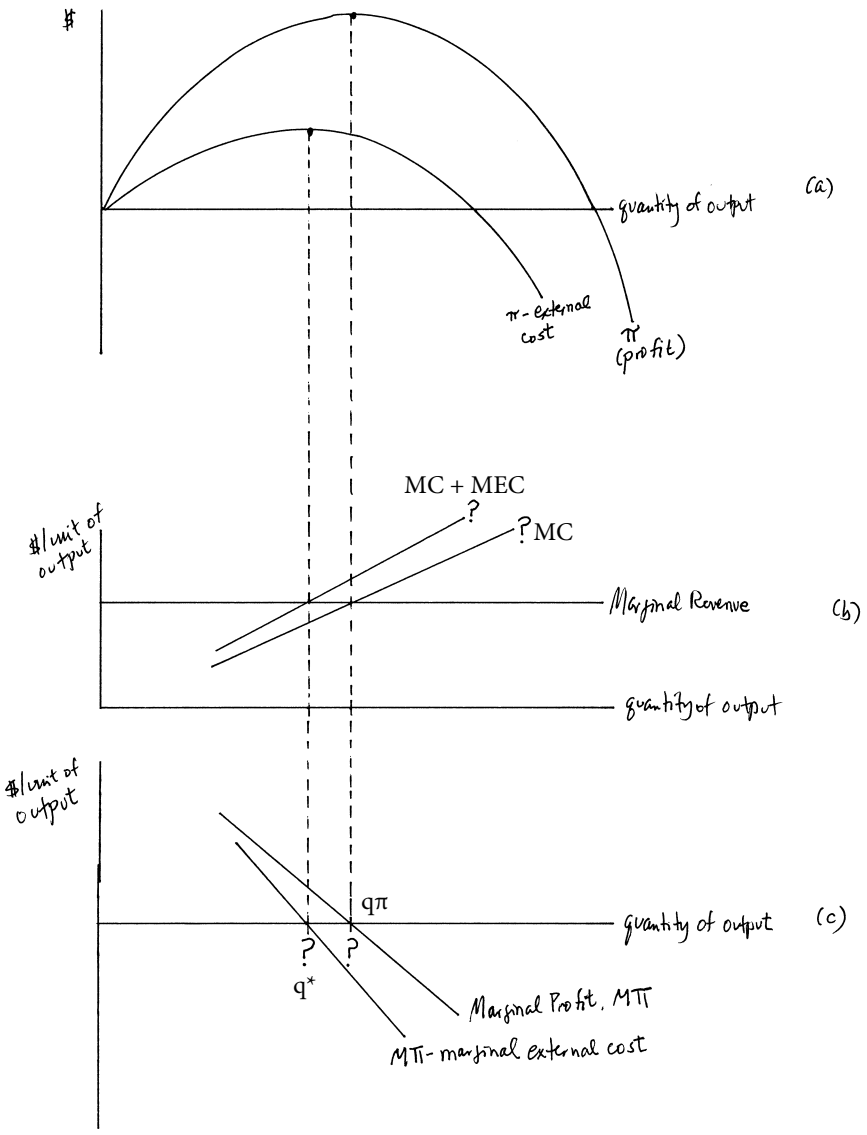
   In the bottom graph, q^π occurs where, in the top graph, profit π is maximized. This is where the tangent line to π is horizontal; the slope of horizontal lines is zero; therefore the slope of the tangent line to profit is zero. "The slope of the tangent line to profit" is marginal profit. So at q^π, marginal profit is zero. This ties the top and bottom graph together. To get the middle graph: at q^π, marginal profit is zero; but marginal profit is always marginal revenue minus marginal cost; so at q^π, marginal revenue minus marginal cost must be zero; so MR must equal MC; which is why the middle graph shows MR being equal to MC at q^π.

   In the bottom graph, q^* occurs where, in the top graph, "profit minus external cost" is maximized. This is where the tangent line to $\pi - EC$ is horizontal; the slope of horizontal lines is zero; therefore the slope of the tangent line to profit is zero. "The slope of the tangent line to 'profit minus external cost' " is "marginal profit minus marginal external cost." So at q^*, marginal profit minus MEC is zero. This ties the top and bottom graph together. To get the middle graph: at q^*, marginal profit minus MEC is zero; but marginal profit is always marginal revenue minus marginal cost; so at q^*, marginal revenue minus marginal cost minus MEC must be zero; so MR must equal MC plus MEC; which is why the middle graph shows MR being equal to MC plus MEC at q^*.

   The socially-optimal level of output is q^*; the firm wishes to go instead to q^*, which maximizes its profit, since it does not care about external cost.

2. Spring 2012 Ex. 1 Qu. 2

3. Many evolutionary biologists think species can be more successful when individual members of the species (such as single human beings) act in a way which is unselfish, sometimes hurting the individual, as long as such unselfish behavior helps enough other members of the species. This is the idea of "group selection": evolution and "survival of the fittest," these biologists believe, function at the level of groups, not at the level of individuals. Truth-telling instead of lying, is, in the context of some contingent valuation surveys, bad for some individuals; but truth-telling usually makes the group of humans more likely to survive, so those individuals may be biologically prone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(b)
quantity of output
$/unit of output
qπ
quantity of output
(c)
?
?
q*
Marginal Profit, MΠ
MΠ - marginal external cost

Figure 3

to tell the truth even if it hurts them as an individual. This contradicts most economists' standard model of humans, which is that they are always selfish.

4. This is a variation of Econ. 3250 Spring 2020 Exam 1 Question 6; it only differs in its initial assignment of property rights.

   (a) If pollution victims have the right to clean air, production will initially be at $Q = 0$ in Figure 2. There, $MEC = 0$ and $M\Pi$ is much higher than zero, at the black dot on the $M\Pi$ curve. Because $M\Pi$ represents the firm's willingness and ability to pay for pollution increases (which imply output increases, in this model), the firm would be willing and able to pay any amount less than the black dot in return for a marginal increase in Q above $Q = 0$. Pollution victims would be willing to accept any payment higher than $MEC = 0$ in return for a marginal increase in Q above $Q = 0$. So any payment from firms to pollution victims between the black dots at $Q = 0$ would result in a mutually-beneficial marginal increase in Q.

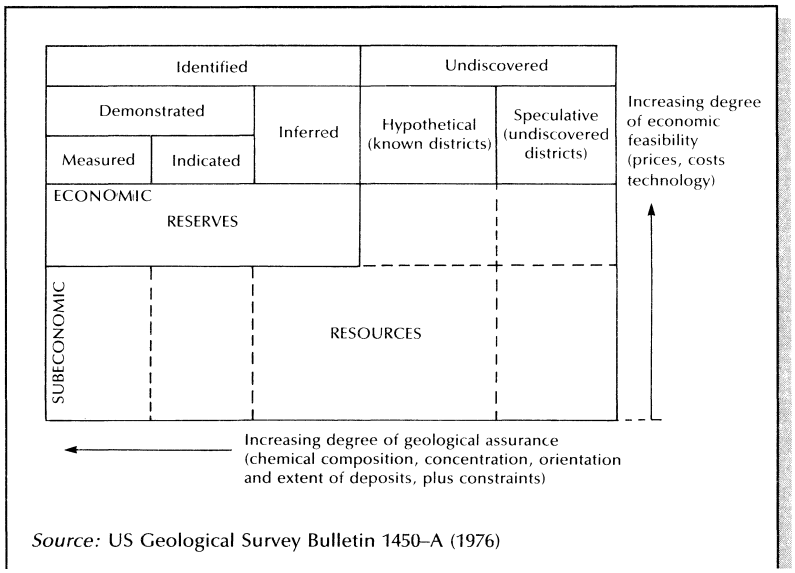
   This logic actually holds not only for $Q = 0$ but for all values of Q between 0 and 1, because for those values of Q, $M\Pi > MEC$. So there are mutually-beneficial ways of getting to $Q = 1$. However to the right of $Q = 1$, $M\Pi < MEC$, so the firm's willingness and ability to pay for further pollution increases (values below $M\Pi$) have no overlap with pollution victims' willingness to accept payment for further pollution increases (values above MEC). So Q will remain at 1.

   This requires costless bargaining (also known as "no transactions costs") and no strategic behavior on the part of firms or pollution victims, as well as well-defined property rights.

   (This analysis implicitly assumes the MEC curve represents the pollution victim's "willingness to accept," WTA, rather than their "willingness (and ability) to pay," WATP/WTP. In situations where the polluter has the right to pollute, MEC represents WATP. Since WTA is not equal to WATP, these MEC curves would differ from each other. See the next part of this question.)

   (b) Starting at $Q = 0$, the initial bargain between the firms and the pollution victims results in an increase of Q, say to $Q = 1/3$. However, it also results in an increase in the income (or wealth) of pollution victims, and by the assumption in the question, this

Box 16.1 McKelvey Box-type diagram: resources and reserves



Source: US Geological Survey Bulletin 1450–A (1976)

Figure 4

causes an increase in their willingness and ability to pay for pollution reductions, that is, their *MEC* curve shifts up. This shift up moves the point at which *MEC* and *MII* intersect over to the left of $Q = 1$. Any further stages of bargaining will move the point even more to the left, further away from $Q = 1$. The bargaining process therefore would end at $Q < 1$.

5. Spring 15 Ex2 Qu2

6. Fall 2003 Final Pt. I Qu. 2, but it had no answer written up.

   Refer to Figure 4. In class, I emphasized only the distinction between "resources" (which is the entire box) and "reserves" (which is the upper left-hand part of the box). Because reserves are high up in the Box, they are available at relatively low cost. Because reserves are to the left in the Box, it is more certain that they exist.

   Malthusians (such as the authors of the book *Limits to Growth*) tend to de-emphasize the varying qualities of exhaustible resources (the McKelvey Box's vertical axis) and de-emphasize the uncertainty of exhaustible resource supply (the McKelvey Box's horizontal axis).

Malthusians tend to think of scarcity as being an "all or nothing" situation, in which the resource is either available or it is not available. Ricardians, by contrast, embrace the distinctions which the McKelvey Box illustrates. To their way of thinking, resource scarcity will not show up as a sudden lack of resource, but rather as a gradual shift to more costly, less abundant deposits. In practice, this leads to the Ricardians being less worried about resource scarcity than the Malthusians are, since the Malthusians do not think much about the usefulness of poorer, scarcer resource deposits.

7. Spring 2017 Ex. 2 Qu. 6

8. Spring 2016 Final Qu. 7

9. This is the chemical reaction of the conversion of ozone into oxygen in the presence of chlorine ions. Those ions come from chlorofluorocarbons (CFC's), artificial chemicals used in refrigeration (and some other processes). This reaction is responsible for the thinning of the ozone layer in the upper atmosphere (the stratosphere). This is bad because that ozone layer prevents some harmful wavelengths of light from the sun from getting to the surface of the Earth. Those wavelengths can partially get through a thinned ozone layer, causing skin cancer, eye cataracts, and other problems on the Earth's surface. (The web site `https://www.epa.gov/ozone-layer-protection/health-and-environmental-effects-ozone-layer-depletion` lists effects on plants, marine ecosystems, biogeochemical cycles, and materials.)

   Fortunately, it has been possible to find relatively inexpensive substitutes for the most ozone-damaging CFC's. Therefore, this problem has been much easier to fix than global warming, where no substitutes for fossil fuels have been inexpensive until very recently, and where large parts of the economy rely on fossil fuels (much larger parts of the economy than are reliant on refrigeration). International agreements to reduce CFC emissions, or find more "ozone-friendly" CFC's, have been largely successful because of the low cost of adopting "ozone-friendly" chemicals and processes.

10. Spring 2008 Final Qu. 6