

Lecture 14: Public Goods

PPPA 6007
Fall 2024

Case Study Answer Key: Satellites and Low Earth Orbit

Weinzierl, Acocella, and Yamazaki, “Astroscale, Space Debris, and Earth’s Orbital Commons.” Linked on course webpage.

1. What is the public good in this article?

There are many possible ways to answer this question. The key is to describe something that is non-rival and non-excludable and explain why it is non-rival and non-excludable.

Low Earth Orbit (LEO) is rival – your consumption of it hinders others’ consumption. This means that LEO itself is a common pool resource.

However, a clean LEO is a public good. The clean LEO is non-rival and non-excludable.

Other things students mentioned that are not public goods

- debris removal technology: not a public good because the technology itself is rival and excludable
- satellites: the output from these is excludable

2. The case suggests that there is a “market failure.” Which market is failing and why?

There is demand for cleaning up space debris. Yet, despite the fact that everyone agrees we would be better off with debris removed, the market is not providing debris removal. Thus, the market that is failing is the market for debris removal in LEO.

This market fails to exist due to the existence of very large externalities in debris removal. Any actor who removes debris gets private benefits, but also generates very very large external benefits. To the extent that the private actor is not compensated for the benefits the actor gives to others, this actor will provide “too little” debris removal – and maybe not even any at all.

Market failures do not occur due to a lack of demand. Lack of demand means there is not a market, not that the market has failed. Market failures also don’t occur due to the absence of a technology.

Failure of government to act does not indicate a market failure. Usually we turn to government when the private market fails to provide some good or service – that’s why it is called a “market failure.”

3. Name two potential policy solutions. For each solution, explain the benefits and the potential for failure.

There are many possible policy solutions. I list below some of your suggestions with pros and cons.

- International regulatory board
 - Pros
 - experts charge taxes that will solve debris problem

- shared responsibility
 - Cons
 - free rider problem (other side of the coin of shared responsibility)
 - Research challenge to fund technology development
 - Pros
 - may incentivize investment in technology
 - Cons
 - outcome is not collaborative – no obvious incentive to share technology
 - may be difficult to get countries to agree to fund
 - Space debris licensing: Countries are allotted debris permits and then can't create beyond that
 - Pros
 - Would limit future debris creation
 - If countries purchase permits, could use funds for technology development (though this is a transfer, not a straight-up benefit)
 - Cons
 - may be impossible to administer
 - how do you choose who gets how many permits?
 - doesn't deal with past pollution
 - Coase Theorem
 - For this to apply here, we need property rights over LEO. While a country may be able to claim the LEO right overhead, things in LEO are circling in orbit, so property rights strike me as very complicated, making Coaseian bargaining unlikely.
 - Space debris tracker
 - US actually already maintains something like this
 - Not clear that satellites can avoid, even with information
 - Make satellite launch conditional on a plan for getting rid of own future debris
 - I believe that this is already largely the case for US satellites
 - Works going forward for one country, doesn't solve problem of past debris
 - Assign property rights to debris
 - I think this really means assign liability to the trouble caused by debris
 - Might be possible if countries are willing to be held liable and we can individually track debris
4. Do a little web research to update yourself since 2016. Write updates on at least two of the basic facts from the case. Do these updates change your opinion of any of your previous answers? Why or why not?

Here's my summary of the updates I learned from reading your summaries

- Now 170 million particles < 1 cm (2015 > 100 million such particles)
- No debris removal legislation in US

- Satellites are getting better at decommissioning themselves – leave LEO and burn up, so don't create debris
- But... it might be that rockets and satellites burning in the atmosphere is bad for the ozone layer! (See [here](#)).
- 2021 Astroscale did a launch test of their technology
- 2024 Astroscale does another test with Japanese Space Agency
- More satellites are being launched than ever before!
- European Space Agency proposes “Zero Debris Charter,” which “aims to eliminate orbital debris by 2030. As of October 2024, 110 countries and entities had joined the initiative.” (As an aside, think about what we learned about regulation: those that can remove debris will want this and those that cannot, or which can only do it expensively, cannot.)
- NASA now has an “Active Debris Removal Vehicle.” See [here](#). It seems like it removes big pieces of debris but is infeasible for small debris.
- FCC just required satellite providers to complete “post-mission disposal” in 5 years instead of 25. NASA cites this as one of the most cost effective ways to reduce future debris. See [here](#).