Asteroid Mining and Global Equity

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The Problem

The problem at hand that we were asked to solve is to first define global equity. Given a preliminary definition of equity, we were asked to expand on it and discover what that would mean on a global basis. Using the definition that we generated, we were to find a way to measure global equity and validate it using some sort of historical or regional data.

The next part of our task included asteroid mining. Considering that there is not much global experience in asteroid mining, we were to brainstorm some ideas of what it might look like in the future with the assumption that it is possible and financially feasible. After finding a likely possibility, we were to use the model that we created to examine how asteroid mining might impact global equity. Lastly, if our model predicted that asteroid will negatively impact global equity, we were to discover some possibilities of how we can change it to positively impact global equity.

Background Context

Why asteroid mining? The appreciation of asteroid mining starts when we realize the reality of the state in which planet earth is in. Earth, as far as we know, is the only planet or spatial object with human life. In order to fulfill our needs and improve our civilization, and because science tells us that humans have been on earth for 6 million years, we have utilized a lot of the earth's resources. In fact, we are depleting natural resources more than twice as fast as the earth can recover.

Some of the resources that are in exponential decline include: water, coal, Oil, Phosphorous.

How will asteroid mining help this phenomenon? The asteroid belt in our solar system contains 8% metal-rich (M type) asteroids and 75% volatile-rich carbonaceous (C type) asteroids ("Asteroid belt", 2010). The denser metals, like platinum group minerals and REE's, are distributed relatively evenly throughout the asteroid body, simplifying the mining process as drilling can be relatively shallow for ore grades to be surprisingly high. One of the problems with the resources on earth is not necessarily that we do not have enough, but that most of it is located thousands of kilometers below the surface making it impossible to mine. With asteroid mining, that worry is removed.

Definitions

Global Equity: Global Equity is the state in which every global participant has reachable access to the same opportunities and resources in order to achieve an equal outcome. Global equity is achieved by lowering the gap between extreme parties and allocating resources to the parties in need.

Parable of the two buses: To better understand our definition of global, here is an example. Consider two neighborhoods in one city. Neighborhood one has a great bus transportation system, while neighborhood two does not. The city council decided to allocate all the transportation resources of city to neighborhood two so that it can also achieve the same level of transportation as neighborhood one ("Equity vs Equality"). An important fact to note that is essential to our definition is that global equity was not achieved by taking away the bus system of neighborhood one, instead it was achieved by allocating resources to neighborhood two.

Poverty Line: Living on less than $1.90 per day

Extreme Poverty: Living below the poverty line, i.e., living on less than $1.90 per day

Model Overview

Global equity is achieved by lowering the gap between extreme parties and allocating resources to the parties in need.

Our model is based on global poverty rates to correlate with global equity.

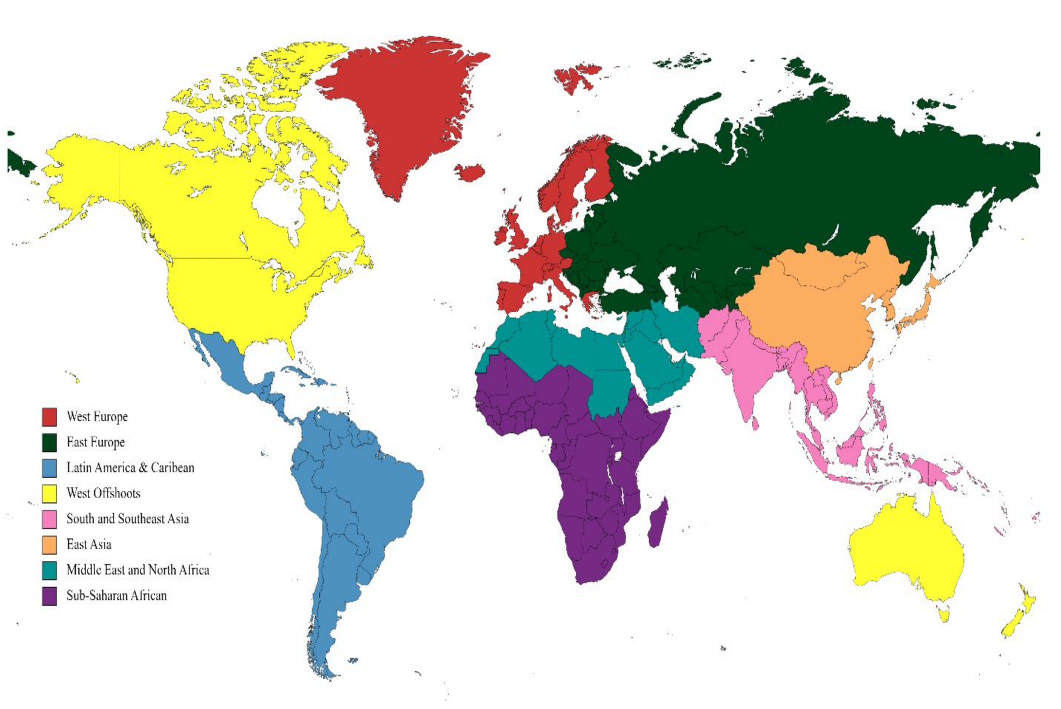
Two assumptions:

- approximately equal variance between the poverty rates of each region
- maximums and minimums of each t data point are not extreme outliers to the dataset

From 1950-2010, we found that the rate of extreme poverty is decreasing over time, so in turn, global equity is increasing

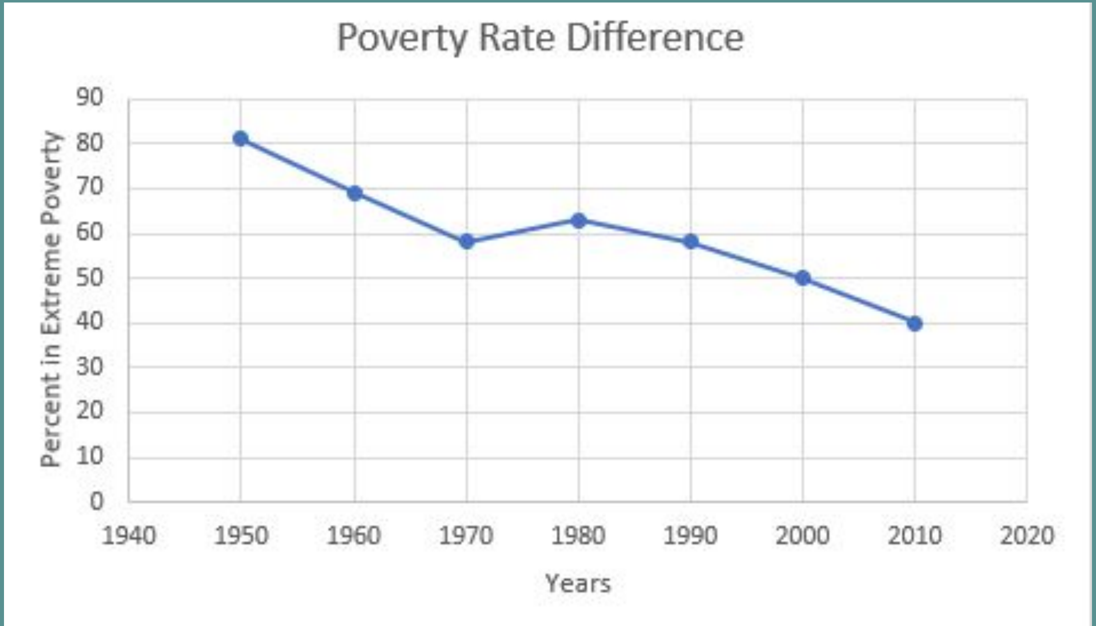
The poverty gap begins at %80 and ends at %50, so we believe we can further decrease extreme poverty and increase global equity.

Eight regions



West Europe
East Europe
Latin American and Caribbean
West Offshoots
South and Southeast Asia
East Asia
Middle East and North Africa
Sub-Saharan Africa

We looked at the rates of extreme poverty in all eight of these regions from 1950-2010. Global equity is inversely related to this rate



In order to find the poverty rate gap between all these regions, we examined the maximum poverty point and minimum poverty point for each decade. For each t from 1 to 7, (each t representing a decade), we subtracted the lowest poverty point from the highest poverty point in order to find the poverty gap over time.

Sources of error: Because of our assumption that the rates of poverty are equally varied, there may be loss in calculation accuracy for the poverty rate difference. Error also arises in the rate of extreme poverty when looking at non-market economies like China and the former Soviet Union among others

Asteroids

An asteroid is a class of small rocky and metallic bodies orbiting the sun. Though this is a rough definition we can classify three types of asteroids, which contain future prospects of mining materials that we are interested in.

1) C-type make up about 75% of the asteroids in our solar system. They consist of hydrogen, helium, and other volatiles.
2) S-type make up about 17% of asteroids in our system. These types contain more metal based elements like nickel, iron, and magnesem.
3) M-type make the rest of the asteroids in our system. They have metal like S-types but are smaller asteroids.

Mining theory

1) The first step is to scout out potential asteroids. The table above provides some examples. We also need to invest in satellite telescopes that will be able to discover potential asteroids. Once they are identified, we will send probes to take close-up pictures, which we can then examine to get a better idea of what the asteroid contains.
2) Our main focus will be to find water in the asteroids. Water can be separated into oxygen and hydrogen, which can then be used as fuel. Mining water would also be very cost effective because space travelers would not need to carry as much water on board. Less water means less weight, and less weight would save a lot of expenses. Therefore, the focus is on C-type asteroids. The mining bots will attach themselves to asteroids and begin the process to collect resources. M-type asteroids would be much more problematic, since their metals are much harder to dig up.
3) Another reason for mining water is for the benefit of the return trip. Machines need energy to make the round trip, which can be attained by mining water as stated above. Once they have that energy, they can then mine and return to earth with the resources collected.

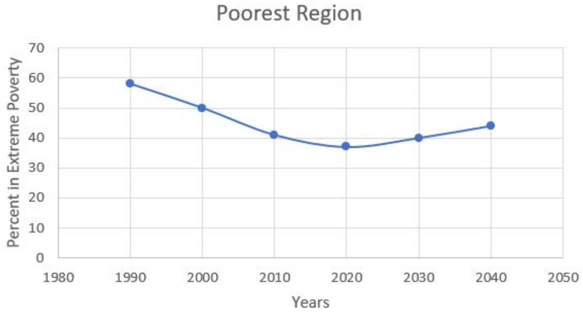
How might Asteroid Mining Affect Global Equity?

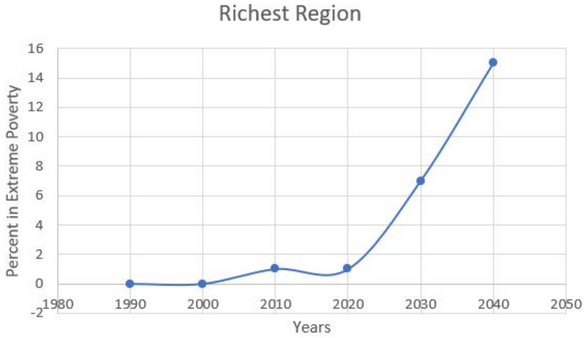
Realistic prediction: During the United Nations' Outer Space Treaty of 1967, only three countries came together to sign it. These countries were the U.S.S.R., the U.S.A, and the U.K. Since that treaty was signed, more and more countries have made advances in order to pursue space exploration. The top five are currently the U.S.A, China, Russian Federation, Japan, and the U.K. In correlation, the three world regions with the lowest poverty rate include most of these countries. We predict that these top three regions of the world will play a large role in funding for asteroid mining in the future. Because of this, they will reap most of the benefits of what asteroid mining will bring back. This means that these regions will be getting richer from those resources, while the other regions will suffer from a lack of resources.

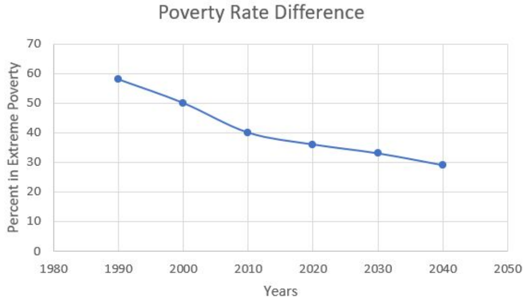
Flooding scenario

In this scenario, we are again assuming that asteroid mining is possible, financially worth the investment, and the resources are being brought back to earth for trading and everyday use. This scenario explores the possibility of bringing back resources that have defined value in the earth's everyday market. For example, a few of the resources that researchers are hoping to bring back are iron, cobalt, water, gold, platinum, and copper. For these resources that are traded and have monetary value, asteroid mining might seem like a dangerous option. The sudden flooding of many resources into the market might cause inflation, leading markets to eventually crash.

How does this affect our model?







As we can see the difference in poverty is decreasing, which would mean that global equity is increasing. However, going back to our definition, there would be a conflict of results, because the poor regions are continuing to get poorer. To prevent this, we are adding one more clause based on a new variable called tolerance. If tol is greater than 5, that means something other than natural occurrences has affected the poverty rate of that particular region, making the mathematical results of our model inconclusive and incompatible with our definition.

Changes in conditions

While we predict a vision of the future of asteroid mining that leads to a decline in global equity, we wish to present an alternate plan that will result in an increase in global equity.

Condition for funding. With the assumption that regions with lower poverty rates will be the main investors, we would add a condition stating that a certain percentage of whatever funding is given will be on behalf of a region with a higher poverty rate.

We would see these nations slowly rising above the poverty line. As a result, they might have the option to invest in asteroid mining themselves and would eventually be able to pay back what had been invested on their behalf initially. Over time, we would see growth in global equity.

Space policy

Space law is a relatively new field in law. That being said, there are a few international laws that are overseen by the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS). These include five treaties:

1) Outer Space Treaty (1967)
    - Space activities are for the benefit of all nations, and any country is free to explore orbit and beyond.
    - There is no claim for sovereignty in space; no nation can “own” space, the moon, or any other body.
    - Weapons of mass destruction are forbidden in orbit and beyond, and the moon, the planets, and other celestial bodies can only be used for peaceful purposes.
    - Any astronaut from any nation is an “envoy of mankind,” and signatory states must provide all possible help to astronauts when needed, including emergency landing in a foreign country or at sea.
    - Signatory states are each responsible for their space activities, including private commercial endeavors, and must provide authorization and continuing supervision.
    - Nations are responsible for damage caused by their space objects and must avoid contaminating space and celestial bodies.
2) The Rescue Agreement

    This agreement states that if an astronaut is in need of help, then help will be received and returned to the respective country.
3) The Moon Agreement

    Where all participants will have no sovereignty over any celestial bodies in space and should only explore for peaceful purposes.
4) The Liability Convention

    It states that all damage caused by a country's space object will be paid in full.
5) The Registration Convention

    All objects in space must be registered in space.