Questions?
"Mind Sized" is a term invented by Seymour Papert in his book "Mind Storms" (1980). The idea is that, in order to be convinced that a certain phenomenon is real, or that it may happen for real, you need to understand what makes it real. For this, a model must be simple enough that you can make sense of it within your mind. This was one of the problems with "The Limits to Growth" study of 1972; the model was so complex that people tended to disbelieve its results mostly because they didn't understand how the model worked, as I argue in my book on this subject (Bardi 2011). So, let's see if we can make mind sized world models, trying to make explicit their relation with thermodynamics.

--Ugo Bardi

Mind-sized world modeling

More compelling

less compelling

simple

understandable

complex

accurate
My criticism of World3

• Too many variables. Not mind-sized.
Which one is mind-sized?
Economics

From a biologist's point of view
Donald Worster 1988

Quoted on p. 268 of Limits to Growth

- People must ... think constantly in terms of making money. They must regard everything around them -- the land, its natural resources, their own labor -- as potential commodities that might fetch a profit on the market. They must demand the right to produce buy and sell those commodities without outside regulation of interference... As wants multiplied, as markets grew more far flung, the bond between humans and the rest of Nature was reduced to the barest instrumentalism.
What is The Economy??

- Economy is ... the production, distribution, or trade, and consumption of goods and services by different agents in a given geographical location. (wikipedia)

- From the point of view of Science Economy is...
  ... a set of trust-based social behaviors that increase the carrying capacity for humans by catalyzing and increasing the efficiency of production, distribution and consumption of goods and services.

- Economics may work through secondary catalysts, such as energy, machines, laws.

- A catalyst of catalysts?
Adding economy to the model?

The Economy fuels the catalysts

Money provides needs for people who provide fossil fuel, machines, labor... food.

The catalyst of "life" may be money!!
How does Economics + Law + Governance + technology affect access to resources?

- **Stone ages** -- no $, no law, low tech.
  - Hunting, gathering, local.

- **Age of agriculture** -- +$, governance, law
  - Local food, climate dependent.

- **Age of exploration** -- +technology
  - Non-local food, technology obtainable with difficulty. Sharing of cultures.

- **Small world** -- +Incr. technology, law
  - Non-local food, technology, easily obtainable. Knowledge barriers still high.

- **Internet age** -- +Incr. technology
  - Sharing of all knowledge. Maximum accessibility, satisfaction.

*Relative inequality of access to resources.*
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Gini* 1

Fighting among ourselves

Cooperating

Fighting together against disease

Fighting together against global limits

*Relative inequality of access to resources.
Greater inequality pits us against each other.

Greater equality pits us against Nature.
Money is transferred only between people.

People are mostly selfish. Motivated by self-interest. Not interested in health and well-being of wild species, land, earth systems.

Resources are transferred from the Earth and other species without compensation. No money is paid to the Earth (e.g. for oil) or to other species (e.g. for land, food.). No services are rendered.

In other words, Nature has no economic power.

Unless the "game is changed" Nature will be consumed until it is gone, or until People find saving Nature to be in their self-interest.
Thoughts on modeling the End Game

• Nature always bats last.
  • Whether we like it or not, the current game will be over and Nature will dictate the rules of the next game.

• The return of inequality.

• One-time violence
  • War is like a balloon.
  • We need two factors to explain the outbreak of war.
Cost of livin' gets so high,
Rich and poor they start to cry:
Now the weak must get strong;
They say, "Oh, what a tribulation!"
Them belly full, but we hungry;
A hungry mob is a angry mob.

--Bob Marley
Opposition lawmaker raise their hands to approve activation of the procedure to **remove magistrates from the Supreme Court** during a session at the National Assembly in Caracas, Venezuela, Wednesday, April 05, 2017. The government over the weekend backed away from the Supreme Court's ruling after strong international and domestic criticism. (AP Photo/Ariana Cubillos)
Washington (CNN)BREAKING: The Senate Thursday triggered the so-called "nuclear option" that allowed Republicans to break a Democratic filibuster of Supreme Court nominee Neil Gorsuch.

The Senate is now expected to vote to confirm Gorsuch Friday.

Maslow's hierarchy of needs.

- **Physiological Needs**: food, water, shelter, sleep
- **Safety and Security**: security of health, property, employment, family and social stability
- **Love and Belonging**: friendship, connection, intimacy
- **Self Esteem**: achievement, confidence, respect of/by others
- **Self-Actualization**: morality, creativity, spontaneity

https://en.wikipedia.org/wiki/Maslow%27s_hierarchy_of_needs
HDI \approx \text{Maslow}

Maslow's hierarchy of needs.

No food, no home, no job,..

Fully self actualized, all needs met,..

https://en.wikipedia.org/wiki/Maslow%27s_hierarchy_of_needs
Data for outbreaks of violence as a function of inequality are hard to find.

Gun violence is roughly correlated with inequality.

Drought helped cause Syria’s war. Will climate change bring more like it?

• By Brad Plumer, Washington Post, September 10, 2013 at 9:34 am

“We looked at the period between 2006 and 2011 that preceded the outbreak of the revolt that started in Daraa. During that time, up to 60 percent of Syria's land experienced one of the worst long-term droughts in modern history. This drought — combined with the mismanagement of natural resources by [Syrian President Bashar] Assad, who subsidized water-intensive crops like wheat and cotton farming and promoted bad irrigation techniques — led to significant devastation. According to updated numbers, the drought displaced 1.5 million people within Syria.”

Civil unrest correlates with food prices.

Increased food cost leads to violent riots. Did inequality also play a role?
One-time violence

Sporadic. Leads to a large "instantaneous" population decrease. Can happen overnight. Rarely extended. Observed in history, current events, even the fossil record.

$$OTV \leftarrow [Gini] \times (1 - [HDI])$$
Modeling OTV

• First **define** the "functional form" of OTV. i.e. How does the variable behave?

  • One-time violence probability (OTV) reaches 1 as both Gini reaches 1 (infinite inequality) and HDI reaches zero (great need). And goes to zero as HDI reaches 1, or Gini reaches 0.

    • OTV <- [Gini]*(1 - [HDI])

• Then **Refine** the function

  • A little satisfaction goes a long way. A small amount of [HDI] has a big effect in decreasing OTV. So raise [HDI] to a power > 1, \(1/m\), where \(m>1\)

    • OTV <- [Gini]*(1 - [HDI]^{(1/m)})

  • A lot of inequality is tolerated, so OTV should curve up as Gini approaches 1, but otherwise stay low. Raise [Gini] to a power > 1.

    • OTV <- [Gini]^n*(1 - [HDI]^{(1/m)})
A data point: Gini and HDI in Rwanda

At the point where violence erupted, Rwanda had a decreasing HDI at around 0.22, and an increasing Gini at around 0.4. "Emergency selling" led to a fast increase in Gini.

If we posit that at this point in time OTV was 0.2, then we can solve for exponents, $n$ and $m$. $n = m = 1.7$
• $m=1.7$
• $n=1.7$
• \( OTV \leftarrow [\text{Gini}]^{1.7} \times (1 - [\text{HDI}]^{(1/1.7)}) \)

As needs go up, possibility of violence goes up.

As injustice go up, possibility of violence goes up.
Work on term projects

• Share your Insights.

• Ask questions.

• Mine for data.