



Dupont Summit 2014

..... Science, Technology, and Environmental Policy Issues

December 5, 2014 ♦ Historic Whittemore House, Washington, DC

The Policy Studies Organization

Speaker

Victor Yakovenko - *University of Maryland*

"Global Inequality in Energy Consumption from the Maximal Entropy Perspective"

After briefly reviewing the principle of maximal entropy in physics and some of its applications to economics, I will present a study of global inequality in energy consumption per capita based on data from the U.S. Energy Information Administration (EIA) for 1980-2010. We found that the Lorenz curves have moved up during this time period, and the Gini coefficient G has decreased from 0.66 in 1980 to 0.55 in 2010, indicating a decrease in global inequality. The global probability distribution of energy consumption per capita in 2010 is close to the exponential distribution with $G=0.5$. We attribute this result to the globalization of the world economy, which mixes the world and brings it closer to the state of maximal entropy. We argue that global energy production is a limited resource that is partitioned among the world population. The most probable partition is the one that maximizes entropy, thus resulting in the exponential distribution function. A consequence of the latter is the law of 1/3: the top 1/3 of the world population consumes 2/3 of produced energy. We also find similar results for the global probability distribution of CO₂ emissions per capita. Since the probability distribution is already close to the state of maximal entropy, we expect a global slow-down in the pace of economic development, which is called by some commentators the coming "economic ice age."

This work was supported by a research grant from the Institute for New Economic Thinking (INET), <http://ineteconomics.org/grants/statistical-physics-approach-income-and-wealth-distribution> Based on the paper by S. Lawrence, Q. Liu, and V. M. Yakovenko in the open-access journal "Entropy" 15, 5565-5579 (2013), <http://www.mdpi.com/1099-4300/15/12/5565>.

Recommended reading and viewing:

- The paper has been published in the open-access journal "Entropy."

<http://www.mdpi.com/1099-4300/15/12/5565>

- Computer animation movies are posted here.

<http://arxiv.org/src/1312.6443v1/anc>

- A popular press release "The Entropy of Nations" is here.

<http://jqi.umd.edu/news/entropy-nations>

http://www.eurekalert.org/pub_releases/2014-01/jqi-teo010314.php

- My TV interview on this subject at Brian Lehrer's show.

<http://www.cuny.tv/show/brianlehrer/PR2002638>

(in the Public Intellectual segment starting around minute 40)



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Victor Yakovenko was born and grew up in Donetsk, studied in physical-mathematical high school in Kiev, obtained a masters degree in physics from the Moscow Institute of Physics and Technology and Ph.D. in theoretical physics from the Landau Institute for Theoretical Physics in Moscow. He arrived to the United States in 1991 as a postdoc at Rutgers University in New Jersey. In 1993, he became an assistant professor of physics at the University of Maryland in College Park, where he is a full professor now. In 1995, he was awarded the prestigious David and Lucile Packard Fellowship in Science and Engineering. In 2004, he was elected a Fellow of the American Physical Society. His main specialty is theoretical solid state physics of various materials, particularly unconventional superconductors. In addition, in 2000, he and his student published a paper "Statistical Mechanics of Money", where they applied methods of statistical physics to probability distribution of money in an ensemble of economic agents. It triggered an explosion of follow-up studies in the interdisciplinary field of econophysics, and now this paper has close to 500 citations on Google Scholar. A brief summary is given in the article published in the May 2014 issue of Science magazine devoted to The Science of Inequality, <http://www.sciencemag.org/content/344/6186/828>.

All of the econophysics papers by Victor Yakovenko are available at <http://physics.umd.edu/~yakovenk/econophysics/>, and particularly recommended are review papers [3.6] and [3.9]. Victor Yakovenko lives in College Park, Maryland, in a house where about 95% of consumed electricity is generated by rooftop solar panels, <http://www.physics.umd.edu/~yakovenk/solar-home/>.