



# On the relationship between income, fertility rates and the state of democracy in society



S. Hutzler\*, C. Sommer, P. Richmond

*School of Physics, Trinity College Dublin, The University of Dublin, Ireland*

## HIGHLIGHTS

- Empirical data for 145 countries shows a strong correlation between gross national income per capita and political form of governance.
- Correlation can be improved by using the Gini index as weighting factor.
- Fertility and the gross national income per capita are correlated in an approximately inverse manner, with a clear separation between hierarchical and more egalitarian or wealthy societies.

## ARTICLE INFO

### Article history:

Received 19 August 2015

Received in revised form 2 February 2016

Available online 11 February 2016

### Keywords:

Econophysics

Sociophysics

Income distributions

Models of society

## ABSTRACT

Empirical data for 145 countries shows a strong correlation between the gross national income per capita and the political form of their governance, as specified by the so-called democracy index. We interpret this relationship in analogy to phase transitions between different states of matter, using concepts of statistical physics. Fertility rates play the role of binding energy in solid state physics.

© 2016 Elsevier B.V. All rights reserved.

## 1. Introduction

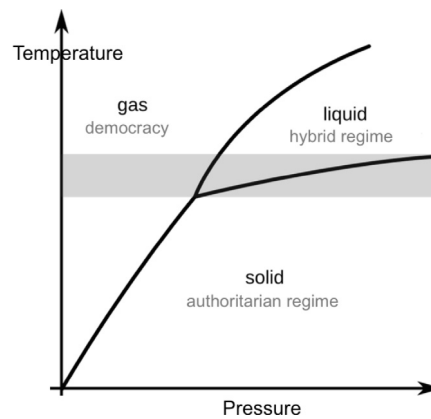
The term ‘social physics’ is frequently ascribed to Auguste Comte, an early 19th century French sociologist who, as a young man, believed it should be possible to study political and social phenomena using methodologies of physics [1]. However, it was in economics rather than sociology where physical methods were first seriously implemented. Arguably this emanated from earlier thoughts of David Hume about rationality. These led directly to the idea that because human beings are part of the physical world, their actions will have a physical explanation [2].

But the physicists were at the time concerned with other matters. The industrial revolution was beginning and there were serious problems arising from the development of the new steam engines. These could not be understood solely from the classical mechanics of Newton. A proper understanding had to wait for almost another 100 years and the development of thermodynamics and statistical mechanics. It was this theory that proved immensely successful during the 20th century as a method for understanding the relationships between the microscopic and macroscopic worlds.

It was almost another 100 years before physicists returned to consider problems in the social and economic sciences using now methods of statistical mechanics [3]. Today, many physicists are exploring the application of its methods to economic and social phenomena, stimulated by the ability to obtain detailed quantitative empirical data sets. Whilst some

\* Corresponding author.

E-mail address: [stefan.hutzler@tcd.ie](mailto:stefan.hutzler@tcd.ie) (S. Hutzler).



**Fig. 1.** Sketch of a phase diagram showing the three different states of matter, solid, liquid and gas as a function of pressure and temperature. Within a certain temperature range (shaded), a material may transform from a solid to a liquid or a gas. In our simple model of society we associate a particular mode of governance, democracy (flawed/full), hybrid or authoritarian regime to the different phases. Transitions between these occur upon a change of a 'social state variable', as described in the text.

from both the physics and sociological communities remain skeptical about the approach, there can be no doubt that already there has been interesting and significant contributions to a number of areas, including distribution of incomes [4,5], voting behavior [6,7], macroeconomics and production [8,9], social networks [10,11], and effects of leaders on societies [12].

In 2006 Mimkes [13] introduced a model for different societal states, based on the three phases of matter, solid, liquid and gaseous. The solid state corresponds to an ordered hierarchical society, where changes of structure are difficult, as all decision-making is often in the hands of a small elite or even a dictator. We may, by contrast, assert a democratic state is more like a gaseous state. It is subject to constant change, as the political leaders evolve their policies in line with the needs of the wider community, or even change completely following elections. In between these two states lies, by analogy with the liquid state, an intermediate state—a so-called 'hybrid regime', as sketched in Fig. 1. (Note that in his 2006 paper Mimkes sees the societal analogies to liquid and gaseous phases reversed [13]. Important for our discussion below is simply the concept of the *existence* of different phases, how they are being mapped does not play a role.)

But any sociological analogy with thermodynamics begs the question, what variables correspond to the thermodynamic state variables, such as temperature, pressure, internal energy etc.? Previous authors have extracted an 'effective' or 'social' temperature from data on income distributions [14] or models of opinion formation [15], or introduced an 'economic pressure' when constructing a theory of physical economics [9]. Here we shall argue that also the so-called 'democracy index' may serve as a social state variable of a society. This index was proposed in the political magazine 'The Economist' in 2007 to quantify the state of democracy in a society [16]. Other indices that have recently been used to assess and compare different countries are the corruption perceptions index [17] and the global competitive index [18].

We begin in Section 2 by examining the correlation between average income and this democracy index. We will argue that the sudden onset of Gross National Income per capita once a society has reached a certain level of democracy, is akin to a phase transition. Section 3 explores a second analogy between physics and society, which is the extent to which fertility, measured by the average number of children per family, can be used as a simple estimate of binding within communities. This will allow us to differentiate between full democracies and hybrid and authoritarian regimes. Section 4 contains summary and conclusions.

## 2. Society and income

The value of the democracy index, here denoted by  $\alpha$ , is based on both political research, as well as opinion polls in the respective countries [16]. It incorporates the assessment of the nature of the electoral process and pluralism, the functioning of government, political participation, political culture, and extent of civil liberties. By aggregating scores for these different attributes and averaging, every country may be assigned a number between 0 and 10. Countries are then classified as follows,

- $0 \leq \alpha < 4$ : authoritarian regime,
- $4 \leq \alpha \leq 5.9$ : hybrid regime,
- $6 < \alpha \leq 7.9$ : flawed democracy,
- $8 < \alpha \leq 10$ : full democracy.

Given this definition, it is interesting to examine how this democracy index correlates with wealth (per capita) for a large number of different countries. There are in fact several ways to measure the wealth of a country. Happiness of the individual has been mooted by a number of authors, e.g. Ref. [19]. Here we shall keep things simple and make the direct association of wealth with income by using the GNI, which measures the value of all goods and services produced by residents of that country. An alternative would have been the use of the Gross Domestic Product (GDP) which measures the value of all goods

Download English Version:

<https://daneshyari.com/en/article/7377926>

Download Persian Version:

<https://daneshyari.com/article/7377926>

[Daneshyari.com](https://daneshyari.com)