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The historical ecological footprint: From over-population to over-consumption☆

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ABSTRACT

The ecological risk from over-population has been recognized since Malthus (1798). GDP growth per capita in agriculture disproved his pessimism but, since the Club of Rome and its case on Limits to Growth more recently there has been concern that there is a parallel risk from such growth in terms of ecological footprints (EF). Authors have developed a GDP/EF correlation function and calculated the ecological footprint (EF) from 10,000 B.C. till 1960, using historical statistics, with the method of backcasting (Brandes and Brooks, 2005).[1] In all major indicators growth patterns have been dominating, not only since the industrial revolution, but in the known history of mankind. From data since 1961, we calculate the correlation between GDP and the ecological footprint and have been able to determine long time data series of population, GDP, biocapacity and EF. Our findings are first: the main driver of growth and environmental degradation is not population per se, but consumption patterns and levels multiplied by the number of consumers, especially in developed economies, as the I = PAT equation recognized (Ehrlich and Holdren, 1971). In fact, as we approach to today, population, which used to be the key driver to growth and environmental degradation, becomes the least important driver, especially in the last two decades. Second: change is not incremental or linear as assumed in much mainstream economics: in line with Schumpeter's bunching and swarming and it jumps and leaps asymmetrically, as in our finding of such a leap (the 7th) between the 1930s and 1970s. Third: the dominant paradigm legitimizing growth (from the late 18th century) while already challenged by many since the Club of Rome and other reports should be revisited in terms of the concept of 'fullness' in the sense that while the earth in 1776 was roughly 10 per cent full, by 2008 this figure was over 150 per cent.

"The earth is the Lord's and the fullness thereof, the world and those who dwell therein."
Psalm 24

1. Introduction

The risk to the future of humanity from the combination of population growth, depletion of resources and destruction of the environment has been forewarned for decades by a series of reports and studies, such as the 1972 report on limits to growth from the Club of Rome (Meadows et al., 1972). The 1987 Brundtland report (1987) warned that if humanity has a common future it will be based on defence, preservation and enhancement of the environment. The same concerns were central to the 1997 Kyoto agenda.

Yet only weeks before the 2009 Copenhagen environment summit, which, twelve years on from Kyoto, was supposed to re-launch joint government action, the chief negotiator for the European Commission, Artur Runge-Metzger, was pessimistic in warning that the governments had not even agreed whether the outcome should be a binding agreement rather than simply another declaration of intent (Open Europe, 2009).

Also, those governments that did sign up to Kyoto have been less than effective in implementing it. As the former UN Under-Secretary General for Africa and former Brandt Commissioner Layachi Yaker put it at the turn of the millennium: 'The result is a paradox. Global inter-governmental cooperation on the

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[1] Backcasting is a method often used in sustainability studies, first it defines a desirable future and then works backwards to identify policies and programmes that will connect the future to the present. We use the method in a slightly modified way: we estimate data back from the current data of the last five decades.

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environment is top of the agenda but appears to be out of the question – at the same time' (Yaker, 2002).

In such a paradoxical manner, the term sustainable development emerged when growth already had become unsustainable. The per capita and total footprint of mankind had been sustainable until approximately 1970, and people were satisfied with a stagnant per capita GDP[2] till the middle 19th century. According to the well supported estimations of Maddison (2008) and van Zanden (2003) the products what we call now GDP could have been between 450 and 700 dollars per head[3] till at least 1820, but then started to rise quickly with the industrial revolution.

Keynes (1930) already had claimed that: "From the earliest times of which we have record-back, say, to two thousand years before Christ down to the beginning of the eighteenth century, there was no very great change in the standard of living of the average person living in the civilized centres of the earth. Ups and downs certainly. Visitations of plague, famine, and war. Golden intervals. But no progressive, violent change. Some periods perhaps 50 per cent better than others at the utmost 100 per cent better-in the four thousand years which ended (say) in A. D. 1700. . . The modern age opened; I think, with the accumulation of capital which began in the sixteenth century" (Keynes, 1930 p. 360–361). Sedlaček (2012) in his *Economics of Good and Evil: The Quest for Economic Meaning from Gilgamesh to Wall Street* gives this assumption of Keynes a central role in his book.

2. Conceptual framework and methodology

The conceptual framework of our paper uses the established concept of *ecological footprint* (Wackernagel and Rees, 1996). The second and new concept is that of '*Earth-fullness*'. This contrasts the biblical assumption of Psalm 24 of the fullness of the earth in the sense of abundance and also with the contrary assumption of mainstream neoclassical economists that economics is about the allocation of scarce resources. In our use, Earth-fullness is the total EF divided by total biocapacity in a given year. We are not aware of similar use in either economics or natural science. Some authors (Bear, 1952; Hoppock, 1954) have used the same term in a different way, closer to that of Psalm 24, in the sense of a resource from God to meet the needs of the whole humanity. Our definition of Earth-fullness, by contrast, has no religious implications, can be quantified and in this sense is consistent with claims for an empirically verifiable scientific concept which may be of use in future data analysis.

A third main concept in the paper is *backcasting* which is a more familiar method often used in sustainability studies. Instead of projecting present trends to the future, although this also is vital in appreciating the degree to which such trends are unsustainable, it works backwards to identify policies and programmes that will change the future in relation to current trends (Brandes and Brooks, 2005).

The fourth main concept is that of paradigms. Following the thinking of Schumacher (1973) we do not define a 'paradigm' as a scientific theory staying in the box of the specialized science (as Thomas Kuhn popularized it in 1962), but a scientific theory, which has conquered the world and become a guiding scheme of thought. Another word for these thought-constructs is *meme*. We do not only think *of* these theories but think *by* them. This is not only true for an elite group of professionals of a special science, but everyday people, who has never heard of the theory itself. In most cases they are the most devoted believers and supporters of the mainstream paradigm(s) and the system constructed by them.

In our statistical calculations in this paper we estimate that the ecological footprint (EF) has been 1.2–1.45 global hectares per capita till the beginning of the 18th century. A very strong correlation (50–75%) can be detected historically. GDP per capita and population growth trends have been calculated before.[4] Adding the EF dimension to these could be expected by those dealing with the central indicator of sustainability science. Sustainability scientists (Boulding, 1965; Brown, 2008; Ehrlich, 1968; Hardin, 1968; Lorenz, 1989) have blamed over-population and identified a dramatic change from the beginning of the industrial revolution.

Our paper also suggests that there has been a 'Seventh Jump' since the early 1970s which is not due to over-population but to over-consumption. We cannot go into country-specific data analysis in this paper, but both empirical research (Galli et al., 2012; Malik, 2014) and our global average data analysis confirms that developed countries have a steady or declining population combined with drammatically increasing per capita consumption levels on the one hand, developing nations face quick population rise but can increase on per capita consumption to a very limited extent, in the other hand. With statistical analysis we can identify the individual impact of the two drivers. This claim is not original. It has been well argued by Jackson (2009) in his case for *Prosperity without Growth* But the paper seeks to support this on the basis of seeking to enhance the concept of ecological footprint, and of what it claims is a 'seventh jump' to unsustainability, since the early 1970s, unless reversed.

3. Whose crystal ball?

Population's historical growth trend is an obvious matter to any educated person. The long standstill of GDP until the industrial revolution and the exponential growth since then is also widely published. The same might apply our modern EF data published here, but the long-term combination of the three factors is most interesting! While very few think – at least among mainstream economists – that GDP growth has a natural limit, there is a huge debate on how many people the Earth can support. Forty years after the report of the Club of Rome we seem to have reached a scientific consensus that we have overridden the natural limits of the Earth, measured, e.g. in ecological footprint.

According to the Global Footprint Network (GFN, 2012), the current overshoot (EF minus biocapacity) is around 50 per cent, in other words we use 1.5 times more ecological "budget" than is available. In reality the situation is even worse, while this is an anthropocentric indicator, not counting with the biocapacity need of the estimated 4.5 million species other than mankind. The Earth Overshoot Day – the approximate date humanity's annual demand on nature exceeds what Earth can renew in a year – was "celebrated" on August 20, in 2013 (GFN, 2013). Some years ago the first EF deficit year was 1986. As the methodology develops, it shifts back to 1970.

The urgent question is how many people can the Earth support and for how long? Estimations range from some hundred millions

[2] Gross Domestic Product.

[3] "Dollars" here refer to a hypothetic computation unit, the so-called Geary-Khamis dollar (G-K $). Its value equals USD in purchase power, in a given year. Its basis is two concepts, the purchase-power parity and the international mean price of basic consumption goods. It cannot be simply calculated (e.g. via international exchange rates) into real US dollars or other currency. The measurement unit developed by Roy C. Geary (1958) and Salem Hanna Khamis (1970–1972) are normally used in historical statistics, it is sometimes called international dollar. For more details as we used see (Martell, 2001).

[4] As the long-term population and GDP data in the school of historical statistics", established by Angus Maddison. But – according to our knowledge – there are no previous estimations available for the historical ecological footprint.