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Scientifically Unacceptable Established Knowledge in Demography and in Economic Research

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Abstract. The established knowledge in demography and in the economic research is based on the concept of Malthusian stagnation and on the associated concept of the escape from the Malthusian trap. These two fundamental concepts were gradually enforced by numerous other related postulates all aimed at explaining the mechanism of the historical growth of population and of the historical economic growth. Examples of publications based on the established knowledge are closely examined. They are used to show why the established knowledge is scientifically unacceptable. It is also pointed out that the established knowledge is contradicted by data and by their analyses. Interpretations of the historical economic growth and of the historical growth of population has to be based on accepting hyperbolic growth. However, the discussed examples point to a more serious problem in these two fields of research. It is a fundamental systemic problem, the problem associated with the way research is conducted. Doctrines, interpretations and declarations used by the established knowledge have to be often accepted by faith. Data are either ignored or manipulated to support preconceived ideas. Contradicting evidence is methodically ignored. To be recognised as science, demographic and economic research has to adhere to the scientific rules of investigation.
Keywords. Economic growth, Population growth, Gross Domestic Product, Hyperbolic growth, Malthusian stagnation, Malthusian trap, Malthusian positive checks, Malthusian oscillations, Fertility rate, Mortality rate, Famines, Pestilence, Wars.
JEL. A10**,** A12, A23, B22, B41, C12, Y80.

1. Introduction

Two fields of research, economic growth and the growth of population, which might appear to be distinctly different, are in fact closely related for at least three reasons. *First*, there is obviously no economic growth without humans. *Second*, there is a close correlation between economic growth and the growth of human population (Nielsen, 2016a; 2016b). *Third*, in order to understand the growth of income per capita, measured by the Gross Domestic Product per capita (GDP/cap), it is obviously necessary to study not only the economic growth but also the growth of human population. It is *inter alia* for these reasons, that the best source of information about the historical economic growth, compiled by the world-renown economist, includes not only the data describing the growth of the GDP but also the growth of population (Maddison, 2001; 2010).

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2. The established knowledge

The established knowledge in demography and in the economic research revolves around two fundamental concepts: the Malthusian stagnation and the explosion, which is supposed to have marked a dramatic escape from the Malthusian trap. Gradually and by accretion, in the process extending over many years, these two fundamental concepts were adorned by various additional explanations, speculations and conjectures all adding to the now established knowledge based on the scientifically unacceptable doctrines and beliefs. These two fundamental regimes of growth, stagnation and explosion, are described as Stage 1 and Stage 2, respectively, in the Demographic Transition Theory (see Nielsen, 2016c and references therein). The epoch of stagnation was supposed to have lasted for many thousands of years and was allegedly strongly controlled by the Malthusian positive checks (Malthus, 1798) generating an unstable stage of growth characterised by irregular Malthusian oscillations. The mechanism of growth is claimed to have changed dramatically at the time of the alleged population explosion when the growth was supposed to have changed from slow to fast. The transition from stagnation to explosion is described as the great escape from the Malthusian trap.

We have already demonstrated that the established knowledge is convincingly contradicted by the relevant data and by their analyses (Biraben, 1980; Clark,1968; Cook,1960; Durand, 1974; Gallant, 1990; Haub, 1995; Kapitza, 2006; Kremer, 1993; Lehmeyer, 2004; Livi-Bacci, 1997; Maddison, 2001, 2010; Mauritius, 2015; McEvedy & Jones, 1978; Nielsen, 2014; 2015a; 2016a; 2016b; 2016c; 2016d; 2016e; 2016f; 2016g; 2016h; 2016i; Podlazov, 2002; Shklovskii, 1962, 2002; Statistics Mauritius, 2014; Statistics Sweden, 1999; Taeuber & Taeuber, 1949; Thomlinson, 1975; Trager, 1994, United Nations, 1973; 1999; 2013; von Hoerner, 1975; von Foerster, Mora & Amiot, 1960; Wrigley & Schofield, 1981). The aim of this publication is (1) to outline briefly the origin of the established knowledge, (2) to explain why the established knowledge is so strongly established, (3) to explain the deceptive evidence in data, which can be used in support of the established knowledge, (4) to give a few examples of how strongly the established knowledge is established and (5) to explain why the established knowledge as illustrated by these examples is scientifically unacceptable.

3. Evidence in data

Data describing the historical growth of population and the historical economic growth are hardly ever analysed. Recently, attempts were made to use some of these data (Maddison, 2001) but they were presented in grossly distorted and misleading diagrams, which appear to be supporting the established knowledge (Ashraf, 2009; Galor, 2005a; 2005b; 2007; 2008a; 2008b; 2008c; 2010; 2011; 2012a; 2012b; 2012c; Galor & Moav, 2002; Snowdon & Galor, 2008). Data were not analysed to learn from them but manipulated to support preconceived ideas. Such approach to research is scientifically unacceptable. Data have to be carefully and methodically analysed to avoid drawing incorrect conclusions. Their superficial examination creates strong impression of stagnation followed by explosion but when closely analysed they show that the apparent explosion was just the natural continuation of the past hyperbolic growth.

Global population in 10,000 BC is estimated at only between 1 and 10 million (McEvedy & Jones, 1978; Thomlinson, 1975). Now the population of this size can be located in just a single city. By AD 1, global population increased to only a few hundred million. The estimated values vary between 170 and 400 million (Biraben, 1980; Durand, 1974; Haub, 1995; McEvedy & Jones, 1978; Thomlinson, 1975;

United Nations, 1973; 1999). Now, the population of this size or even larger can be found in just a single country.

The first billion of global population was reached around AD 1800 (Biraben, 1980; Durand, 1974; Haub, 1995; McEvedy & Jones, 1978; Thomlinson, 1975; United Nations, 1973; 1999) and from that time on the growth was progressing exceedingly fast. The origin of *Homo Sapiens* is usually claimed at around 200,000 years ago but it might have been even earlier (Weaver, Roseman & Stringer, 2008). Thus it took many thousands of years for the world population to increase to one billion but after reaching the first billion, the second billion was added in just only about 130 years (United Nations, 1999). The process of many hundreds of thousands of years was suddenly compressed to just over 100 years. The consumption of natural resources and the stress on the environment started to increase rapidly.

If adding one billion in just 130 years sounds too fast, the next billion was added in just 29 years, the next in 15 years, the next in 13 years, and the next in 12 years, increasing the size of global population to 6 billion (US Census Bureau, 2016). The last billion, which increased global population to 7 billion, was added in 13 years (US Census Bureau, 2016). We call it the slowing-down growth but obviously the slowing down process is still too slow.

Assuming a medium-intensity growth, the size of the world population is projected to increase to 8.39 billion in 2030 and 9.63 billion in 2050 reaching a maximum of 10.48 billion around 2080 (Nielsen, 2006). These projections are in good agreement with the US Census Bureau (2016) projections of 8.34 billion in 2030 and 9.41 billion in 2050. It is what we hope for, but the high intensity growth could lead to 12.26 billion by the end of the current century (Nielsen, 2006), assuming that such a growth can be supported by the availability of natural resources.

Similar surprising pattern of a slow growth in the past and a fast growth in recent years is reported for the growth of the Gross Domestic Product (Maddison, 2001; 2010). The first trillion dollars ($\$10^{12}$) of the GDP (expressed in the 1990 international Geary-Khamis dollars) was reached in 1870. The next trillion was added in just 51 years, the next in 19 years and the next in only 10 years, increasing global GDP to $4 trillion in 1950. By 1998, global GDP increased to $34 trillion. The latest estimate for 2014 is $91 trillion (World Bank, 2016) and the projected value for 2050 is $118 trillion (Nielsen, 2015b).

Using such numbers, it would be easy to conclude that there was a long epoch of stagnation in the past economic growth and in the growth of human population and that this stagnation was followed by a sudden explosion. However, such a conclusion, which is the corner stone of the established knowledge in demography and in the economic research, would be unscientific because impressions can be misleading. Scientific research has to be conducted scientifically. If economic and demographic research is supposed to be recognised as science they have to adhere to the scientific rules of investigation.

In science, data have to be methodically analysed. This fundamental requirement in scientific research appears to have been ignored in economic and demographic research. Hasty conclusion about stagnation followed by explosion is also clearly incorrect and scientifically unacceptable because over 50 years ago, von Foerster, Mora & Amiot (1960) demonstrated that the growth of population during the AD era was hyperbolic. This crucial contribution to science should not have been ignored. It should have been further investigated because hyperbolic growth rules out the interpretations based on the assumption of stagnation followed by explosion.

Postulates of the established knowledge are also unacceptable because hyperbolic growth have been recognised and confirmed by other independent investigations (Kapitza, 2006; Kremer, 1993; Podlazov, 2002; Shklovskii, 1962; 2002; von Hoerner, 1975). Accepting the fundamental postulates of established knowledge is scientifically unjustified because for a long time now there was a large body of data describing the growth of population not only during the AD era but also during the BC era (Biraben, 1980; Clark,1968; Cook,1960; Durand, 1974; Gallant, 1990; Haub, 1995; Livi-Bacci, 1997; McEvedy & Jones, 1978; Taeuber & Taeuber, 1949; Thomlinson, 1975; Trager, 1994; United Nations, 1973; 1999; 2013). These data should have been analysed to check the earlier claims about the hyperbolic growth.

Fundamental postulates of the established knowledge are now contradicted by the excellent new data describing economic growth and the growth of population (Maddison, 2001; 2010). These postulates are scientifically unacceptable because they are consistently contradicted by the analysis of relevant data (Nielsen, 2013a; 2013b; 2013c; 2014; 2015a; 2016a; 2016b; 2016c; 2016d; 2016e; 2016f; 2016g; 2016h; 2016i).

Data describing birth *and* death rates and the associated growth of population are limited (Lehmeyer, 2004; Mauritius, 2015; Statistics Mauritius, 2014; Statistics Sweden, 1999; Wrigley & Schofield, 1981) but they also show consistently that the established knowledge, as expressed in the Demographic Transition Theory, is contradicted by their analysis (Nielsen, 2016c). We do not even have to analyse these data mathematically to see that they are in contradiction of the established knowledge because even though the birth and death rates and the associated growth rates were fluctuating, their time-dependence does not fit into the patterns claimed by the Demographic Transition Theory. Furthermore, the corresponding distributions describing the growth of population do not display any form of stagnation during the alleged Stage 1 or a transition to the alleged Stage 2, which is supposed to represent the explosion. Data show no such patterns.

Demographic Transition Theory is based on a persistent and blatant disregard for relevant data. This theory is supported by largely meaningless presentations of data for birth *or* death rates. These rates have to be studied *together* and they should show the expected behaviour, as claimed by the Demographic Transition Theory, that the gap between them is approximately zero during the alleged Stage 1 and that it increases during the alleged Stage 2. Such patterns are not confirmed by the best available data (Lehmeyer, 2004; Mauritius, 2015; Statistics Mauritius, 2014; Statistics Sweden, 1999; Wrigley & Schofield, 1981), which show that the Demographic Transition Theory is contradicted by the data describing birth and death rates and by the associated data describing the growth of population. Paradoxically, when methodically analysed, data used in support of the Demographic Transition Theory are in fact in its clear contradiction.

A theory contradicted by just a single set of data is scientifically unacceptable and the Demographic Transition Theory was first contradicted by the results of von Foerster, Mora & Amiot (1960) who demonstrated that the growth of human population during the AD era was hyperbolic and thus that Stages 1 and 2 claimed by this theory did not exist. The Demographic Transition Theory should have been rejected or at least fundamentally modified over 50 years ago. Its continuing use over such a long time has been scientifically unjustified.

Postulates of Malthusian stagnation followed by explosion, and all other associated postulates and explanations of the historical economic growth and of the historical growth of population followed by a mythical escape from the Malthusian trap have no place in science. They may, however, have a place in the history of science.

4. Hyperbolic growth

Hyperbolic distributions are strongly deceptive and it is easy to make a mistake with their interpretation. Fortunately, however, analysis of hyperbolic distributions is also trivially simple (Nielsen, 2014) and it is easy to avoid making an easy mistake.

Examples of two hyperbolic distributions, a hyperbolic distribution describing the growth of the world population during the AD era and the distribution describing the world economic growth, are shown in Figures 1 and 2. Their analysis is based on using the method of reciprocal values (Nielsen, 2014). For a sufficiently wide range of data, hyperbolic distributions can be *uniquely* identified using this method because if the reciprocal values are decreasing linearly, then the growth is hyperbolic. There is no other option. It is something similar to the unique identification of the exponential growth. For a sufficiently large range of good quality data, exponential growth can be uniquely identified by the linear distribution of the logarithm of the size of a growing entity.

Figures 1 and 2 show that the growth of human population and economic growth were indeed slow over a long time, but it was hyperbolic growth, which *is* slow over a long time and fast over a short time. It is still the same, *monotonically*-increasing, growth. It is *impossible* to divide such a growth into distinctly-different components and the best way to see it, is to examine the reciprocal values of the size of the growing entity, in our case the reciprocal values of the GDP or of the size of the population (Nielsen, 2014).

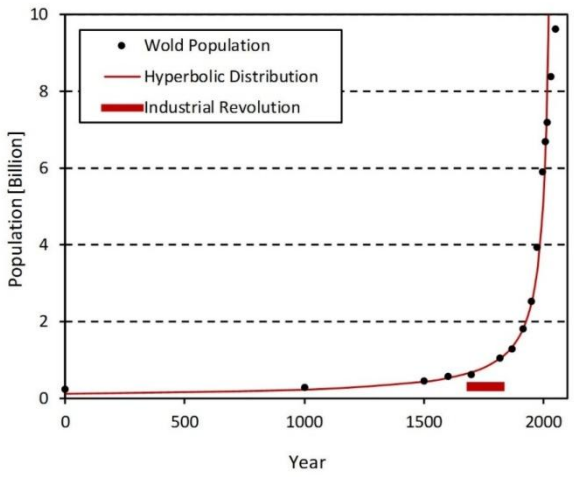

Figure 1. *Data describing the growth of the world population (Maddison, 2010) are compared with hyperbolic distribution.*

Hyperbolic distributions have to be analysed and interpreted as a whole. The same mechanism has to be applied to the slow and fast growth. If we apply the mechanism of Malthusian stagnation to the slow growth, we have to apply precisely the same mechanism to the fast growth. If we apply the mechanism of explosion to the fast growth, then precisely the same mechanism should be applied to the slow growth, which obviously is incorrect because explosion has to be triggered by something and there was clearly no explosion along the slow growth.

The usually assumed event that was supposed to have triggered population explosion or a sudden takeoff in economic growth or in the growth of population is the Industrial Revolution but as we can see in Figures 1 and 2, there was no sudden explosion during the Industrial Revolution or at any other time. The growth was

increasing monotonically. Transition from slow to fast growth takes place all the time. We could demonstrate this monotonic growth even more clearly by using reciprocal values of data or by the semilogarithmic display (Nielsen, 2014; 2016a; 2016b; 2016c; 2016d; 2016e; 2016f; 2016g; 2016h; 2016i) but the primary aim of presenting these two diagrams is to illustrate the deceptive character of hyperbolic distributions. They can easily lead to incorrect interpretations particularly when they are not analysed but only used to quote certain, well-selected numbers or when they are deliberately manipulated and distorted (Ashraf, 2009; Galor, 2005a; 2005b; 2007; 2008a; 2008b; 2008c; 2010; 2011; 2012a; 2012b; 2012c; Galor & Moav, 2002; Snowdon & Galor, 2008) to support preconceived ideas. Hyperbolic distributions have to be analysed.

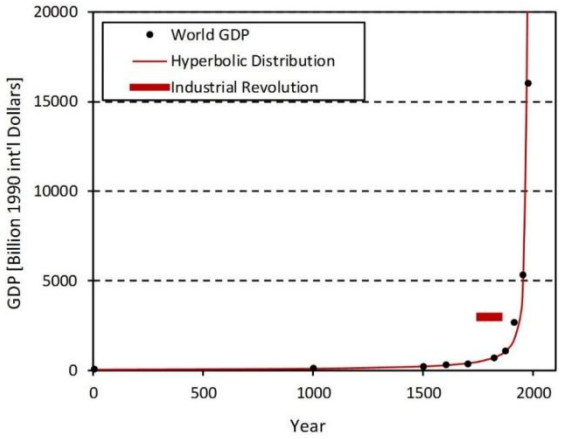

Figure 2. *Data describing the growth of the world Gross Domestic Product (Maddison, 2010) are compared with hyperbolic distribution.*

Figure 1 shows also that the growth of population is not yet levelling off. It is still following closely the fast-increasing historical hyperbolic distribution. Maddison's data end in 2008. The point representing the size of the population in 2014 is from the US Bureau of Census (2016) while the last two points are the predicted values (Nielsen, 2006). Not until 2030 or maybe even until 2050 could we expect a clear departure from the historical hyperbolic trend. The future of the population growth is uncertain, in much the same way as the future of the world economic growth (Nielsen, 2015b).

5. The origin of the concept of stagnation

Two features make the concept of the epoch of Malthusian stagnation deceptively attractive: (1) it is strongly believable and (2) it is supposed to have originated over 200 years ago. It is believable because the growth of human population and the economic growth over thousands of years were indeed slow, so slow that they appear to have been stagnant. It is also an old concept because its origin is traced, to Malthus (1798), perhaps inaccurately because Malthus never used the word *stagnation* in his book.

> The Malthusian theory, as was outlined initially by Malthus (1978), captures the main attributes of the epoch of Malthusian stagnation that had characterized most of human existence… (Galor, 2005, p. 221).
>
> The idea of multiple equilibria, or poverty traps, can be retraced back to Malthus (Wang, 2005, p. 36).

The work of Malthus was the first well-documented attempt to understand and explain the mechanism of growth of human population but it appears that this is

also precisely where it ended. Considering the time when Malthus was writing his book, it was a remarkable achievement, but his work should have been not only checked but also extended using a large body of data, which were not available to Malthus but which are readily available to us.

> The history of population theory can be summarized in three words: pre-Malthusian, Malthusian, and post-Malthusian. Hardly ever in intellectual history does one man so dominate a field as does the Reverend Thomas Robert Malthus in demographic theory. To paraphrase a quotation attributed to Newton, Malthus' shoulders *must* be climbed (Thomlinson, 1965, p. 47. Italics in the original text.).
>
> …the demographic transition experiences three regimes: the 'Malthusian Regime,' the 'Post-Malthusian Regime,' and the 'Modern Growth Regime.' *Any theory* attempts (sic) to describe the process of demographic transition *must* include these three periods (Wang, 2005, p. 3. Italics added.).

Claiming, suggesting or assuming that something *must* be accepted just because it comes from a certain source is not acceptable in science. Any theory can be questioned and even should be questioned, and if necessarily corrected or rejected. The sooner it is done, the better it is for science. If Malthus's shoulders must be climbed it is only for the same reason as climbing the shoulders of any giant of human intellect: to see better and further ahead. It is not just to have a comfortable ride.

However, we are not even climbing Malthus's shoulders. Attaching his name to the concept of stagnation and calling it Malthusian stagnation sounds like defamation. It is questionable whether Malthus would be pleased with such a dubious distinction. We are putting our interpretation into his work and we are claiming that he did it.

If we read his publication carefully, we can find that he was writing not only about the devastating effects of positive checks but also about their regenerating effects (Nielsen, 2013b). Given enough time he would have probably studied this issue further. Descriptions of destructive effects of positive checks, which we label rather inaccurately as Malthusian stagnation should be balanced by descriptions of regeneration, which Malthus mentions in his book.

The name "Malthusian stagnation" is a misnomer because Malthus never claimed that positive checks would produce prolonged and wide-spread stagnations in the growth of population and because we know now that Malthusian positive checks, even if present, were not producing such effects (Kapitza, 2006; Kremer, 1993; Nielsen, 2013a; 2014; 2016b; 2016c; 2016d; Podlazov, 2002; Shklovskii, 1962; 2002; von Hoerner, 1975; von Foerster, Mora & Amiot, 1960). They appear to have been generally either too weak or their destructive impacts were effectively compensated by the well-known, natural process of regeneration (Nielsen, 2013a; 2013b; 2013c).

It would be interesting to search for impacts of Malthusian positive checks on the growth of population by investigating the growth of local populations. Generally, there appears to have been no impact. The only known example (Nielsen, 2016d) is a minor distortion in the growth of the world population between AD 1200 and 1400, which appears to be correlated with the convergence of *five* major demographic catastrophes: Mongolian Conquest (1260-1295) with the total estimated death toll of 40 million; Great European Famine (1315-1318), 7.5 million; the 15-year Famine in China (1333-1348), 9 million; Black Death (1343-1352), 25 million; and the Fall of Yuan Dynasty (1351-1369), 7.5 million. In general, demographic catastrophes were too weak to disturb the growth of global population (Nielsen, 2013c).

Looking for convincing evidence of impacts of Malthusian positive checks on the growth of population would not be easy because we would have to demonstrate

not only clear discontinuities in the growth of population but also that these discontinuities are correlated with the records of demographic catastrophes. We would have to know the intensity of these demographic catastrophes not just in the number of deaths but in their relative impact. However, even then we would have to be aware of the possibility of spurious correlations.

Malthus never claimed that his concepts must be accepted. On the contrary, he was open to new ideas. Referring to himself in the third person he wrote:

> If he should succeed in drawing the attention of more able men to what he conceives to be the principal difficulty in the way to the improvement of society and should, in consequence, see this difficulty removed, even in theory, *he will gladly retract his present opinions and rejoice in a conviction of his error* (Malthus, 1798, p. viii. Italics added.)

It is interesting that Malthus used arithmetic and geometric progressions to support his arguments but it is not certain whether he was familiar with the hyperbolic growth, let alone that he appreciated the difference between hyperbolic and exponential (geometric) types of growth. Even now, hyperbolic distributions are repeatedly misinterpreted and exponential growth is used to explain the growth of just about anything.

Malthus claimed that "Population, when unchecked, increases in a geometrical ratio" (Malthus, 1978, p. 4). Now we know that this is not true. Population, when unchecked does not increase in a geometrical ratio (exponentially) but hyperbolically (Kapitza, 2006; Kremer, 1993; Nielsen, 2016b; 2016d; Podlazov, 2002; Shklovskii, 1962; 2002; von Hoerner, 1975; von Foerster, Mora & Amiot, 1960).

Malthus did not base his claims on a rigorous analysis of data. If he lived long enough to have better data, he would have probably discovered that the growth of population is not characterised by a constant doubling time and consequently that it could not have been increasing exponentially. If he were familiar with hyperbolic growth, he would have probably discovered that population increases hyperbolically. However, Malthus did not live long enough, he did not have access to good data and he was probably unfamiliar with hyperbolic growth. Those who lived after him and those who live now are more privileged.

6. Examples of questionable claims

6.1. The alleged Law of Population

During the alleged but non-existent epoch of Malthusian stagnation, birth rates are claimed to have been high because new generations were needed to support many tiresome and mundane activities such as hunting, gathering, cultivating crops, caring for children and generally for coping with harsh living conditions.

> According to Classical economists, and early Neo-Classical economists as well, population size was determined by the demand for labor. This was the Law of Population which constantly operated behind the seemingly random variations in fertility and mortality induced by epidemic, famine, and war (Lee, 1997, p. 1063).

Claims:

1. Population size was determined by the demand for labour.
2. This is the Law of Growth.
3. This law has been accepted by Classical and early Neo-Classical economists.
4. There were seemingly random variations in fertility and mortality.
5. Random variations were caused by epidemics, famine and war.
6. This law operated constantly behind these seemingly random variations.

It is interesting how much is claimed in this single paragraph and it does not matter whether Lee agrees with all these claims or just describes them. This

quotation represents a typical set of questionable claims often encountered in publications related to the concept of the epoch of Malthusian stagnation. Can we prove them or do we have to accept them by faith?

To prove this "Law of Population" we would have to have data about the demand for labour and about the growth of population extending over thousands of years, and we would have to prove that there is a correlation between the demand for labour and the size of human population. We would have to prove that population size was determined by the demand for labour. We cannot prove it because we do not have such data, but we can show that the population data (Nielsen, 2016b; 2016d) do not display any features that could be linked with this alleged "Law of Population." This law has to be accepted by faith but this law is also in contradiction with data and with their analysis.

It is easy to imagine and claim, without a proof, that there were random variations in the fertility and mortality. It would be probably more difficult to expect that there were no variations but we have no information about these variations. We can only imagine them but we cannot analyse them.

We have reliable data about the *size* of human population (Biraben, 1980; Clark,1968; Cook,1960; Durand, 1974; Gallant, 1990; Haub, 1995; Livi-Bacci, 1997; Maddison, 2001; 2010; McEvedy & Jones, 1978; Taeuber & Taeuber, 1949; Thomlinson, 1975; Trager, 1994; United Nations, 1973; 1999; 2013) over thousands of years but we have *no matching data for fertility and mortality (birth rates and death rates)*. We also have no matching data about epidemics, famines and wars to study how they were correlated with "random variations in fertility and mortality." We have absolutely no way of proving that "the Law of Population" "constantly operated behind the seemingly random variations in fertility and mortality induced by epidemic, famine, and war." This claim is *unscientific* because we can never expect to verify it by data but also it is scientifically unacceptable because data and their analysis give no support for such declarations.

It should be also noted that growth of population is not determined directly by birth and death rates but by the *difference* between these two quantities. This difference determines the *growth rate*. More precisely, it determines the rate of natural increase but generally migrations rates are relatively small and consequently the difference between birth and death rates can be taken as determining the growth rate.

A constant (non-zero) difference (constant growth rate) produces *exponential* growth. A zero difference produces *constant* population. However, variable difference between birth and death rates (i.e. the variable growth rate) does not necessarily produce a variable *size* of the population. In fact, even large fluctuations in the growth rate are not readily reflected in the growth of population. They might be reflected only as small and negligible variations (Nielsen, 2016c).

Fluctuations in birth and death rates have no impact on the mechanism of growth because they do not change population growth trajectories. We can see it even without analysing data. We can easily check that even for data characterised by large fluctuations in birth and death rates, and consequently by large fluctuations in the growth rate, the corresponding data, which describe the growth of population are not affected by such fluctuations. Fluctuations in birth and death rates do not change the general character of the distributions describing the growth of population (Lehmeyer, 2004; Mauritius, 2015; Statistics Mauritius, 2014; Statistics Sweden, 1999; Wrigley & Schofield, 1981). These data are well known. Some of them are even repeatedly used to defend the erroneous Demographic Transition Theory but no-one cared to check the population data published in the same sources, which list the fluctuating birth and death rates. While the fluctuating birth and death rates are taken as the confirmation of the established knowledge,

the data describing the growth of population, data coming from precisely the same sources as the data for birth and death rates, are methodically ignored. Data describing the growth of population are in contradiction of the Demographic Transition Theory and in contradiction of the established knowledge.

6.2. The alleged losing battle

According to the concept of the epoch of Malthusian stagnation, as soon as the population started to increase, it was significantly reduced by numerous factors associated with severe living conditions.

> During the first [stage of the demographic transition], fertility is assumed to have been sufficiently high to allow a population to grow slowly even in the face of a rather high level of mortality. However, periodic epidemics of plague, cholera, typhoid and other infectious diseases would *in one or two years wipe out the gains made over decades*. *Over long periods of time there would, consequently, be almost no population growth at all* (van de Kaa, 2010, p. 87. Italics added.).

Claims:

1. During the first stage of the demographic transition, fertility and mortality are assumed to have been high.
2. Population was growing slowly.
3. Population growth was strongly controlled by periodic epidemics of plague, cholera, typhoid and other infectious diseases.
4. Periodic epidemics of plague, cholera, typhoid and other infectious diseases would in *one or two years* wipe out the gains made over *decades.*
5. Over long periods of time there was no population growth at all.

Van de Kaa describes the first of the four stages of growth claimed by the classical Demographic Transition Theory, the stage corresponding to the mythical but non-existent epoch of Malthusian stagnation (Nielsen 2016b; 2016c; 2016d).

Here we have a vivid description of what was happening so long ago and over a long time; not only a vivid description but also an explanation. In science, one would have to do a lot of solid work in order to be able to make such a sweeping declaration. We would have to prove that our conclusions are supported by data. We would have to give frequent examples that *the growth of population* was indeed *controlled* by "periodic epidemics of plague, cholera, typhoid and other infectious diseases." We would have to demonstrate convincingly that there were *frequent correlations* between "periodic epidemics of plague, cholera, typhoid and other infectious diseases" and the growth of population. Ideally, we would also have to prove that these frequent irregularities were *caused* by "periodic epidemics of plague, cholera, typhoid and other infectious diseases" because even observed correlations could be spurious.

Van de Kaa produces no such proof. He does not even give reference to such research. As far as we can tell, no-one has ever carried out such systematic and well-documented research.

His claims have to be accepted by faith and even more importantly, by a fixated faith because they are contradicted by data (Biraben, 1980; Clark,1968; Cook,1960; Durand, 1974; Gallant, 1990; Haub, 1995; Livi-Bacci, 1997; Maddison, 2001; 2010; McEvedy & Jones, 1978; Taeuber & Taeuber, 1949; Thomlinson, 1975; Trager, 1994; United Nations, 1973; 1999; 2013). With only one exception in the past 12,000 years, between AD 1200 and 1400 (Nielsen, 2016d), there is no convincing evidence of generally occurring "long periods of time" when there was "almost no population growth at all" and that the growth was controlled by "periodic epidemics of plague, cholera, typhoid and other infectious diseases." The only way we could hope to give support to his claims would be to find exceptions to the generally observed regularities in the growth of population

but even then his claims would not have a general application. The established knowledge may sound plausible and convincing but it has to be accepted by faith.

It is scientifically incorrect to take an easy way out by assuming that something happened, which we *think* could have happened and claim with such absolute certainty that it *did* happen. We might feel or think that our descriptions are true; we might wish for them to be true, but we should test them by following the generally accepted process of scientific investigation.

6.3. The alleged food-controlled homeostatic equilibrium

Harsh living conditions, and in particular the availability of food, are supposed to have a suppressive influence on the growth of human population but these intuitive expectations are again contradicted by data (UNDP, 2011) showing that growth rate is not directly proportional to the level of affluence but to the level of deprivation (Nielsen, 2013b). There is also convincing evidence that harsh living conditions in the distant past did not shape the growth of population (Nielsen, 2016b; 2016d; von Foerster, Mora & Amiot, 1960). Again, it is scientifically inexcusable to take an easy way out, ignore data and try to mould science in the image of our wished-for interpretations.

> …the food-controlled homeostatic equilibrium had prevailed since time immemorial (Komlos, 2000, p. 320).
>
> …the population tends to oscillate in a homeostatic mechanism resulting from the conflict between the population's natural tendency to increase and the limitations imposed by the availability of food (Artzrouni & Komlos, 1985, p. 24).

Claims:

1. There was a food-controlled homeostatic equilibrium.
2. This equilibrium prevailed since time immemorial.
3. Population tends to oscillate in a homeostatic mechanism.
4. Oscillations are caused by the natural tendency of the population to increase and by the limitations imposed by the availability of food.

It is easy to *assume* that "the food-controlled homeostatic equilibrium had prevailed since time immemorial" but it is more difficult to *prove* it. It is easy to *claim* that "the population tends to oscillate in a homeostatic mechanism resulting from the conflict between the population's natural tendency to increase and the limitations imposed by the availability of food" but it is more difficult to *prove* it.

Authors of these confident declarations do not prove anything nor do they give reference to such a proof because such a proof does not exist. These declarations are in harmony with the established knowledge but the established knowledge is in conflict with science (Kapitza, 2006; Kremer, 1993; Nielsen, 2016b; 2016d; Podlazov, 2002; Shklovskii, 1962; 2002; von Hoerner, 1975; von Foerster, Mora & Amiot, 1960).

In order to have these declarations supported by science we would have to work a little harder. We would have to design a model with the homeostatic equilibrium. We would have to have data for the availability of food "since time immemorial." We would have to have corresponding data describing the growth of population. These data would have to be at small time intervals in order to detect the postulated oscillations. We would have to demonstrate convincingly that there were oscillations in the growth of population and that there was a correlation between the recorded oscillations in the growth of population and the oscillations in the availability of food. We would have to prove that the oscillations in the growth of population were *caused* by the oscillations in the availability of food. Acceptable evidence would have to be in demonstrating that our mathematical model reproduces all these oscillations. This would have been science but what we are offered is just a story, which has to be accepted by faith.

It is easy to claim many things but it is more difficult to prove them. Our postulates and explanations might sound plausible but they would have to be verified by the rigorous process of scientific investigation. Data (Biraben, 1980; Clark,1968; Cook,1960; Durand, 1974; Gallant, 1990; Haub, 1995; Livi-Bacci, 1997; Maddison, 2001; 2010; McEvedy & Jones, 1978; Taeuber & Taeuber, 1949; Thomlinson, 1975; Trager, 1994; United Nations, 1973; 1999; 2013) give no support for the existence of the claimed fluctuations or oscillations.

There is no scientific basis for claiming that "food-controlled homeostatic equilibrium had prevailed since time immemorial." This claim has to be accepted by faith. We have to accept by faith that "population tends to oscillate in a homeostatic mechanism resulting from the conflict between the population's natural tendency to increase and the limitations imposed by the availability of food." It all might sound plausible but we cannot prove it. However, even if it sounds plausible it is contradicted by the rigorous analysis of data (Nielsen, 2016b; 2015d).

Artzrouni & Komlos (1985) carried out model calculations, which incorporated the assumed mechanism of Malthusian stagnation. Their contribution is important but for reasons, which were not even noticed in their publication because their results show that the mechanism of Malthusian stagnation does not work. We shall discuss this issue in one of our forthcoming publications.

6.4. The allegedly characteristic features of the past human history

> Stage 1 [of the Demographic Transition Theory] presumably characterizing *most of human history*, involves high and relatively equal birth and death rates and little resulting population growth" (Guest & Almgren, 2001; p. 621. Italics added.).
>
> This stage is characterized not by changes in *average* death rates but by a *stagnation of death rates at extremely high levels* for a period of what is believed to be *thousands of years*" (Olshansky & Ault, 1986, p. 357. Italics added.).

Claims:

1. Stage 1 proposed by the Demographic Transition Theory characterised presumably most of human history.
2. During this stage there were high and relatively equal birth and death rates.
3. During this stage there was little resulting population growth.
4. This stage was not characterised by changes in the average death rates.
5. This stage was characterised by stagnation of death rates at extremely high levels.
6. This stagnation is believed to have lasted for thousands of years.

It is amazing how firmly the established knowledge is now established if so much can be so easily claimed. The declaration that Stage 1 proposed by the Demographic Transition Theory was "characterized not by changes in *average* death rates but by a *stagnation of death rates at extremely high levels* for a period of what is believed to be *thousands of years*" has to be accepted by faith and by faith alone because we can never expect to have systematic data describing death rates to check its validity. No-one has yet demonstrated the validity of the Demographic Transition Theory. No-one has yet demonstrated the existence of the first two stages of growth, let alone the existence of all stages of growth.

Examples used in support of the Demographic Transition Theory are in fact in its direct contradiction (Nielsen, 2016c). As pointed out earlier (Nielsen, 2016c), the only way to demonstrate the apparent empirical features, which seem to be in agreement with the Demographic Transition Theory, is by a suitable manipulation of data consisting in stitching together the birth and death rates data for Mauritius with the data for Sweden.

It should be also remembered that any scientific theory is acceptable only if it is consistently confirmed by empirical evidence. A single convincingly contradicting evidence questions the validity of an accepted theory. For the Demographic Transition Theory, it is the other way round. There is not a single convincing empirical evidence in support of this theory but there is overwhelming empirical evidence showing that this theory is incorrect. This theory is contradicted by birth and death rates and by the corresponding distributions describing the growth of population (Nielsen, 2016c). Furthermore, within the range of analysable data (Biraben, 1980; Clark,1968; Cook,1960; Durand, 1974; Gallant, 1990; Haub, 1995; Livi-Bacci, 1997; Maddison, 2001; 2010; McEvedy & Jones, 1978; Taeuber & Taeuber, 1949; Thomlinson, 1975; Trager, 1994; United Nations, 1973; 1999; 2013) growth of population was hyperbolic (Kapitza, 2006; Kremer, 1993; Nielsen, 2016b; 2016d; Podlazov, 2002; Shklovskii, 1962; 2002; von Hoerner, 1975; von Foerster, Mora & Amiot, 1960). Stages of growth proposed by the Demographic Transition Theory did not exist.

Birth and death rates may have been high and strongly fluctuating but high and fluctuating birth and death rates do not prove the existence of a stagnant state of growth because, as mentioned earlier, growth is determined by the average *difference* between these two quantities. Furthermore, these two quantities have to behave in a very specific way to produce the stagnant state of growth. Studying just death rates *or* birth rates, or equivalently studying just the fertility rates (Lehr, 2009) cannot be used as the evidence in support of the Demographic Transition Theory. Using scraps of favourable information while ignoring contradicting evidence is strongly misleading and consequently scientifically unacceptable.

6.5. The allegedly well-documented evidence

> It is well documented that the fluctuations experienced by the world's population throughout history did not have a regular, cyclical pattern, but were, to a large extent, brought about by randomly determined demographic crises (wars, famines, epidemics, etc.). As McKeown and others have pointed out, the main cause of these fluctuations of the past were mortality crises. There are four kinds of crises: subsistence crises, epidemic crises, combined crises (subsistence/epidemic), and finally crises from other causes, which are mainly exogenous (wars, natural or other catastrophes)
>
> Crises followed by *periods of population decline* during which the nutritional status of the population improved gave rise to fluctuations which testify to the continued existence of the 'Malthusian trap': population would not grow beyond its carrying capacity for long, and when it did, the resulting overshoot was followed by a 'crash' (i.e. the positive checks such as diseases, famines, wars, etc.) (Artzrouni & Komlos 1985, p. 24. Italics added.).

Claims:

1. There were fluctuations in the world's population throughout history.
2. These fluctuations are well documented.
3. It is well documented that these fluctuations did not have a cyclic pattern.
4. It is well documented that these fluctuations were, to a large extent, brought about by randomly determined demographic crises (wars, famines, epidemics, etc.).
5. The main cause of these fluctuations were mortality crises.
6. There are four types of crises.
7. Crises were followed by periods of population decline.
8. Population decline improved nutritional status.
9. Fluctuations testify to the continuing existence of the Malthusian trap.
10. Population was repeatedly reaching its carrying capacity.
11. Population would not grow beyond its carrying capacity for long.
12. Population growing beyond its carrying capacity was reflected in overshoots.

13.Overshoots were followed by crashes.

If all this is so well documented, where is the documentation of this well documented research? It would be interesting to see at least a few references to this important and fundamental research work, to see the *data* showing fluctuations "throughout history," to see a positive proof that the "the fluctuations experienced by the world's population throughout history" are *correlated* with "demographic crises (wars, famines, epidemics, etc.)," that they were "brought about by randomly determined demographic crises." It would be also interesting to see convincing evidence that population was reaching its carrying capacity, that "population would not grow beyond its carrying capacity for long," the convincing evidence of overshoots and crashes, evidence that crashes were associated with "positive checks such as diseases, famines, wars, etc." It would be interesting to see the compelling evidence of the existence of the Malthusian trap, the demonstration of frequent "periods of population decline," the compelling proof that periods of population decline caused by demographic crises were improving nutritional status. All this vital and "well documented" evidence is missing.

What is well documented is the repeated fiction stories, which have to be accepted by faith. We have many publications propagating such stories. The repeatedly related stories of fiction are by now accepted as the undisputable facts. What is well documented is a system of beliefs, doctrines, wished-for explanations, opinions, views, theories, hypotheses, conjectures and speculations, added gradually over a long time until they became the established knowledge, the "well-documented" established knowledge but the knowledge, which is contradicted by science.

In contrast, it is well documented (Biraben, 1980; Clark,1968; Cook,1960; Durand, 1974; Gallant, 1990; Haub, 1995; Livi-Bacci, 1997; Maddison, 2001; 2010; McEvedy & Jones, 1978; Taeuber & Taeuber, 1949; Thomlinson, 1975; Trager, 1994; United Nations, 1973; 1999; 2013) that the growth of human population does *not* show fluctuations or random behaviour. It is well documented that the data show no signs of frequent overshoots and crashes, no signs of growth reaching its carrying capacity, no signs of the "continued existence of the 'Malthusian trap'," no evidence that the "population would not grow beyond its carrying capacity for long," and no repeated "periods of population decline." All these colourful and dramatic descriptions associated with the narrative based on the assumption of the existence of the mythical epoch of Malthusian stagnation are contradicted by data.

It is obvious, that demographic crises were often causing decline in the size of *local* populations, depending on the scale of these crises and depending on what we understand by a local crisis. Sometimes it might have been just a large death toll in a city, in a part of a country, as for instance in China (Mallory, 1926), or maybe in the whole country or even extending over a few countries. However, a large death toll does not necessarily mean a significant impact on the growth of human population. A large death toll should not be immediately interpreted as a population decline; it could have been just a slower growth over a limited time followed by a more intensified growth, as it happened after AD 1400 for the world population.

All these issues should be closely investigated by examining records of demographic catastrophes. To arrive at any reasonably supported conclusion, we would have to do some hard work. However, data which should be used for such investigations are strongly limited. We have no data showing that local demographic crises were repeatedly causing fluctuations in the growth of regional or global populations. In fact, the data show remarkably stable growth of human

population, generally unaffected by demographic crises (Nielsen, 2013a; 2013c; 2016b; 2016d).

The opening paragraph in the above quotation contains two interesting and characteristic elements, the elements occurring repeatedly in the descriptions of the concept of the epoch of Malthusian stagnation: (1) it makes a highly-questionable but confident declaration about the *existence* of certain features (in this case about the existence of fluctuations) and (2) it equally confidently *explains* them while ignoring empirical evidence. The normal progression in scientific research is *first to observe* certain features and then try to *explain* them. We can also reverse the process: we can first *predict* the existence of certain features. However, to accept the prediction and the associated explanation, we would have to *demonstrate the existence* of the predicted features. This is how science works but for doctrines accepted by faith scientific process of investigation is too tedious and consequently it is readily ignored.

So in this case, we would have to show first that there were significant fluctuations in the birth and death rates and in the size of human population extending over thousands of years, and then we would also have to explain them convincingly by demonstrating that they were correlated with demographic crises. Alternatively, we would have to predict (using a suitable mathematical model) the existence of fluctuations in birth and death rates and in the size of human population and then we would have to show that our predictions are confirmed by relevant data.

We cannot prove that there were fluctuations "throughout history" in the birth and death rates because we do not have relevant data, but we can prove that there were no fluctuations "throughout history" in the *size* of human population because we have the relevant data (Biraben, 1980; Clark,1968; Cook,1960; Durand, 1974; Gallant, 1990; Haub, 1995; Livi-Bacci, 1997; Maddison, 2001; 2010; McEvedy & Jones, 1978; Taeuber & Taeuber, 1949; Thomlinson, 1975; Trager, 1994; United Nations, 1973; 1999; 2013). There is nothing in the data, which calls for the explanations of fluctuations in the growth of population because there are no fluctuations. What needs to be explained is perhaps the remarkable *absence* of fluctuations, the absence of random behaviour, crashes, overshoots or "periods of population decline." What needs to be explained is why the growth of population was so remarkably stable during the past 12,000 years (Nielsen, 2016d) and why it was hyperbolic. The quoted declarations are in perfect agreement with the established knowledge but they are in conflict with science.

6.6. The allegedly long-run equilibrium between population size and the food supply

Referring to three sources (Habakkuk, 1953; Kunitz, 1983; McKeown, 1983), Komlos explains:

> Malthusian positive checks (mortality crises) maintained *a long-run equilibrium between population size and the food supply*. Crises followed by periods when human nutritional status was above the level of subsistence gave rise to *cycles. …the cycles testify to the continued existence of the 'Malthusian population trap'*: *population could not grow beyond an upper bound imposed by the resource and capital constraints* of the economic structure in which it was imbedded. The *'escape' from this trap* occurred only when the aggregate capital stock was large enough and grew fast enough to provide additional sustenance for the population, which thereby overcame the effects of the diminishing returns that had hindered human progress during *the previous millennia*. After escaping from the Malthusian trap, population was able to grow unchecked. In historic terms, this escape corresponds to the industrial and demographic revolutions. Removal of the

> nutritional constraint, at least for the developed part of the world, resulted in the population explosion (Komlos, 1989, pp. 194, 195. Italics added.).

Claims:

1. There was a long-term equilibrium between population size and the food supply.
2. This equilibrium was maintained by positive checks (mortality crises).
3. Crises were followed by periods when human nutritional status was above the level of subsistence.
4. This process gave rise to cycles.
5. The cycles testify to the continued existence of the 'Malthusian population trap'.
6. Population could not grow beyond an upper bound imposed by the resource and capital constraints of the economic structure in which it was imbedded.
7. Malthusian trap was active for millennia.
8. The escape from the Malthusian trap occurred when the aggregate capital stock was large enough and grew fast enough to provide additional sustenance for the population.
9. The removal of nutritional constrains caused population explosion.

Massive amount of work would have to be done to support all these impressive declarations. We would have to study food supply over millennia and determine how they were correlated with the growth of human population. We would have to prove that there was "a long-run equilibrium between population size and the food supply." We would have to study mortality crises over millennia. We would have to establish a correlation between the growth of human population, food supply and mortality crises. We would also have to investigate upper bounds of "resource and capital constraints" and prove that over millennia the size of the population was repeatedly reaching the limits of these upper bounds.

Conducting scientific research is not easy but results have a high degree of reliability. Writing fictions stories, whose general script is already provided by the established knowledge based largely on faith is much easier, but this is not science.

It is easy to declare so much so quickly and with such a confidence, but it is harder to prove it. It is also hard to accept it, but accept we must if we want to accept the concept of the epoch of Malthusian stagnation promoted by the established knowledge.

The claimed cycles cannot possibly testify to "the continued existence of the 'Malthusian population trap'" because they did not exist in the growth of population (Nielsen, 2016b; 2016d; von Foerster, Mora & Amiot, 1960). Population growth, global and regional, was remarkably stable and unconstrained. The claim that "population could not grow beyond an upper bound imposed by the resource and capital constraints" is contradicted by the analysis of population data. This claim appears to be based on pure fantasy and on a wished-for mechanism that did not exist. There was no Malthusian trap in the growth of population.

We know nothing about any possible cycles in birth and death rates because we have no relevant data extending over a long time in the past. We do not know how large were these alleged cycles. We do not even know whether they existed. Discussions of these cycles are irrelevant because we know that cycles in birth and death rates are of little or no consequence for explaining the mechanism of growth (Nielsen, 2016c). Even if they were present they did not have any significant influence on the growth of the world population in the past 12,000 years (Nielsen, 2016d). They also had no influence on the growth of regional populations (Nielsen, 2016b). The absence of cycles in the growth of population combined with the evidence of the steadily increasing growth testify that the Malthusian trap did *not* exist. We cannot also claim that there was "'escape' from this trap" because there

was no trap in the growth of population. There was also no trap in the economic growth (Nielsen, 2014; 2015a; 2016a; 2016e; 2016f; 2016g; 2016h; 2016i). Again, the quoted declarations are in perfect agreement with the established knowledge but they are in conflict with science.

6.7. The alleged fluctuation of fertility and mortality rates around zero

Discussing the first stage of the Demographic Transition Theory, Warf explains:

> Because both fertility and mortality rates are high, the *difference* between them — natural population growth — is relatively low, *fluctuating around zero*" (Warf, 2010, p. 708. Italics added.).

Claims:

1. During the first stage of the demographic transition fertility and mortality rates were high.
2. The difference between them (the natural population growth) was fluctuating around zero because they were high.

Just because fertility and mortality rates were high it does not follow that the difference between them was zero. The difference between them can fluctuate around zero even if they are low. However, this is just a minor issue.

In this quotation the "natural population growth" is identified as the *difference* between the fertility and mortality rates. It is, therefore, the rate of natural increase or the *growth rate* because, in general, migration rates are relatively small and can be neglected.

We shall recall that while the growth rate fluctuating around a constant value describes exponential growth, the growth rate "fluctuating around zero' describes the constant size of the growing entity, i.e. in our case, the constant size of the population. The claim made by Warf is contradicted by data, which show that for thousands of years the size of human population was not constant but steadily *increasing* (Nielsen, 2016b; 2016d; von Foerster, Mora & Amiot, 1960). Furthermore, the size of population was increasing hyperbolically. The "natural population growth" (growth rate) could not have been "fluctuating around zero" but it must have been increasing hyperbolically because for the hyperbolic growth, the growth rate also increases hyperbolically (Nielsen, 2016h).

6.8. The alleged roughly constant population

In line with the accepted interpretations of the first stage of the Demographic Transition Theory, Lagerlöf writes:

> The Malthusian Regime in our model is a stable situation where death and birth rates are both high, and *population roughly constant*. Moreover, mortality is highly volatile, increasing dramatically in periods of big epidemic shocks. In periods with mild shocks population expands. This worsens the impact of the next epidemic, equilibrating population back to its Malthusian state (Lagerlöf, 2003a, p. 756. Italics added.).
>
> In our model, the world can thus be stuck in a *Malthusian equilibrium* for centuries and then suddenly escape, and never contract back. As suggested by a referee, this process could possibly be interpreted in terms of wars, instead of epidemics (Lagerlöf, 2003a, p. 766. Italics added.).
>
> *Throughout human history, epidemics, wars and famines have shaped the growth path of population*. Such shocks to mortality are the central theme of the model set up by Lagerlöf, which endogenously generates a long phase of *stagnant population* and living standards, followed by an industrial revolution and a demographic transition (Lagerlöf, 2003b, pp. 434, 435. Italics added.).

Claims:

1. It is assumed that there was a Malthusian regime.
2. It is assumed that Malthusian regime is characterised by high birth and death rates.

3. During the Malthusian regime population is roughly constant.
4. Mortality is highly volatile.
5. Mortality increases dramatically in periods of big epidemic shocks.
6. Population expands when the mortality shocks are mild.
7. Expanding population worsens the impact of the next epidemic and equilibrates population to the Malthusian state.
8. Malthusian equilibrium lasts for centuries.
9. The process of Malthusian equilibrium can be also explained by wars instead of epidemics.
10. Throughout human history, epidemics, wars and famines have shaped the growth path of population.
11. Model based on the assumption of shocks to mortality generates a long phase of stagnant population.
12. The "long phase of stagnant population and living standards" is "followed by an industrial revolution and a demographic transition."

Here again, and quite typically, we have a series of declarations that have to be accepted by faith. However, paradoxically if not ironically, Lagerlöf was on the verge of discovering that doctrines accepted by faith were contradicted by his own model.

He has carried out an interesting and important research work but unfortunately he did not finish it: he did not compare results of his calculations with data (Maddison, 2001), which were available to him before publication of his work. He did not take the final and the most essential step. If he did, he would have discovered that the mechanism of Malthusian stagnation incorporated in his model did not produce fluctuations in the model-generated growth of population, that model-generated growth of population was not stagnant and it did not fit the relevant data. He would have found that contrary to what he claims in his publication, his model generated population was *not* "roughly constant." If he cared to consult data (Maddison, 2001) he would have also found that the population reported by Maddison was also not "roughly constant." We shall discuss these issues in a separate publication.

Lagerlöf presents a plot of the growth rate and calls it erroneously "Population growth" (Lagerlöf, 2003b, p. 436). He fails to take the most essential step in this type of work and to use his model-generated growth rate to calculate model-generated distribution describing the growth of population. He ignores data (Maddison, 2001) and yet his unfinished work is accepted for publication maybe because it proclaims loud and clear the doctrines of the established knowledge. Science appears to be of no importance.

6.9. Incorrect claims about the growth rate

> In our model, this leads to a *constant rate* of population growth prior to the adoption of the Solow technology. This result is consistent with population data from Michael Kremer (1993), where *the growth rate of population fluctuates around a small constant* throughout most of the Malthusian period (from 4000 B.C. to A.D. 1650) (Hansen & Prescott (2002), p. 1205. Italics added.).

Claims:

1. Growth rate of population fluctuates around small constant during the Malthusian period (i.e. prior to the adoption of Solow technology).
2. Small and roughly constant growth rate is consistent with population data from Michael Kremer (1993).

First, it appears that Hansen and Prescott might be confusing constant growth rate with constant population. It might be the same mistake as it appears to have been made by Lagerlöf (2003b). A constant (non-zero) growth rate does not

produce a constant (non-zero) size of population. A constant (non-zero) growth rate produces *exponential* growth.

Second, this declaration appears to contain conflicting information. It is hard to imagine that random forces characterising the mythical Malthusian period would produce a steadily increasing exponential growth. Steadily-increasing growth suggests the presence of a dominating constant force, overruling any random forces.

Third, fluctuations in the growth rate are not readily reflected as fluctuations in the growth of population (Nielsen, 2016c). We can demonstrate it even without carrying mathematical analysis of the fluctuating growth rate. Data alone (Lehmeyer, 2004; Mauritius, 2015; Statistics Mauritius, 2014; Statistics Sweden, 1999; Wrigley & Schofield, 1981) show clearly that fluctuating growth rates do not produce significant fluctuations in the growth of population and that they have no impact on the mechanism of growth because they do not alter growth trajectories.

Fourth, we would have to show convincingly that the growth rate was indeed fluctuating around a small constant value as claimed by Hansen & Prescott (2002). There is no such proof because we do not have the data for the growth rate extending over thousands of years. However, there is a proof that the growth rate during the AD and BC eras was *not* fluctuating around a small constant value but that it was increasing hyperbolically because the growth of the population was hyperbolic (Kapitza, 2006; Kremer, 1993; Nielsen, 2016b; 2016d; Podlazov, 2002; Shklovskii, 1962; 2002; von Hoerner, 1975; von Foerster, Mora & Amiot, 1960). For the hyperbolic growth, the growth rate increases hyperbolically with time or in the direct proportion to the size of population (Nielsen, 2016h), as observed also by Kremer (1993).

Fifth, Kremer (1963) did not carry out an extensive study of the growth rate. He has presented rough calculations of this quantity using strongly varying local gradients, which do not represent the real gradient of growth. His calculations are strongly inaccurate for the BC era when individual data values are separated by large time intervals. It is scientifically unjustifiable to use such calculations and claim fluctuations around a constant value.

Sixth, for the hyperbolic growth, growth rate is small over a long time because it is also hyperbolic. Growth rate might appear to vary around a small constant but such interpretation is incorrect. Growth rate should be preferably calculated using interpolated gradients to avoid spurious effects of strongly-varying local gradients between adjacent data values. It is also useful to display growth rate using various types of displays to help in its interpretation. Using the approximate calculations of Kremer (1963) and claiming that growth rate was varying around small constant is self-misleading and scientifically unjustified.

This example illustrates that in science it is essential to carry out methodical analysis of data. In economic and demographic research this is particularly important because historical economic growth and historical growth of population were increasing hyperbolically. Hyperbolic distributions are strongly misleading and can easily lead to their misinterpretations. Furthermore, for hyperbolic distributions, the growth rate and the gradient increase in a similar fashion. The growth rate increases hyperbolically and the gradient follows the second-order hyperbolic distribution, both of them containing the same confusing features of a slow growth over a long time and a fast growth over a short time, but both increasing *monotonically* over the entire range of time. Hyperbolic growth of the GDP and population as well the monotonically-increasing growth rates and gradients cannot be divided into two or three distinctly different sections. They all have to be analysed and interpreted as a whole. The same mechanism has to be

applied to the slow and to the fast growth because slow and fast growth belongs to the same, monotonically-increasing distributions.

6.10. The alleged density-dependent variations in mortality

> If population *density* increases the mortality rate rises, equilibrating population back to the Malthusian trap (Lagerlöf, 2003a, p. 765. Italics added.).

This statement has to be also accepted by faith because there is no convincing research supporting such declaration. Creative imagination appears to be taking full control in the established knowledge.

Here we have an example of an interesting *detail* added to the concept of the epoch of Malthusian stagnation, illustrating how one fantasy can lead easily to a new fantasy and how such gradual additions reinforce the established knowledge. This statement claims the dependence of mortality rate on the *density* of human population. It offers an *explanation* how the phantom Malthusian trap regulates the growth of human population. It describes some kind of a general rule that the Malthusian trap is activated when the population *density*, not its size, reaches a certain limiting value.

There is no research confirming the described mechanism; no research showing how the growth of human population depends on its *density*. Even if we could show some isolated examples of the density-dependent growth we would have to demonstrate that such mechanism applies also to regional and global populations. The best data available to us show the *time*-dependence of the size of human population and there is nothing in them to suggest any form of *density*-dependence, let alone the existence of the Malthusian trap triggered by the density of population.

This statement is yet another example of the leaps of faith, of confident declarations requiring a huge amount of work to be accepted as a reliable contribution to science. The descriptions of the epoch of Malthusian stagnation are full of such unscientific declarations. Indeed, they are made of them.

Other terms used to describe the alleged stagnant and fluctuating state of growth during this mythical epoch of Malthusian stagnation are "equilibrium trap" or "population trap" (Leibenstein, 1957; Nelson, 1956), "multiple equilibria" or "poverty trap" (Wang, 2005).

The belief in the stagnant and fluctuating growth is so strong that mathematical models are deemed successful if they can generate the desired oscillations during this mythical epoch of Malthusian stagnation, and no-one seems to care to take the next and the most essential step and to compare model calculations with population data. As long as oscillations of some kind are generated by a mathematical model, they are taken as the proof of the existence of the epoch of Malthusian stagnation. This line of reasoning shows that the primary, if not the exclusive, aim of such mathematical exercises is to translate a story into a mathematical language and when the translation is done properly, when mathematical formulae generate *any kind of oscillations*, large or small, significant or negligible, these formulae are then taken as a proof of the existence of Malthusian stagnation.

6.11. The alleged Age of Pestilence and Famine

The epoch of Malthusian stagnation is also described as the Age of Pestilence and Famine (Omran 1971; 1983; 1998).

> In this stage, the major determinants of death are the Malthusian positive checks, namely epidemics, famines and wars (Omran, 1983, p. 306; Omran, 2005, p. 737).
>
> Even if fertility approached its biologic maximum, depopulation could and did occur as a result of epidemics, wars and famines, which repeatedly pushed mortality levels to high peaks (Omran, 2005, p. 733).

> The pattern of growth [of human population] until about 1650 is cyclic (Omran, 1971, Table 4, p. 533).

Claims:

1. During the Age of Pestilence and Famine (i.e. during the epoch of Malthusian stagnation) major determinants of death are the Malthusian positive checks (epidemics, famines and wars).
2. Depopulation was occurring even when fertility was approaching its biological maximum because epidemics, wars and famines were repeatedly pushing mortality levels to high peaks.
3. Growth of population before AD 1650 was cyclic.

To justify the first claim we would have to have reliable records of the *causes of death* over thousands of years. We would then have to show convincingly that indeed the major causes of death were epidemics, famines and wars. We would also have to show that there was a clear change in the causes of death when the epoch of Malthusian stagnation ceased to exist. We cannot present such proofs because we do not have the supporting data. In principle, therefore, this claim is not scientific because we cannot check it by data. It has to be accepted by faith.

To justify the second claim, we would have to have reliable records of fertility and mortality over thousands of years. We would then have to demonstrate that fertility was approaching biological limits, that such events were coinciding with high mortality peaks and that these high mortality peaks were caused by epidemics, wars and famines. We do not have relevant data to check whether these descriptions are true. They are therefore also unscientific and they have to be accepted by faith.

The growth of population, global and regional, before AD 1650 was *not* cyclic (Nielsen, 2016b, 2016d). This statement is contradicted by data (Biraben, 1980; Clark,1968; Cook,1960; Durand, 1974; Gallant, 1990; Haub, 1995; Livi-Bacci, 1997; Maddison, 2001; 2010; McEvedy & Jones, 1978; Taeuber & Taeuber, 1949; Thomlinson, 1975; Trager, 1994; United Nations, 1973; 1999; 2013).

6.12. The alleged main cause of mortality

> During the first stage, *mortality vacillated at high levels*, with infectious disease as the main cause of death plus a large proportion due to wars and famines (Robine, 2001, p. 191. Italics added.).

Claims:

1. During the first stage of demographic transitions mortality vacillated at high levels.
2. The main causes of death were infectious diseases.
3. Large proportion of death were caused by wars and famines.

We cannot prove that "mortality vacillated at high levels" because we have no relevant data for the so-called "first stage" to carry out such a study, the stage that is assumed to have lasted for thousands of years. We cannot prove that these imagined and wished-for vacillations were correlated with infectious disease, wars and famines. We cannot prove that the *main* causes of deaths were infectious diseases. We cannot prove that a *large propo*rtion of death was due to wars and famines. We do not have sufficiently extensive records of causes of death extending over thousands of years. We do not know how the causes of death were changing over time. We do not have the records to help us to distinguish between the major and minor causes. We do not know whether the main cause of death was the same over thousands of years. The concept of the epoch of Malthusian Stagnation and all these claims have to be accepted by faith.

6.13. The alleged unsustained growth of population

> The first transition phase, called the 'Age of Pestilence and Famine,' is characterized by *high and fluctuating mortality rates*, variable life expectancy

> with low average life span, and *periods of population growth that are not sustained* (McKeown, 2009, p. 20S. Italics added.).

Claims:

1. During the Age of Pestilence and Famine (i.e. during the hypothetical but non-existent epoch of Malthusian stagnation) mortality rates were high and fluctuating.
2. Average life span was low.
3. There were periods when the population growth was not sustained.

Mortality rates might have been high and fluctuating but we have no data extending over thousands of years to prove it. Furthermore, we would yet have to show that these hypothetical high and fluctuating mortality rates could have been responsible for creating stagnation. What we know is that strongly-fluctuating mortality rates do not change the growth of population (Lehmeyer, 2004; Mauritius, 2015; Nielsen, 2016c; Statistics Mauritius, 2014; Statistics Sweden, 1999; Wrigley & Schofield, 1981). There is also nothing in the data and in their analysis to show that "low average life span" was affecting the growth of population. As for the "periods of population growth that are not sustained" this claim is contradicted by the analysis of data (Nielsen, 2016b; 2016d).

6.14. Positive forces were allegedly balanced by negative forces

> The positive forces of growth had existed all along. However, they had been counterbalanced by the negative forces of malnutrition and disease (Komlos & Baten, 2003, p. 19).

We have no reliable empirical evidence to support this claim, no study of positive and negative forces, no study of their balancing, and no study of their influence on the growth of human population. This is not science but story-writing prompted and approved by the established knowledge.

How do we know that the so-called positive forces were balanced by forces of malnutrition and disease? They obviously were not because economic growth and the growth of population were hyperbolic and remarkably stable (Nielsen, 2016a, 2016b, 2016d). Such a strong and stable growth could have been only generated by a strong and dominating force.

Here again, authors of this declaration take an easy way out. They have made no attempt to consult data available to them at the time of the publication of their paper (Biraben, 1980; Clark,1968; Cook,1960; Durand, 1974; Gallant, 1990; Haub, 1995; Livi-Bacci, 1997; Maddison, 2001; McEvedy & Jones, 1978; Taeuber & Taeuber, 1949; Thomlinson, 1975; Trager, 1994; United Nations, 1973; 1999). They have made no attempt to reconcile their interpretations with the already documented evidence of hyperbolic growth (Kapitza, 2006; Kremer, 1993; Podlazov, 2002; Shklovskii, 1962; 2002; von Hoerner, 1975; von Foerster, Mora & Amiot, 1960). Again, this declaration is in perfect agreement with the established knowledge but is in conflict with science.

6.15. The continuing misinformation

The established knowledge is by now so strongly established that it will be difficult to change it. It continues to be supported by the scientifically-unsubstantiated claims and descriptions. It would take volumes to list and discuss all such examples and to show that these repeatedly propagated doctrines, explanations and interpretations have to be accepted by faith.

The current established knowledge based on the assumption of Malthusian stagnation followed by explosion and reinforced by many complicated explanations is similar to the established knowledge about the dynamics of celestial bodies, interpretations which were established for about two millennia before they were eventually abandoned. Describing the work of mathematicians of his time, Osiander wrote:

> With them it is as though an artist were to gather the hands, feet, head and other members from his images from divers models, each part excellently drawn, but not related to a single body, and since they in no way match each other, the result would be monster rather than man (Copernicus, 1995).[1]

Historical economic growth and historical growth of population can be expected to be described by a simple mechanism because hyperbolic growth is simple. This issue will be discussed in a separate publication, where a simple explanation of the mechanism of hyperbolic growth will be also presented. Hyperbolic growth prevailed for at least 12,000 years for the growth of population (Nielsen, 2016d) and for hundreds of years for the economic growth (Nielsen, 2016a). The established knowledge in demography and in economic research offers complicated explanations, which have to be accepted by faith. Hopefully we shall not have to wait for two thousand years to abandon these erroneous doctrines and replace them by science.

7. Summary and conclusions

Established knowledge in demography and in economic research is based on a series of doctrines and explanations revolving around the concept of Malthusian stagnation and around the concept of the escape from the Malthusian trap described as explosion, takeoff, sprint or spurt. It is a system of interpretations, which have to be accepted by faith.

It is easy to understand why these concepts are so attractive because the growth of population and economic growth were increasing hyperbolically and hyperbolic growth creates an illusion of stagnation followed by explosion.

It is essential to understand that hyperbolic distributions should be analysed and interpreted *as a whole*. If we take just a few examples along the hyperbolic growth, we can easily make a mistake and arrive at incorrect conclusions. If hyperbolic distributions are already difficult to understand without their methodical analysis, linearly-modulated hyperbolic distributions (Nielsen, 2015a) describing income per capita are even more difficult to understand because they create even stronger illusion of stagnation followed by a sudden explosion. Here again, just taking a few examples along these distributions is bound to lead to incorrect conclusions. These distributions have to be also analysed with care. Careful and methodical mathematical analysis of data describing historical economic growth and the growth of population is unavoidable.

Distributions describing income per capita are generated by a division of two hyperbolic distributions. The characteristic feature of this ratio is that for a long time the growth of income per capita was not just slow, as for hyperbolic distributions, but nearly constant. This feature characterises the division of any hyperbolic distributions, not just the division of the GDP and population (Nielsen, 2015a). It is a purely mathematical property, which has nothing to do with specific properties of economic growth,

The nearly constant income per capita should never be interpreted automatically as stagnation. The only way to claim stagnation for this nearly-constant income per capita is to *analyse* the GDP and population data separately and to *prove* that these distributions are not hyperbolic but stagnant.

[1] This quotation comes from a letter written by Andreas Osiander, Lutheran theologian and a friend of Copernicus, a letter addressed to the chief editor, Pope Paul III. Osiander argues in favour of the mathematically simple and elegant heliocentric system as opposed to the complicated geocentric descriptions. This letter was later used as an unsigned introduction to the book *De revolutionibus orbium coelestium*, and was mistakenly attributed to Copernicus.

It is incorrect to take a few values of income per capita, show that they are nearly constant and claim stagnation. If the GDP and population increase hyperbolically, then income per capita increases by following the *monotonically*-increasing linearly-modulated hyperbolic destitution and it is incorrect to try to divide such a monotonically-increasing distribution into two different sections, slow and fast. Mathematically, it is impossible to make such a division. It is impossible to identify a point or a range of points and claim them as marking the place of transition.

Even though the ratio of two hyperbolic distributions is nearly constant over a long time and nearly vertical over a short time, the transition from the nearly constant to the nearly vertical patterns occurs all the time along the entire range of such distributions. Linearly-modulated hyperbolic distributions representing income per capita should be also interpreted as a whole. The same mechanism should be applied to the nearly constant and to the nearly vertical growth, unless we can prove that the GDP and population were not following hyperbolic distributions but were stagnant.

We have presented many examples of claims revolving around the concepts of stagnation followed by explosion. We have shown why such claims are scientifically unacceptable.

The origin of the fundamental concepts of the established knowledge can be traced, perhaps not entirely correctly, to Malthus (1798). He has presented an important pioneering work but unfortunately the ensuing studies of economic growth and of the growth of population have taken a wrong turn at a certain time in the past, perhaps because relevant data were not available.

By the time the relevant data (Biraben, 1980; Clark,1968; Cook,1960; Durand, 1974; Gallant, 1990; Haub, 1995; Livi-Bacci, 1997; Maddison, 2001; 2010; McEvedy & Jones, 1978; Taeuber & Taeuber, 1949; Thomlinson, 1975; Trager, 1994; United Nations, 1973; 1999) became available, they were ignored. More recently, some of them (Maddison, 2001) were manipulated to support the established knowledge (Ashraf, 2009; Galor, 2005a; 2005b; 2007; 2008a; 2008b; 2008c; 2010; 2011; 2012a; 2012b; 2012c; Galor & Moav, 2002; Snowdon & Galor, 2008). Earlier analyses of data (Kapitza, 2006; Kremer, 1993; Podlazov, 2002; Shklovskii, 1962; 2002; von Hoerner, 1975; von Foerster, Mora & Amiot, 1960) showing that the growth of population was hyperbolic were also ignored. By now, the established knowledge is so well established that anything being in its conflict is methodically ignored, rejected or suppressed. This is not science.

Recent analyses of data (Nielsen, 2014; 2015a; 2016a; 2016b; 2016d; 2016e; 2016f; 2016g; 2016h; 2016i) confirmed the earlier studies (Kapitza, 2006; Kremer, 1993; Podlazov, 2002; Shklovskii, 1962; 2002; von Hoerner, 1975; von Foerster, Mora & Amiot, 1960) and demonstrated that the historical growth of population and the historical economic growth were hyperbolic. The established knowledge based on the scientifically-contradicted concepts of stagnation followed by explosion (takeoff or the escape from the Malthusian trap) has to be replaced by explanations based on accepting hyperbolic growth.

It is incorrect to interpret the past harsh living conditions as a proof of the existence of Malthusian stagnation. Whatever harsh living conditions might have been present in the past, their effects are generally not reflected in growth trajectories. The only known example is for the growth of global population between AD 1200 and 1400 coinciding with the convergence of *five* major demographic catastrophes (Nielsen, 2016d). However, even then, the recorded effect is small.

Negative effects of the Malthusian positive checks should be never used robotically to describe the past growth of population or the economic growth. If we

want to claim that positive checks were shaping the growth of population or economic growth, we have to prove it. If we want to claim that the so-called Law of Population was shaping growth trajectories, we have to prove it. If we want to claims that demographic catastrophes were shaping the growth of population, we have to prove it. If we want to claim that Industrial Revolution was shaping growth trajectories, we have to prove it. We cannot take shelter in the established knowledge because in this respect established knowledge is repeatedly contradicted by data. Any data we might have, should to be methodically analysed to prove the negative effects of Malthusian positive checks but whatever we would prove would be just an exception from the general and well-demonstrated pattern that the historical growth of population and historical economic growth were not only hyperbolic but that they also remarkably stable.

Interpretations based on the concepts of Malthusian stagnation and on the claims of the escape from the Malthusian trap are not only incorrect but also dangerously misleading. They suggest that after the endless epoch of stagnation we have now entered the sustained growth regime (Galor, 2005a; 2011). This hypothesis creates a sense of security. In contrast, analysis of data shows that the past growth was sustainable but now for the first time in human history it is unsustainable and insecure (Nielsen, 2015b). While in the past, economic growth and the growth of population, global and regional, were following the slowly increasing hyperbolic trajectories (Nielsen, 2014; 2015a; 2016a; 2016b; 2016d; 2016e; 2016f; 2016g; 2016h; 2016i) indicating the unconstrained and secure growth, now the growth is at the stage of the dangerously fast increase (see Figures 1 and 2). The growth is no longer hyperbolic but the current growth increases close to the historical hyperbolic trajectories. For the first time in human history, these growth trajectories are clearly unsustainable because such a fast increase cannot be possibly tolerated for much longer.

The established knowledge is not only in conflict with data describing the past economic growth and the growth of human population but also in conflict with the general knowledge about the current mounting problems threatening our future. The established knowledge in demography and in economic research created its own world of fiction divorced from the real world.

We have not escaped the Malthusian trap because there was no trap in the economic growth or in the growth of population. The past growth was unconstrained and sustainable as demonstrated by the undisturbed hyperbolic distributions. However, now we are in the trap. For the first time in human history we are in the trap of numerous critical problems, which threaten our global security and our survival (Nielsen, 2006). For the first time in human history our combined ecological footprint is larger than the ecological capacity and it continues to increase (WWF, 2010). For the first time in human history our growth is supported by the increasing ecological deficit.

In order to understand the past and present economic growth, erroneous interpretations revolving around the concept of Malthusian stagnation have to be abandoned and replaced by scientifically acceptable interpretations. What needs to be explained is why the past economic growth and the growth of population were hyperbolic. Why was the growth so remarkably stable? Why was it not influenced by many random forces, which might have been present? Why did the growth start to divert to slower trajectories? Why does it continue so closely to the dangerously fast hyperbolic trajectories? And the most important questions of all: How to slow down the current growth? How to control growth?

Examples presented here suggest that there is a problem not just with certain interpretations adopted and protected by the established knowledge in the demographic and economic research but with the way research is carried out in

these two fields. It is not just the problem with one or two theories, such as the Demographic Transition Theory or the Unified Growth Theory, which need to be corrected or most likely replaced. It is not even just the problem with the accepted paradigm based on the concept of Malthusian stagnation, which needs to be abandoned. It is a *systemic* problem. It is a problem, with the way research is conducted in these two fields. It is a problem with creating stories and interpretations, which have to be accepted by faith. It is a problem with a selective use of data. It is a problem of ignoring contradicting evidence, such as the contradicting evidence published over 50 years ago by von Foerster, Mora and Amiot (1960). It is problem with manipulating and distorting data to fit the preconceived ideas, as it has been done repeatedly in the Unified Growth Theory and in other related publications (Ashraf, 2009; Galor, 2005a; 2005b; 2007; 2008a; 2008b; 2008c; 2010; 2011; 2012a; 2012b; 2012c; Galor & Moav, 2002; Snowdon & Galor, 2008). It is a problem of testing data by a theory rather than testing theory by data. It is a problem with protecting a system of doctrines, which are accepted on faith.

As outlined briefly elsewhere (Nielsen, 2016i), there are two ways of conducting research: (1) the dynamic scientific method, which is used in the self-correcting disciplines of science and (2) the stale method, which is used routinely in the usually emotional and dishonest defence of doctrines accepted by faith. It is unfortunate, that as pointed out earlier (Nielsen 2013a; 2013b; 2013c; 2014; 2015a; 2016a; 2016b; 2016c; 2016d; 2016e; 2016f; 2016g; 2016h; 2016i), demographic and economic research appears to gravitate strongly towards the unscientific method.

The established knowledge revolving around the concept of Malthusian stagnation has to be changed because there was no stagnation in the historical economic growth and in the historical growth of population. There was also no escape from the Malthusian trap because there was no trap. This paradigm has to be changed because historical economic growth and the historical growth of population were hyperbolic. However, in order to make the demographic and economic research scientifically acceptable, the systemic problem has to be also solved. Scientific research can be based only on the well-known and generally recognised scientific rules of investigation. Anything else is not science.

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