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The Principle of Population vs. the Malthusian Trap

A Classical Retrospective and Resuscitation

Tim Lueger*

April 6, 2018

Abstract

In spite of two centuries of extensive debate, a consistent framework of the classical theory of population on which economists can universally agree has not been established. This means that either the theory lacks consistency or it has been misunderstood in important ways. This paper attempts to settle this issue by arguing that the latter was the case, revealing prevailing misconceptions. Since a large amount of these misconceptions most probably arose from the lack of a consistent nomenclature, the paper intends to clarify the classical theory of population by employing unambiguous definitions of the principle of population, the Malthusian trap, positive checks and preventive checks to population. The classical theory of population can then be applied to analyze the transition from economic stagnation to economic growth. As a result, numerous current theories trying to explain the transition to growth that are based on an increase of production will prove secondary when compared to the great preventive check.

JEL classification: B12, J1, N3, O11

Keywords: Demographic Transition, Malthusian Trap, Unified Growth Theory, Classical Growth Theory, Positive Checks, Preventive Checks

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1 Introduction

"If only Malthus, instead of Ricardo, had been the parent stem from which nineteenth-century economics proceeded, what a much wiser and richer place the world would be today! We have laboriously to rediscover and force through the obscuring envelopes of our misguided education, what should never have ceased to be obvious."[1]

Two hundred years ago, T.R. Malthus'[2] theory of population was widely-known and its importance with regard to economic theory seemed generally accepted among economists. During the nineteenth century, it constituted the theoretical foundation not only of the science of political economy, but also of the emerging sciences of sociology and biology. However, over the course of the centuries, as new generations were not confronted with the same everyday problems the classical economists were facing, its popularity declined sharply as it was first increasingly misinterpreted and finally considered to have been falsified.

Nonetheless, over the past decade, Malthusian ideas have attracted renewed interest among economists. Largely owed to the works of Clark (2007) and Galor (2011), some interpretation of the theory of population is today commonly viewed as a cornerstone of (unified) growth theory, as it appears to offer a simple framework in explaining economic long-run stagnation in GDP per capita until the beginning of the demographic transition in late-eighteenth-century Europe. Notwithstanding its well-founded theoretical and empirical reasoning, there remains a fair portion of skeptics, some of whom seem to have interpreted the original theory surprisingly wrongly. Although these authors frequently refer to Malthus (1798) as chief historical source and economic authority, it seems that neither the critics nor the majority of the proponents of the theory of population have consulted Malthus' later editions (1803-1826) on the principle of population. If they had done so, they might have arrived at the insight that the proposed theory not only supplies a mechanism of a stylized historical regime of stagnation in production per capita, but at the same time offers a mechanism by which stagnation could be overcome.

As they are crucial in elucidating modern economic growth, this paper intends to resuscitate and to clarify the "vaguer intuitions" of the classical economists on the escape

[1] Keynes (1933), Essays in Biography, Malthus, pp. 120–121. Sir John Maynard Keynes (1883–1946), British economist, member of the Royal Commission in 1913, financial representative for the Treasury to the 1919 Versailles peace conference, founder of modern macroeconomics.

[2] Thomas Robert Malthus (1766–1834), British professor of history and political economy at the East India Company College in Haileybury, fellow of the Royal Society.

from economic stagnation by providing an updated version of the theory of population. To this end, the paper makes use of several didactic approaches. As the work argues rather qualitatively, mathematical modeling is confined to a few very basic equations and the use of empirical data is minimized to the extent that is necessary to follow the argumentation. Instead, much emphasis is put on exhaustive definitions and logical deductions. To adhere as closely as possible to Malthus' own, undistorted thoughts, deductions are often sustained by quoting Malthus himself. Also, as it is the authors' conviction that the relevance of the theory is most thoroughly grasped by evaluating the intellectual impact it exerted on some of the most celebrated contemporary scientists, these corresponding authorities, providing first-hand evidence, will be frequently cited as well. Furthermore, following the classical tradition, the derived arguments are supported by illustrations to provide anecdotic evidence and to enable an easy understanding of the theory.

The portrayal of the theory of population is structured as follows. The second chapter provides an introductory definition of the principle of population and of the resulting pressure of population. In chapters three to five, the three individual remedies capable of mitigating the pressure of population and accordingly facilitating a rise in production per capita are separately investigated and eventually combined to establish a theoretical framework indispensable for any further investigation in (unified) growth theory. As a by-product, two prevalent misconceptions will be enlightened. First, since there seems to exist some confusion with regard to the terms "principle of population" and "Malthusian trap", this paper intends to settle the distinction. Second, as it constitutes the most complicated part of the theory, the remedy to "escape the Malthusian trap" as suggested by the classical economists, the great preventive check, deserves a somewhat more elaborate treatment, as it has not been sufficiently put forward by unified growth authors yet. In the last chapter, it will be concluded that the classical theory of population had already largely accounted for a unified, interdisciplinary growth theory. If the theory is found to be correct, for which there is not much reason to doubt, it ought to be ranked as one of the most enlightening achievements of thought on which every social science should be built upon.

2 The Principle of Population

A presentation of the classical theory of population must necessarily start with a definition of the principle of population. Malthus' (1798) first important presumption on the theory of population was to state that every population possessed the power to grow exponentially, or as the classical authors used to call it, "in a geometric ratio". Although it became controversially debated during the first years after its appearance, the presumption was soon well-received among the profession of political economists. By the year 1836, N.W. Senior[3] had outlined the classical theory of population, beginning with the assertion that *"it is now generally admitted, indeed it is strange that it should ever have required to be pointed out, that every species of plant or animal which is capable of increase, either by generation or by seed, must be capable of a constantly increasing increase."*[4] Likewise, J.S. Mill[5] (1848), referring in turn to Senior, granted the power of population an important role in his "Principles"*."To this property of organized beings, the human species forms no exception. Its power of increase is indefinite, and the actual multiplication would be extraordinarily rapid, if the power were exercised to the utmost."*[6] Nonetheless, the bulk of recent discussions seems to have systematically overlooked that the term "power" was merely intended to be used as a theoretical reference point that would only be realized under optimal environmental conditions, or – as an economist would call it today – under optimal economic incentives.

To provide an illustration, the following calculation will demonstrate the power of unregulated exponential population growth. It has been estimated that the global human population of the year 1804 amounted to about one billion people.[7] If the maximum life expectancy was assumed to be eighty years, which is certainly under the mark, and with maximum fertility having been calculated at about 16.7 children per woman, these values imply, given a stationary population, a birth rate of 10.43% and a death rate of 1.25%.[8] With the natural change in population size being given by

$$\Delta N = Births - Deaths = B - D \tag{1}$$

the maximum growth rate of population can thereafter be computed by

[3] Nassau William Senior (1790–1864), British lawyer, professor of political economy at the University of Oxford, member of Royal Commissions in 1832, 1837 and 1861.

[4] Senior (1836), p. 141.

[5] John Stuart Mill (1806–1873), British philosopher, Rector of the University of St Andrews, Member of Parliament for Westminster.

[6] Mill (1848), book I, chapter X.

[7] Bloom et al. (2003).

[8] See Livi-Bacci (2012), p. 12.

$$g_N = \Delta N/N = (B - D)/N = Birth\ Rate - Death\ Rate = BR - DR \qquad (2)$$

to be 9.19%. Thus, if the power of population would have operated unrestrictedly, the correspondingly projected population size would in the year 2017 have amounted to approximately 135,155,105 billion inhabitants, i.e. the average person would have produced over 135 million descendants after 213 years.[9] For other species, the case can be even more strikingly portrayed. H. Spencer[10] (1852), an advocate of the theory of population, reported instances experiencing the enormous power of population. *"In the polygastric animalcules, spontaneous fission takes place so rapidly that it has been calculated by Prof. Ehrenberg that no fewer than 368 millions might be produced in a month from a single Paramecium; and even this astonishing rate of increase is far exceeded in another species, one individual of which [...], is calculated to generate 170 billions in four days."*[11]

Having thus stated the potential of population growth, Malthus eventually suggested to what extent it was exerted in reality. Yet, by claiming that population as a whole was observed to display the "tendency" to multiply in an exponential manner, he argued deductively, without examining what causes induced individuals to generate progeny. It was left to C.R. Darwin[12] (1871), building on Malthus and Spencer, to remark that the origin of high individual rates of propagation was rooted in genetically varying inheritable traits. *"The fertility of each species will tend to increase, from the more fertile pairs producing a larger number of offspring, and these from their mere number will have the best chance of surviving, and will transmit their tendency to greater fertility."*[13] Hence, reproductive success might be seen as a dominant evolutionary strategy to every species, for if they did not conform to this rule they would generation after generation be reduced to a minor share of the population of the earth. As a result, every individual is with a high probability inherently equipped with a strong pursuit of procreation. In stating what economists would denominate a microeconomic theory of

[9] The reason for our inclination to meet these numbers with disbelief and skepticism might be rooted in our thinking being limited to changes that are taking place during our lifetime. After 80 years, the average individual would have generated an offspring of "merely" 1,000. However, as we are slow in observing gradual changes that last longer than a few generations, the effects of the subsequent 133 years are rarely taken into account and intuitively underestimated.

[10] Herbert Spencer (1820–1903), British anthropologist, biologist, sociologist, subeditor for the journal The Economist, nominated the Nobel Peace Prize in 1901 and the Nobel Prize in Literature in 1902 (declined).

[11] Spencer (1852), §3.

[12] Charles Robert Darwin (1809–1882), British naturalist, geologist, biologist, founder of the theory of evolution by natural selection and sexual selection, fellow of the Royal Society.

[13] Darwin (1871), p. 319.

fertility behavior, Darwin argued that *"in looking at nature, it is most necessary [...] never to forget that every single organic being may be said to be striving to the utmost to increase in numbers."*[14]

A third premise of Malthus was provided by the quite incontrovertible statement that the space as well as the physical matter supplied by the earth was limited. The space limit of the earth is unquestionably well-defined, and since extraterrestrial resources have not yet been accumulated in any considerable amount, we shall also agree on the finiteness of resources from the beginning of the existence of life until present times. Given that space is limited and presupposing that population consumes space, it is undeniable that there must exist some point at which population growth would have to come to a halt. More practically spoken, it should be obvious that there exists a limited amount of supply provided for the maintenance of all living beings that Malthus had, in the case of the human species, defined as "means of subsistence". From the existence of a limited resource constraint, in turn, he derived his first proposition that *"population is necessarily limited by the means of subsistence."*[15]

Malthus combined the power to increase exponentially, the tendency for increase and the existence of a resource constraint to formulate the "principle of population". *"According to the principle of population, the human race has [...] a constant tendency to people a country fully up to the limits of subsistence; meaning, by these limits, the lowest quantity of food which will maintain a stationary population."*[16] In economic terms, it has the tendency to increase population proportionally whenever production has been raised. Among others, J.R. McCulloch[17] (1863) sustained Malthus' view, maintaining that humanity had indeed been facing the principle of population at any point in history, although it would sometimes not reveal itself at first glance.*"The principle, whose operation under favourable circumstances has thus developed itself, is, in the language of geometers, a 'constant' quantity. The same power that has doubled the population of Kentucky, Illinois, and New South Wales in five-and-twenty or thirty years, exists everywhere, and is equally energetic in England, France, and Holland."*[18] Correspondingly, it might already be noted that the operation of the principle of population does not require every population to exhibit exponential growth in reality at all times, as is

[14] Darwin (1859), chapter III.
[15] Malthus (1826), book I, chapter II.
[16] Malthus in Senior (1836), p. 147.
[17] John Ramsay McCulloch (1779–1864), British professor of political economy at London University, comptroller of Her Majesty's Stationary Office.
[18] McCulloch (1863), part I, chapter VIII.

sometimes asserted, but rather reflects a latent "pressure" steadily operating toward an increase of numbers. However, if the principle of population displayed its full power to increase merely in theory, it should be legitimately asked by what forces its pressure is attenuated in reality.

Stating in his second proposition that *"population invariably increases where the means of subsistence increase, unless prevented by some very powerful and obvious checks"*[19], Malthus implicitly determined the conditions under which population would not hit the limits of subsistence. Defining the means of subsistence as production Y and the average individual subsistence level as production per capita $y = Y/N$, the denominator of the latter would, according to the principle of population, tend to rise until an economy was fully peopled up to the limits of subsistence and beyond, with production per capita struggling to stay above a minimum existence level. Hence, for all real applications the pressure of population could only be relaxed by either "increasing the means of subsistence" or by "checking powerfully and obviously" population. Knowing that the change of the last one was given by equation (1), *"Mr. Malthus has divided the checks to population* $[N]$ *into the preventive and the positive. The first are those which limit fecundity, the second those which decrease longevity. The first diminish the number of births* $[B]$*, the second increase that of deaths* $[D]$*. And as fecundity and longevity are the only elements of the calculation, it is clear that Mr. Malthus's division is exhaustive."*[20] Hence, the three dinstinct remedies eligible for mitigating the pressure of population and consequently determining the level of productivity are "positive checks", "increasing the means of subsistence" and "preventive checks". Thus, the operation of these remedies will subsequently be analyzed with regard to their effects on population, production and thereby productivity – the main object of all economic inquiries.

3 The Positively Checked Economy

First, we will consider the most primitive case of a non-human economy with a fixed resource constraint, in which the inhabitants are assumed to be incapable of artificially increasing the means of subsistence. In this simple case, the pressure of population could only be released by reducing population growth. As it is often asserted that homo sapiens is the only species capable of birth control or of what Malthus called "the prudential restraint from marriage", the preventive checks are equally supposed to be

[19] Malthus (1826), book I, chapter II.

[20] Senior (1836), p.141 [squared brackets by the author].

non-existent and will be examined at a later point after having considered the principle of population in the human economy. We will, therefore, turn to an economy where the principle of population is reflected by an unrestricted birth rate.

Assuming the principle of population to have operated for millions of years, Darwin justly concluded that in reality *"owing to the high geometrical rate of increase of all organic beings, each area is already fully stocked with inhabitants."*[21] At the same time, to secure survival, every individual must have occupied an economic niche providing subsistence. The assumed steady operation of the (unrestricted) principle of population implied first and foremost that the emerging generation tended to outnumber the former generation. However, since the supposedly stable environment did not provide additional niches for the upcoming generation, some individuals had to remain niche-less. As a result, there would of necessity be competition between these abundant individuals resulting in a "struggle for existence", which is one of the most consolidated findings in biology.[22] In contrast, competition would in fact strongly diminish if the emerging generation would have been of the same size or smaller than the former, such that resources and niches would merely be passed on to the succeeding generation without raising any conflicts of interest.

The following example illustrates a very simple and obvious case of the pressure arising from the principle of population. In a forest that is fully covered by beeches, it is impossible for seeds to start growing until an existing tree has died off. On the other hand, if an old individual has recently vanished and thus supplied a vacant spot under the sunlight, the free area will, according to the principle of population, soon be covered by seedlings. While growing up, however, each seedling will consume an increasing amount of space and resources until irreconcilable conflicts emerge, as it is physically impossible for all seedlings to grow up to a full tree. Although the precise outcome of these conflicts may be uncertain in general, they cannot be bypassed and reveal themselves through regular competition between individuals.

Even though we might allow animal populations to respond far more dynamically to these conflicts, they are nonetheless subjected to the same principle of competition. *"Hence, as more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species, or with the individuals of distinct species, or with the physical conditions of life. It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable*

[21] Darwin (1859), chapter IV.

[22] See for example Weiner (1995).

kingdoms; for in this case there can be no artificial increase of food, and no prudential restraint from marriage. Although some species may be now increasing, more or less rapidly, in numbers, all cannot do so, for the world would not hold them."[23] Consequently, some of those redundant individuals were determined to die prematurely, ultimately by starvation, although among most species prevailed advanced mechanisms of positive population control such as disease, infanticide, suicide or homicide.

From Malthus' definition that *"the positive checks to population [...] include every cause [...] which in any degree contributes to shorten the natural duration of life"*[24] , it is clear that the strength of the positive checks and the quantity of the death rate are measured by the same magnitude. Wherever the positive checks operate powerfully, the death rate is high. Where the death rate is close to its minimum level and the average individual lives out its "natural duration of life", the positive checks are the weakest. However, when measuring the operation of the positive checks, it should be borne in mind that their existence does not necessarily prove the presence of a strong degree of population pressure. Where they are measured it is merely proven that population growth is kept below its maximum rate.

Also, it should already be noted that there are instances in which the struggle for existence does not necessarily follow from an excess of newly born individuals expanding beyond the nutrition provided for it. Competition might also be called into action after an already fully stocked territory has been struck by a diminution of natural conditions, lowering the resource base, or from an increasing population owed to improved conditions for survival such as the disappearance of predators or diseases, lowering mortality. Nevertheless, the principle of population remains the most regular driving force for competition, for if there would be no tendency for the number of births to exceed the number of deaths, each territory would not categorically be fully stocked. Only from the steadily repeated application of this universal natural principle may we derive the rule *"that each [individual] lives by a struggle at some period of its life; that heavy destruction inevitably falls either on the young or old, during each generation or at recurrent intervals. Lighten any check, mitigate the destruction ever so little, and the number of the species will almost instantaneously increase to any amount."*[25]

[23] Darwin (1859), chapter III.
[24] Malthus (1826), book I, chapter II.
[25] Darwin (1859), chapter III [squared brackets by the author].

4 Increasing the Resource Constraint

4.1 The Animal Economy

Notwithstanding the assumption of a fixed resource boundary in the former section, we should not too hastily fall into the error of believing that the limits of subsistence in fact remain constant in every animal economy. By analyzing the divergence into different animal species from a common ancestor and establishing a mechanism for evolutionary development, Darwin implicitly proposed a way by which the natural resource barrier could be raised. Although deadly conflicts were the rule, the pressure of population comprised milder forms of competition, for example pushing individuals into niches that could not possibly be occupied by the former generation.

Since the progeny of most species differed from its parental generation in genetic endowment, it could happen that it explored living spaces that were denied to its ancestors, as is illustrated in the following example. One might imagine a rodent colony having initially fully populated the ground of a given territory. Arising from the principle of population, an abundant number of young individuals might be pushed into an environment so far unsuitable for the common rodent. With this progeny displaying genetic variation, there may at some point appear a specimen endowed with the ability to climb trees, another to dive into water and a third to dig into the soil – abilities that were denied to the parent generation. If these specific abilities, by exploring new kinds of nutrition providing additional subsistence, were sufficient to sustain offspring, the specimen had created their own niches. Once they were established in these specialized niches, their growing number of offspring, displaying another large pool of variation, would again be subjected to competition. By the process of "natural selection", the abundant descendants unfit for survival were generation by generation frequently weeded out, while those displaying the highest genetic fitness under the prevailing conditions tended to propagate most rapidly. In this way, becoming ever more slightly adapted to the new environment, the "specialized species" squirrel, otter and mole emerged.

Thus, Darwin had derived two important outcomes of the (unrestricted) principle of population. Firstly, in the case of the animal economy, the operation of the principle is critical in generating specialization and as a by-product to lift the natural resource constraint. Since the overall population of individuals increased with the number of additional niches, the natural limits of subsistence must have been raised as well. Hence, by the simple means of population growth and variation, competition had not only

generated new species, but had also created a symbiosis by which the resource constraint was permanently elevated. Secondly, although genetic variation enhanced the original individual's prospects for survival, it did not ameliorate the material situation of its respective descendants in the long run, since the speed of increase of the means of subsistence derived from specialization was clearly inferior to the speed of population growth. Individual specialization was merely intended to secure immediate survival, not to accumulate wealth, and the offspring of the first individual was in most cases not much better off than those living before the divergence of the species had started. Thus, it is owed to the supreme power of population in outperforming innovation by genetic variation that the mechanism of natural selection could endure a very long time without producing any individual material gains. To Darwin, the struggle for existence, which is a logical implication of the second outcome, formed the fundament of the theory of evolution by natural selection. He unambiguously urged his disciples to realize that *"nothing is easier than to admit in words the truth of the universal struggle for life, or more difficult – at least I have found it so – than constantly to bear this conclusion in mind. Yet unless it be thoroughly engrained in the mind, the whole economy of nature, with every fact on distribution, rarity, abundance, extinction, and variation, will be dimly seen or quite misunderstood."*[26]

4.2 The Human Economy

Although the operation of the principle of population has been sufficiently proven by application of the theory of evolution by natural selection to non-human species and is widely accepted in natural sciences, its relevance for mankind is not rarely doubted. Assuming the validity of the above process of innovation, the most regular critique Malthus' theory was facing over the last two hundred years was the argument that homo sapiens apparently possessed the ability to raise its natural resource constraint self-dependently without necessarily having to rely on slow genetic improvement. It was, however, no secret to Malthus, nor to any other classical economist, that increasing production was a regular phenomenon accompanied by human population growth. They understood that growth of production was to the largest part owed to individual specialization based on what A. Smith[27] (1776) had called the "division of labor", beginning his celebrated first three chapters by announcing that *"the greatest improve-*

[26] Darwin (1859), chapter III.

[27] Adam Smith (1723–1790), British professor of moral philosophy at the University of Glasgow, one of the founders of classical economics/political economy.

ment in the productive powers of labour, and the greater part of the skill, dexterity, and judgment with which it is anywhere directed, or applied, seem to have been the effects of the division of labour."[28] However, as will be realized subsequently, the emergence of the Smithian division of labor in human economies, or what is today sometimes called "Smithian growth"[29], is not much different from what we have observed in the animal economy in the form of a symbiosis of specialized species.

As was the case in the animal economy, the process of human specialization into different professions might be traced back to the operation of the principle of population. Since we continue to presume that the preventive checks are non-existent and that fertility is exerted at its maximum level, a newly emerging generation will tend to outnumber their foregoing cohorts, creating conflicts, competition and population pressure. As in the case of the animal economy, this pressure of population would induce the abundant individuals to explore new methods of production. Starting out as hunter and gatherer communities, the members of a tribe deemed redundant by the community tended to venture capturing new species of prey or testing unknown fruits. If the exploration was unsuccessful, the respective individual would ultimately be exterminated. If it was successful, the new way of production could be permanently integrated into the overall production of the community, securing an additional niche for survival and again providing subsistence for further progeny. As with the tendency for growth the number of successful explorations steadily increased by trial and error, the community tended to accumulate numerous forms of production.

Notwithstanding those similarities to the animal economy, the mechanism by which specialized professions were accumulated seems to have been largely independent of genetic variation in the human economy. That the new processes were indeed regularly integrated into the economic system was, as Smith (1776) emphasized, owed to the inherent and apparently unique tendency of human beings to "exchange" their products. In turn, the introduction of exchange and the correspondingly increasing demand brought with it the obvious advantage of "economies of scale" – to specialize in the production of one good and to supply the demand for the whole community. As long as an employment was sufficient to provide subsistence for a family, it could be properly denominated "profession". However, still facing competition arising from the principle of population and thus constantly being forced to defend their niches against other rivals and tribes, the members of the community were in the long run determined to

[28] Smith (1776), book I, chapter I.

[29] See for example Kelly (1997).

focus again on those processes that corresponded most efficiently to their individual natural endowments, creating a division of labor among the working population. This tendency to redistribute labor according to genetic ability is perhaps best illustrated by the sexual division of labor prevailing in many aboriginal societies where hunting is largely conducted by the males and gathering by the females.

It does not require a large degree of abstraction to imagine this evolutionary process to be, gradually diffusing, responsible for every subsequently emerging profession, from the rice farmer to the watchmaker up to the modern era. Smith used the production of the woolen coat to demonstrate to what extent specialization and division of labor had grown in pre-industrial times. *"The shepherd, the sorter of the wool, the wool-comber or carder, the dyer, the scribbler, the spinner, the weaver, the fuller, the dresser, with many others [...] how many ship-builders, sailors, sail-makers, rope-makers, must have been employed to bring together the different drugs made use of [...] let us consider only what a variety of labour is requisite in order to form [...] the shears with which the shepherd clips the wool. The miner, the builder of the furnace for smelting the ore, the seller of the timber, the burner of the charcoal to be made use of in the smelting-house, the brick-maker, the brick-layer, the workmen who attend the furnace, the mill-wright, the forger, the smith, must all of them join their different arts in order to produce them."*[30]

As from the animal economy, the same two important rules could be derived if the above modelled human economy was empirically confirmed. The first rule being the idea that the combination of the principle of population and specialization might have constituted the only source of permanent economic innovation and the second being the tendency to return to a subsistence level of productivity, since the speed of generating new innovations in early societies seems, as will be more explicitly shown below, to have lagged behind the speed of population growth, preventing real production per capita from increasing. The latter point would certainly not come as a surprise if the growth of population is regarded to be the primary stimulus to innovations, for if population would not have kept up with production, there would have been no strong degree of competition. Indeed, following Mill's (1848) assessment that *"only through the principle of competition has political economy any pretension to the character of a science"*[31], most classical economists were convinced that the tendency for economic improvement

[30] Smith (1776), book I, chapter I.
[31] Mill (1848), book II, chapter IV.

generally exhibited in a human economy must be fully owed to this kind of competition derived from the principle of population.

4.3 Empirical Evidence

From an empirical point of view, there are three facts that give at once strong evidence of the above evolutionary model of economic growth. Firstly, most economic historians will concur when stating that recent data have confirmed the impression that human production per capita did not crucially differ in the year 1800 AD as compared to the year 10,000 BC. Even if these estimations on GDP per capita were rejected, the corresponding stagnation of body stature would provide unambiguous evidence.[32] Secondly, it has been estimated that, although with no inconsiderable oscillations, the human population rose exponentially from roughly six million to about 1,000 million over the same time span.[33] Thirdly, presuming in addition that, as with every species, the earth had already been "fully stocked" with human individuals in the first place, it is obvious that an increase in professions took place over the same period. From the last point it seems proven that specialization had occurred. Since, however, productivity had not increased in the long run although specialization had lifted the resource constraint, it is evident that population growth must have fully consumed the gains from specialization. This last deduction represents the logic of the "Malthusian trap" as it is currently represented in economic history in the form of a stylized fact and as it was intended by Malthus in his original "essay" in the form of the (unrestricted) principle of population.[34]

To offer a more recent example, beginning in the eighteenth century, aided chiefly by the introduction of the potato and the disappearance of the plague epidemic, European economies started to experience strong population growth.[35] Since an increasingly growing population meant an increasingly larger number of innovations from trial and error, the pace of specialization increased with the size and the pace of population growth – a process that would culminate in what we call today the Industrial Revolution, which was an important reference point for Smith's considerations on the division of labor and which has often been viewed, in particular by historians, as a turning point in the history of mankind toward a new path of sustained economic growth. However,

[32] See Tanner (1994) in Komlos (1994).
[33] See Livi-Bacci (2012), p. 25.
[34] See for example Galor (2011) or Clark (2007).
[35] See Nunn and Qian (2011) on the potato, Langer (1963) on the plague.

what was the Industrial Revolution if not another exploration of new production tasks resulting from the pressure of population? This line of argumentation is sustained by illustrating the rise of urbanization as the one distinct process measuring the progress of the Industrial Revolution quite unambiguously. When the countryside became ever more densely populated, it was the markets and harbors of towns and cities that could absorb the abundant farm workers into specialized factories and transport companies making use of economies of scale without, however, raising productivity in its early stages.[36] As a consequence, the only substantial difference between the process of the first Industrial Revolution and the process of the Neolithic Revolution seems to have consisted in the speed they exhibited in spreading innovations due to a varying total population, while both events were subject to the same underlying Malthusian and Smithian principles. Consequently, Smithian growth, being identical with a lasting increase of the human resource constraint, cannot, although having been fundamental in inducing the Industrial Revolution, generally be viewed as a remedy decisively relieving the pressure of population.

Notwithstanding the rightness of the above considerations, it is evident that the interpretation of a "Malthusian trap" cannot be upheld empirically when considering the enormous increase in productivity that has taken place since the eighteenth century. Consequently, at the end of the nineteenth century, the Malthusian trap became viewed to have been falsified, which had the unfortunate effect that, due to the prevailing confusion existing with regard to the two expressions, the principle of population subsequently became equally rejected. With this apparent rejection, however, alternative theories that had already been convincingly discredited by classical economists once again won recognition in modern economic thought. The author has identified three major fallacies of currently circulating economic theories that deserve a more explicit clarification, as they continue to prevent a proper understanding of the principle of population. Firstly, some authors consider the escape from the Malthusian trap as a matter of "technological progress", stating that the power to produce is, as a general rule, superior to the power of population, clearly contradicting the principle of population. Secondly, the Malthusian trap is to be understood as a "self-evident fact", in contrast to the theoretical "tendency" that the principle of population was originally intended to be. Thirdly, a negative correlation between the average productivity of an economy and its fertility induced numerous authors to believe in a negative causal

[36] According to Allen (2001) and Clark (2009), a lasting increase in English wages cannot be observed until after 1820.

relationship running from the former to the latter, which would lead to the principle of population ad absurdum. These fallacies will be enlightened in the appendix.

5 The Preventively Checked Economy

5.1 The Release from the Pressure of Population

Having established the tendency to people a country fully up to the limits of subsistence and beyond, it has been suggested that an unrestricted increase in population would in reality inevitably lead to a "struggle for existence" and over the long run to the "Malthusian trap". The latter is generally characterized by a strong operation of positive checks and increasing specialization, i.e. production. Moreover, it has been argued that neither positive checks nor increasing production are in this case capable of raising productivity in the long run. When thus excluding these factors as potential forces toward a more permanent increase in production per capita, it remains to evaluate the final option, i.e. to remedy the pressure of population by checking the number of births preventively and to conclude the preventive checks to be solely responsible for the "escape from the Malthusian trap". It is often overlooked that this result follows directly from one of Malthus' most crucial illustrations. *"In an endeavour to raise the proportion of the quantity of provisions to the number of consumers in any country* $[y = Y/N]$*, our attention would naturally be first directed to the increase of the absolute quantity of provisions* $[Y]$*; but finding that, as fast as we did this, the number of consumers* $[N]$ *more than kept pace with it, and that with all our exertions we were still as far as ever behind, we should be convinced, that our efforts directed only in this way would never succeed. It would appear to be setting the tortoise to catch the hare. Finding, therefore, that from the laws of nature we could not proportion the food* $[Y]$ *to the population* $[N]$*, our next attempt should naturally be, to proportion the population to the food. If we can persuade the hare to go to sleep, the tortoise may have some chance of overtaking her."*[37]

Although often portrayed as a pessimist, Malthus saw the improvement of the individual economic situation as a very real possibility. Evidently, if population growth is restricted, the power of population will not be fully exerted. Moreover, if and only if the power of population is embanked, a situation is created in which production can possibly outrun population, generating per capita growth. Logically, apart from the positive

[37] Malthus (1826), book IV, chapter III [squared brackets by the author].

checks, the only feasible way by which "the hare could be persuaded to go to sleep" was to propose birth control and hence to check population preventively. *"It is not in the nature of things that any permanent and general improvement in the condition of the poor can be effected without an increase in the preventive check; and unless this take place, either with or without our efforts, everything that is done for the poor must be temporary and partial. [...] This is a truth so important, and so little understood, that it can scarcely be too often insisted on."*[38]

According to Malthus, the preventive checks include any action affecting the number of births that is intended to reduce the maximum rate of fertility. These actions encompass those cultural customs explicitly and implicitly imposed such as a one-child policy, contraception, abortion, or linking the possibility for legitimate marriage to the capacity to provide subsistence for a family. Analogously to the case of the positive checks, he advised employing the level of the birth rate to measure the operation of the preventive checks. *"The preventive check is perhaps best measured by the smallness of the proportion of yearly births to the whole population."*[39] Accordingly, wherever the preventive checks are at work, the birth rate will be observed to be low and vice versa. Problematically, Malthus seems to have inconsistently distinguished between the "preventive checks", the "preventive check" and the "great preventive check". He used the first two terms to define the "usual restraints" that were comprehensibly displayed by cultural traditions in most human societies. In contrast, the notion of the "great preventive check", which was betimes also abbreviated to the "preventive check", referred to a state of affairs in which these traditions were abandoned and individuals were left to their "natural and reasonable" decisions as a tool to restrict their fertility.[40] Although he argued that the great preventive check was crucial in preventing the population from growing exponentially, many classical economists did not follow his "vaguer intuitions", as Keynes (1933) put it, and there seems to have been no definite agreement on the precise mechanism and definition of the "great preventive check". A.R. Wallace[41] (1890) summarized the apparently unsolved situation. *"At first sight it may appear that in any state of [a liberal] society [...] all the usual restraints to early marriage as they now exist would be removed, and that a rate of increase of the population unexampled in any*

[38] Malthus (1826), book IV, chapter XIII.

[39] Malthus (1826), book II, chapter XI.

[40] Malthus also employed the expressions "prudential restraint from marriage" and "moral restraint from marriage".

[41] Alfred Russel Wallace (1823–1913), British naturalist, co-founder of the theory of evolution by natural selection, fellow of the Royal Society.

previous era would be the result, leading in a few generations to a difficulty in obtaining subsistence, which Malthus has shown to be the inevitable result of the normal rate of increase of mankind when all the positive as well as the preventive checks are removed. As the positive checks – which may be briefly summarised as war, pestilence and famine – are supposed to be non-existent, what, it may be asked, are the preventive checks which are suggested as being capable of reducing the rate of increase within manageable limits?"[42] In the following, it will be attempted to show that the operation of the great preventive check has increased "without our efforts".

5.2 The Principle of Maintenance and the Conflict of Generations

Although it has been stated that high fertility was a dominant evolutionary strategy, natural selection has in many species come up with a multitude of preventive checks to avoid a permanent state of overpopulation. Spencer (1874) proposed that *"proportioning of reproduction to mortality is requisite for mankind as for every other kind"*[43], which he defined as *"the law of maintenance of all races; seeing that when they cease to conform to it they cease to be. [...] Individuation and reproduction are antagonistic."*[44] When looking at nature, it seems obvious that each species that has endured for millions of generations must, as soon as the available territory had been fully stocked and with the pace of specialization advancing very slowly, have exhibited a relatively stable population over this timespan. This, in turn, requires fertility and mortality to be in equilibrium over the long run. In fact, birth rates and death rates can be found to mutually balance each other. If fertility suddenly increased, the species must gradually become more numerous, until from lack of resources mortality would adjust to the level of fertility via the operation of the positive checks. If, conversely, mortality increased, then the species must diminish, until from resources becoming relatively more abundant, fertility would rise to the level of mortality, as otherwise the species would become extinct. Also, it appears intelligible that a reduction of fertility eased the pressure on the means of subsistence and consequently might decrease mortality. However, the causal effects inducing fertility to adapt to diminished mortality, i.e. the "natural" preventive checks, are less clearly exposed. The nature of these most general preventive checks among advanced species will be enlightened in the following.

[42] Wallace (1890).
[43] Spencer (1874), §272.
[44] Spencer (1852), §2, §4.

In an unchecked non-human economy, reproduction could be practiced by each individual as long as it was able to acquire the necessary resources. In this case, it has been argued that an excess of fertility had the tendency to ultimately force abundant individuals of the same generation into competition – a tendency that might generally be denoted as "intragenerational competition for niches". However, as has already been mentioned in chapter three, an excess of individuals and the concomitant pressure of population might, according to equation (2), alternatively emerge from a reduction in the positive checks diminishing mortality [DR] and raising the population share of older individuals.[45] In this case, if two subsequent generations of individuals existed at the same time, a universally prolonged longevity would raise conflicts between the old, established and the young, emerging generation and correspondingly intensify "intergenerational competition for niches". The latter will be found to decisively cause the operation of the great preventive check.

5.3 The Animal Economy

To inquire into the universal underlying causes that are responsible for confining fertility to a "manageable limit", we may again first turn to the non-human economies. The strongest degree of intergenerational competition must be borne in the plant economy, where the possession of a natural niche almost exclusively relies on the availability of a fixed amount of territory. We may thus return to the initial statement that in a forest that is fully covered by beeches, it is impossible for seeds to start growing until an existing tree has died off. In this case, the conflict between subsequent generations itself constitutes the great preventive check in its most fundamental form. Among many bird and mammal species, where regular individual competition for territory is observed, growth is likewise limited by the prevalence of an adult generation. In these instances, a relatively higher share of mature individuals established on a given amount of land tends to diminish the emerging generations' resources and timespan usually reserved for propagation and consequently the potential number of their offspring. This is most readily seen by observing the contrary fact that, if a "mortality crisis" induced the death of a large share of old, established individuals, a pool of newcomers would be readily available to take possession of the abandoned territory and strive to increase in numbers.

[45] For simplicity, the diminution of infant and child mortality will not be considered in this work, as the effects of the eventual abolition of "child replacements" seem to be in line with the operation of the preventive checks outlined here.

Furthermore, the great preventive check is quite considerably complicated by the existence of sexual reproduction. It is an important biological finding that among territorial species exhibiting different sexes, a too high fertility can be suppressed by a mechanism Darwin (1871) called "sexual selection". In cases where one sex is relatively abundant (in most species the males), the other sex can exert some choice on their potential partners. Among territorial species, possession of a territorial niche serves, beyond merely providing means of subsistence, as the decisive criterion of sexual attraction. Since, therefore, the possession of territory is an important condition for propagation, its occupation has evolved as the primary instinct of individuals of the abundant sex. The latter argumentation is based on observations made by J.S. Huxley[46] (1926). *"Territory in some form or other is of prime biological importance in the life of birds (and probably of other groups as well). The first sign of sexual activity – the first effect, presumably, of the vernal change in the sexual organs – is in most species seen in the instinct of the males, not, as has usually been assumed to seek out the females, but to find, occupy, and defend a territory. So far as there is choice of mates in monogamous species, it is by the females, who seek out the males; but they only compete for those males who are in possession of territory."*[47] Given this form of sexual selection and that established individuals will already have acquired territory complementary attracting the other sex, nicheless individuals – in most cases young males – are regarded as unattractive and are therefore not considered for pairing, lowering the birth rate of the species.

The operation of the above preventive effect of sexual selection is more strongly exposed by restricting our attention, following Huxley, to monogamous species, where the attraction of one partner excludes the attraction of other potential candidates. Under this state of affairs, nicheless individuals – in most cases young females – are commonly not considered for reproduction and interbreeding is restricted to old, established pairs, further naturally reducing the reproductive capacity of the whole species.

Consequently, among monogamous territorial species, the great preventive check is, in addition to the usual degree of intergenerational competition, proportionally amplified by the degree of sexual selection. Under circumstances that concede low mortality, free choice of mating will deny juvenescent male and female individuals the possibility to

[46] Sir Julian Sorell Huxley (1887–1975), British naturalist, biologist, first Director of UNESCO, founding member of the WWF, first President of the British Humanist Association, fellow of the Royal Society.

[47] Huxley (1926), p. 148.

reproduce. This great preventive check is, as will be shown shortly, even more actively operating among the human species.

5.4 The Human Economy

"But whence comes it, that the country where [...] the mean life, in whatever way the calculation is made, is higher than in any other, should be precisely that in which the fecundity is the smallest?"[48]

One might be tempted to extend the fertility-preventing combined effect of intergenerational competition and sexual selection to the human case considering Malthus' view of a fully peopled pure pasture economy. *"Under such circumstances, how would it be possible for the young men who had reached the age of puberty, to leave their fathers' houses and marry, till an employment of herdsman, dairyman, or something of the kind, became vacant by death?"*[49] Moreover, apart from the possession of a niche required for subsistence and sexual attraction, the decisive component leading to a drastic increase in the preventive effect in a regime of low mortality is owed to the fact that human fertility is, particularly within monogamous couples, limited by age, preventively checking the potential fertility of old – in most cases female – individuals.[50] Malthus concluded that a strong degree of intergenerational competition would force an emerging generation to postpone reproduction until it will often be completely impeded by old age. *"The sons of farmers are exhorted not to marry, and generally find it necessary to comply with this advice, till they are settled in some business or farm, which may enable them to support a family. These events may not perhaps occur till they are far advanced in life. [...] Marriages would be among persons so far advanced in life, that most of the women would have ceased to bear children."*[51] In the following argumentation we will thus presume the existence of monogamy and a fertility interval limited by age in a human economy.[52]

The mindful reader will object that the suggested analogy projected from the bird economy to the human "territorial" economy masks an important Smithian character-

[48] M. Muret in Malthus (1826), book II, chapter V.
[49] Malthus (1826), book II, chapter V.
[50] However, it should be noted that menopause is not a purely human characteristic; see for example Ward et al. (2009).
[51] Malthus (1826), book II, chapter VIII.
[52] It should be remarked that the change from the domestic institution polygamy to that of monogamy as well as the change from patriarchy to matriarchy are quite common and regularly observed phenomena among human as well as animal populations. See for example Spencer (1874).

istic of human societies, namely the existence of a social structure arising from regular exchange between individuals.[53] Since in human hunter and gatherer societies territory is in many cases not owned by single individuals, but by a community, scarcity of territory ceases to be the point of contention causing intergenerational conflicts. Correspondingly, sexual selection must be exerted on other grounds than territorial ones. Nonetheless, it seems most plausible to assume that choice of mating will still tend to fall on those individuals that are assessed to be able to best provide subsistence for progeny. Indeed, in social economies, an individual's free choice appears to frequently center their attention on the social status, or as the classical economists called it, the "social rank" a potential partner appears to represent, which is quite reliably displayed by a corresponding "social niche", or in other words, a profession.[54] It is, hence, reasonable to replace the preventive effect resulting from the possession of a territorial niche with that resulting from the occupation of a social niche as a sign of attraction in human social economies.

Being thus confronted with a further criterion of sexual selection, the pursuit of territory must, from an evolutionary point of view, have been gradually complemented by a pursuit of social eminence as a "drive of prime biological importance". More explicitly, the average young individual must under a strong degree of intergenerational competition constantly strive to attain the former generation's social rank and consequently develop an instinct for social success, which is probably based on the experience of the parental success. Malthus, Senior and McCulloch suggested that the universal "fear of losing a social rank" would account for this additional instinct. *"Men will not be industrious without a motive; and the desire of bettering our condition, though powerful, is less so than the pressure of want, or the fear of falling to an inferior station. [...] With the lower classes the existence of present, and with the middle and upper classes the fear of future want, are the principal motives that stimulate intelligence and activity. The desire to maintain a family in respectability and comfort, or to advance their interests, makes the spring and summer of life be spent, even by the moderately wealthy, in laborious enterprises."*[55] Accordingly, while the pressure of want forced an individual of low rank to merely occupy *some* social niche, the fear of losing a social rank induced individuals exhibiting a higher social status to pursue those professions that retained

[53] It is obvious that the existence of a social structure is not solely restricted to the human species.

[54] This positive relationship between income and marriage is indeed nothing but the microeconomic foundation of the principle of population.

[55] McCulloch (1863), part I, chapter VIII [bold letters by the author].

their social rank to impress the other sex with what Senior had called "decencies". *"The great preventive check is the fear of losing decencies, or, what is nearly the same, the hope to acquire, by the accumulation of longer celibacy, the means of purchasing the decencies which give a higher social rank."*[56]

To illustrate the operation of the great preventive check, let us suppose a high-mortality-economy with a stationary population. Assuming the death rate to be 20 per thousand would correspond to a life expectancy of 50 years. Furthermore, suppose an inhabitant of this economy at the age of 25 whose parents - former physicians - have recently died at the age of 50, bequeathing their business to their child. Having acquired the parental social niche and consequently displaying the corresponding social status, the new physician will not hesitate to start a family. Now suppose mortality would fall over the next 25 years, such that the death rate was reduced to 12.5 per thousand, i.e. life expectancy would increase toward 80 years. In this case, the new physician's progeny is at the age of 25 confronted with a new situation. Since their parents are well and alive, intergenerational competition arises, in most instances favouring the established generation. From the resulting inferior position, fearing the loss of the decencies they were used to grow up with, the progeny will realize that they have to study medicine or experience additional medical on-the-job-training to be able to compete with the former generation to ultimately retain their social rank, until finally either the parental productivity has been achieved, or, as is much more common, the parents have retired or died. During the period of extended education, the offspring will generally neither commit to a partner, nor will they attract a potential partner of a corresponding social rank, thereby aggravating the finding together of the sexes. Once the third generation has inherited the business and the social niche has been secured, it will again tend to propagate. However, assuming e.g. the parental retirement age to be 65 years, the newly established couple is most arguably too far advanced in life to produce their desired number of offspring such that their their potential fertility is correspondingly reduced.

To summarize the operation of the great preventive check in human economies, it might be stated that it is triggered by decreasing mortality and concomitantly intensified intergenerational competition for professions, preventing a young individual from occupying a social niche. The great preventive check comprises those actions stemming from "the fear of losing a social rank" that result in a postponement of reproduction

[56] Senior (1836), p. 144.

onto a later point in life. Accordingly, it must be remarked that its effect would be almost imperceptible if human fertility was not limited by age and is greatly reinforced by the prevalence of the domestic institutions monogamy and free choice of marriage. That the foregoing considerations are in accordance with Malthus' understanding of the great preventive check is highlighted by his most fundamental policy advice, that *"I have stated expressly, that a decrease of mortality at all ages is what we ought chiefly to aim at. [...] It will be generally found true, that the increasing healthiness of a country will not only diminish the proportions of deaths, but the proportions of births and marriages."*[57] The great preventive check is empirically confirmed by observing the "Demographic Transition" in every developed economy. Here, a long-run reduction of the death rate below a threshold of 20 per thousand will generally be followed by an even stronger reduction of the birth rate.

5.5 Economic Growth in the Preventively Checked Economy and Empirical Evidence

"No plan for social improvement can be complete unless it embrace the means both of increasing the production of wealth and of preventing population from making a proportionate advance."[58]

This last section will give a short outline of the effects, the operation of the preventive checks is supposed to have on production with regard to innovation. It has been found that, if the preventive checks are weak, unchecked propagation results in a too large number of descendants. "Too large" here means that production per capita of the original generation is diminished for the subsequent generation by subdividing the means of production inherited from the parental niche. Although the larger number of offspring might have been forced to invent new methods to raise total production via specialization and labor division, the growth rate of production was found to remain inferior to that of population growth, causing stagnation of productivity on a subsistence level.

On the other hand, given a situation in which preventive checks operate extraordinarily strongly, niches are ultimately passed on from ancestor to descendant. In this case, as young individuals are neither threatened with being pushed out of existing niches, nor are they, owing to a stagnating population, facing potential economies of scale, improved productivity except for what is required to practice the parental profession becomes to

[57] Malthus (1826), book V, chapter I and Malthus (1826), book III, chapter II.
[58] Senior (1836), p. 146.

the greatest extent useless. McCulloch even went a step further, believing that in an economy where (intra- as well as intergenerational) competition would be completely eliminated, the corresponding "motives that stimulate intelligence and activity" would vanish as well. *"If, indeed, it were possible that the stimulus arising from this principle [of population] would be suddenly removed, it is not easy to determine what life would be except a dreary blank, or the world except an uncultivated waste. Every exertion to which civilisation can be traced, proceeds, directly or indirectly, from its effects; either from the actual desire of having a family, or the pressing obligation of providing for one, or from the necessity of rivalling the efforts produced by the operation of these motives in others."*[59]

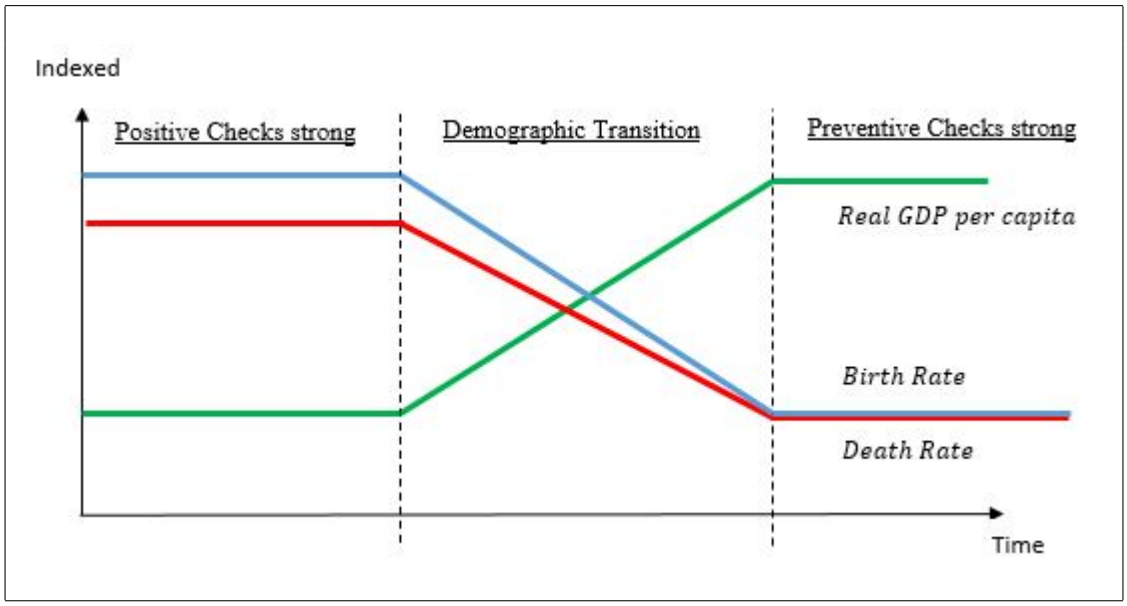
As the two above extremes of unchecked and fully checked population growth are obvious, it follows that there must be some transitional, intermediate point in which the preventive checks operate in such a moderate degree as to allow for a slow increase of population and at the same time for an equally moderate pursuit of innovation. However, since the formerly suggested mechanism of innovation relying on a struggle for existence cannot be upheld in a preventively checked economy, where resources for survival are in most cases readily available, it has hitherto remained unclear how innovation and consequently economic growth can be motivated in this instance.

Regardless of whether an innovation is caused by "want" or "the fear of losing a social rank", it generally tends to take place only if the current cohort outnumbers the former, i.e. by intragenerational competition, driving an abundant number of young individuals into new niches. When, at the same time, the average number of abundant descendants became sufficiently small to be absorbed by new forms of specialization, which arose from the increased market size, parental niches would not need to be subdivided. As a result, innovations from specialization might enable a permanent rise in productivity while "the hare is asleep". As the outcome of this last corollary depends on the varying pace of the introduction of labor division in each single economy, it is left to further research on the principle of labor division. For visualization, the supposed empirical demographic transition from a weakly preventively checked toward a strongly preventively checked economy is stylized in Figure 5.1.

The final appraisal the principle of population received in classical economics is perhaps best summarized by the following quote of McCulloch. *"The principle of increase, as explained by Malthus [1798], [...] appeared to form an insuperable obstacle to all*

[59] McCulloch (1863), part I, chapter VIII [squared brackets by the author].

Figure 5.1: The Classical Transition of Demographic and Economic Variables.



permanent improvement in the condition of society, and to condemn the great majority of the human race to a state approaching to destitution. But farther inquiries have shown that the inferences drawn [...] from the principle [...], are contradicted by the widest experience; that the too rapid increase of population is almost always prevented by the influence of principles which its increase brings into activity; that a vast improvement has taken place in the condition of the people of most countries [...] and that, so far from being inimical to improvement, we are really indebted to the principle of increase for most part of our comforts and enjoyments, and for the continued progress of arts and industry. [...] That the tendency to increase is not inconsistent with the improvement of society, is a fact as to which there can be no dispute."[60]

6 Conclusion

Contrary to what has recently been implicitly assumed by a majority of growth economists, there exists a difference between the classical principle of population and the Malthusian trap. The Malthusian trap defines a state of stagnating economic productivity resulting from the operation of an unrestricted principle of population. As the Malthusian trap is a testable fact, its existence was – following Malthus' experience

[60] McCulloch (1863), preface [squared brackets by the author].

– first reasonably verified and later equally reasonably falsified. In contrast, the underlying principle of population is the incontrovertible tendency of each living being to increase in numbers whenever its means of subsistence increase. If this tendency is allowed to operate freely, it causes strong competition for resources and consequently hardship and innovation. If it is fully suppressed preventively, lack of competition and hardship diminish the number of innovations to a minimum level. If, however, its operation was embanked to such a moderate degree as to allow for a slowly increasing population, the benefits and the detriments arising from competition might be balanced such that economic growth per capita is optimized.

Although certain preventive checks have been extensively outlined in this work, they cannot be said to have been exhaustively determined, except for stating that they are triggered by diminishing mortality. As a practical result, it might be generally asserted that the increase in labor productivity over the past two hundred years was not solely owed to the Industrial Revolution, as is commonly assumed, but chiefly to the Epidemiological Revolution. If it would not have been for the great preventive check, the population of the earth would certainly not have been confined to less than ten billion inhabitants.

Finally, the reader might have realized that a sufficient knowledge of historical or evolutionary development must be a prerequisite to understand that the principle of population governs every biological population, since its observation requires constant comparison with real populations. Furthermore, without the ability to generalize and categorize these natural phenomena one cannot expect to be capable of comprehending the great principles of nature. As a consequence of the tendency to increase, human history and evolution have been constantly accompanied by population expansion. The classical economists – in most cases well educated economic historians – understood that the ensuing competition constituted the foundation of their entire economic theory. Accordingly, when intending to tread in their footsteps, it is essential to acknowledge that the general tendency for (perfect) competition is a result of a universally operating principle of population and that nothing makes sense in classical economic theory, if not seen in the light of the theory of population.

References

[1] Allen, R. C.: 2001, "The great divergence in European wages and prices from the Middle Ages to the First World War". *Explorations in Economic History* 38(4), 441-447.

[2] Becker, G. S.: 1991, *A Treatise on the Family*, Harvard University Press, Cambridge.

[3] Bloom, D. E., Canning, D. and Sevilla, J.: 2003, *The Demographic Dividend – A New Perspective on the Economic Consequences of Population Change*. RAND, Pittsburgh.

[4] Carey, H. C.: 1837, *Principles of Political Economy: Volume I. Band 1.* A. M. Kelley, 1965.

[5] Clark, G.: 2007, *A farewell to alms: a brief economic history of the world.* Princeton: Princeton Univ. Press.

[6] Clark, G.: 2009, *The macroeconomic aggregates for England, 1209-2008.* Davis, Calif.: Dep. of Economics, Univ. of California.

[7] Darwin, C. R.: 1859, *On the origin of species by means of natural selection; or, The preservation of favored races in the struggle for life.* New York, D. Appleton and Company, second edition 1872.

[8] Darwin, C. R.: 1871, *The descent of man, and selection in relation to sex.* London: John Murray. Volume 1. 1st edition.

[9] Galor, O.: 2011, *Unified Growth Theory.* Princeton: Princeton University Press.

[10] Huxley, J. S.: 1926, *Essays in Popular Science.* London: Chatto and Windus.

[11] Kelly, M.: 1997, The Dynamics of Smithian Growth. *Quarterly Journal of Economics* 112: 939-964.

[12] Keynes, J. M.: 1933, *Essays in Biography.* Harcourt, Brace.

[13] Komlos, J.: 1994, (Ed.), *Stature, Living Standards, and Economic Development: Essays in Anthropometric History.* Chicago: The University of Chicago Press. 1994.

[14] Langer, W. L.: 1963, Europe's Initial Population Explosion. *The American Historical Review* 69(1).

[15] Livi-Bacci, M.: 2001, *A Concise History of World Population.* Wiley.

[16] Malthus, T. R.: 1798, *An essay on the Principle of Population.* London: Reeves and Turner, 1st edition.

[17] Malthus, T. R.: 1803, *An essay on the principle of population or, A view of its past and present effects on human happiness.* London: J. Murray, 2nd edition.

[18] Malthus, T. R.: 1826, *An essay on the principle of population or, A view of its past and present effects on human happiness.* London: J. Murray, 6th edition.

[19] Marshall, A.: 1890, *Principles of economics.* London and New York, Macmillan and co. McCulloch, J. R.: (1863), A treatise on the principles and practical influence of taxation and the funding system. Edinburgh: A. and C. Black.

[20] McCulloch, J. R.: 1863, *A treatise on the principles and practical influence of taxation and the funding system.* Ediburgh: A. and C. Black.

[21] Mill, J. S.: 1848, *Principles of Political Economy – with Some of Their Applications to Social Philosophy.* London: John W. Parker, West Strand.

[22] Nunn, N. and N. Qian: 2011, "The Potato's Contribution to Population and Urbanization: Evidence from a Historical Experiment". *Quarterly Journal of Economics* 126(2), 593-650

[23] Senior, N. W.: 1836, *An outline of the science of political economy.* London: Clowes.

[24] Smith, A.: 1776, *An inquiry into the nature and causes of the wealth of nations.* Dublin: Printed for Messrs. Whitestone and 19 others.

[25] Spencer, H.: 1852, *A Theory of Population, deduced from the General Law of Animal Fertility.* The Westminster Review 57 (1852[New Series, Vol I, No. II]): 468-501.

[26] Spencer, H.: 1874, *The Principles of Sociology in Three Volumes. Part 3: Domestic Institutions.* New York D. Appleton and Company.

[27] Tanner, J.: 1994, *Growth in Height as a Mirror of the Standard of Living* in Komlos, J.: 1994, (Ed.), *Stature, Living Standards, and Economic Development: Essays in Anthropometric History*. Chicago: The University of Chicago Press. 1994.

[28] Wallace, A.R.: 1890, *Human Selection. Alfred Russel Wallace Classic Writings. Paper 5, 2010.*

[29] Ward, E. J., Parsons, K., Holmes, E. E., Balcomb, K.C. and Ford, J. KB. (2009), *The role of menopause and reproductive senescence in a long-lived social mammal.* Frontiers in Zoology 6(4).

[30] Weiner, J.: 1995, *The Beak of the Finch*. Vintage Books, New York, 1994.

[31] Young, A. A.: 1928, "Increasing Returns and Economic Progress". *The Economic Journal* 38(152).

Appendix: Three Fallacies

Fallacy 1: Assuming the Power to Increase Production being Superior to the Power of Population

Before the emergence of neoclassical economics, population growth was widely considered as an essential factor responsible for "Smithian growth" i.e. as a driver of economic output.[61] The tendency to increase and to correspondingly specialize was according to Spencer – as it was to Smith, Malthus and Darwin – the main driving force of every civilization. *"From the beginning, pressure of population has been the proximate cause of progress. It produced the original diffusion of the race. It compelled men to abandon predatory habits and take to agriculture. It led to the clearing of the earth's surface. It forced men into the social state; made social organization inevitable; and has developed the social sentiments. It has stimulated to progressive improvements in production, and to increased skill and intelligence. It is daily pressing us into closer contact and more mutually dependent relationships."*[62]

Nonetheless, a minority of writers rejected the – apparently inhuman – idea that total economic production was mainly triggered by population pressure by employing an argument which today unjustly seems to be quiet agreement. While average productivity gains generated by the first English industrial revolution between 1760 and 1820 had been regularly outperformed by population growth, the increase in productivity observed exclusively among the upper classes during the early nineteenth century had already induced some economists to believe that the benefits stemming from the division of labor were generally capable of outperforming the increase in population. Naturally, the simplest way of explaining a lasting increase in production per capita is to claim that production possessed the power to outgrow population. As Senior summarized, *"on one side are those who believe that an increase of numbers is necessarily accompanied not merely by a positive, but by a relative increase of productive power; that density of population is the cause and the test of prosperity; and that, were every nation under the sun to be released from all the natural and artificial checks on their increase, and to start of breeding at the fastest possible rate, many, very many generations must*

[61] As Young (1928) put it, *"Senior's positive doctrine is well known, and there were others who made note of the circumstance that with the growth of population and of markets, new opportunities for the division of labour appear and new advantages attach to it. In this way, and in this way only, were the generally commonplace things which they [the classical authors] said about 'improvements' [...]".*

[62] Spencer (1852), §16.

elapse before any necessary pressure could be felt."[63] However, this belief, being closely related to the modern notion of "increasing returns from technological progress", does not stand the test of reality, as will be briefly investigated.

Being very well acquainted with the process of specialization, labor division and therefore technological progress, Malthus naturally defended the idea that the power of population growth was superior to the power of growth in production. *"The power of the earth to produce subsistence is certainly not unlimited, but it is strictly speaking indefinite; that is, its limits are not defined, and the time will probably never arrive when we shall be able to say, that no further labour or ingenuity of man could make further additions to it. But the power of obtaining an additional quantity of [resources] from the earth by proper management, and in a certain time, has the most remote relation imaginable to the power of keeping pace with an unrestricted increase of population."*[64]

In spite of those exceptional historical instances in which the discovery of new land or of rare natural resources have raised the production of an economy tremendously over the short run, Senior (1836) argued likewise that such cannot be the permanent state of affairs. *"Although, therefore, it is not possible to assign any certain limits to the progress of improvement, it is notwithstanding evident that it cannot continue for any considerable period to advance in the same proportion that population would advance supposing [resources] were abundantly supplied."*[65] Employing a simple illustration, H. Carey[66] (1837) equally hinted at a dynamic principle of diminishing returns. *"If land would always yield in proportion to the quantity of labor and capital applied to it, there would be no need to cultivate more than a single farm, or a single district, for the supply of any number of inhabitants; and because such cannot be the case, it is assumed that every fresh application of labor and capital to cultivation, must be attended with a diminished return."*[67] Correspondingly, to the modern economist it ought to appear utterly impossible to supply a population of the aforementioned potential of around 135,000 trillion inhabitants that arose from an unrestricted growth in population within about two hundred years.

While the annual growth rate of production rarely exceeded five or six percent in historically recorded economies, we have shown that population possessed the ability to grow

[63] Senior (1836), p. 146.
[64] Malthus (1826), book V, chapter I.
[65] Senior (1836), p. 147.
[66] Henry Charles Carey (1793–1879), American economist, chief economic adviser to US president Abraham Lincoln.
[67] Carey (1837), vol. 3, p. 8.

by around nine percent annually. Accordingly, we would have to expect a permanent growth rate of more than nine percent in those economies that have yet succeeded in surpassing the subsistence level to justify the idea that production had outrun population. Although this may not be impossible, it has not been observed so far, and the often displayed constancy of productivity in economies with considerable total economic growth can quite frequently be accredited to an equally rapidly growing population. Even as late as 1848, Mill doubted the superior power of "technological progress" as compared to population. *"Hitherto it is questionable if all the mechanical inventions yet made have lightened the day's toil of any human being. They have enabled a greater population to live the same life of drudgery and imprisonment."*[68]

Admittedly, population has not yet been observed to grow by nine percent either. Nonetheless, Malthus' notion that the number of niches created by specialization is observed to be insufficient to provide the emerging generations with employment is – if not by constant productivity – well supported by high rates of emigration and mortality that often accompanied rapid growth rates of population. In most industrializing economies, a strong degree of competition frequently used to force abundant individuals to emigrate or to drive them into deadly competition, often by collectively waging war. Reversely, McCulloch observed the resulting operation of the positive checks as a regular phenomenon in history, stating that *"wars, plagues, and epidemics, those 'terrible correctives' [...] of the redundance of mankind, set the operation of the principle of population in a striking point of view. They lessen the number of the inhabitants, without, in most cases, proportionally lessening the capital that feeds and maintains them."*[69]

As a result, since it is regularly observed that mortality crises tend to eventually increase the productivity of the remaining labor force, a diminished population cannot, in these cases, possibly have had the effect to reduce the means of subsistence more than proportionally. Consequently, as it is neither theoretically nor empirically convincing, the doctrine that population growth would generally raise production more than proportionally through faster accumulation of capital or technology cannot constitute an economic principle.

[68] Mill (1848), book IV, chapter VI.
[69] McCulloch (1863), part I, chapter VIII.

Fallacy 2: Assuming the Principle of Population as a "Self-Evident Fact"

In opposition to Spencer's and McCulloch's optimistic view, the principle of population was by most economists primarily perceived as a source of misery, and less as a driver of total economic output, for Malthus (1798) had written in his original essay that *"natural inequality of the two powers of population and of production in the earth, and that great law of our nature which must constantly keep their effects equal, form the great difficulty that to me appears insurmountable in the way to the perfectibility of society. All other arguments are of slight and subordinate consideration in comparison of this. I see no way by which man can escape from the weight of this law which pervades all animated nature."*[70] Against this statement, an important criticism regarding the "great difficulty that appears unsurmountable" was legitimately raised. The controversial and famous argument Malthus had brought up was to conjecture that population would in reality inevitably catch up to the level of production in the long run. In the later editions of his essay it became apparent that he had realized that such was not the case. Having travelled large parts of Europe, gathering impressions and population data, he had arrived at the insight that it was possible to embank the power of population, attenuating his former conclusions in his later editions (1803-1826) by more frequently employing the expression "tendency" of a return toward a subsistence level. A tendency, however, should be interpreted as a permanently operating, abstract causal effect employed as a reference point on theoretical considerations. In contrast, the "Malthusian trap" has often been perceived as a readily testable empirical fact, and employed as a practical benchmark on real observations. Senior incorporated Malthus' renewed formulation in his outline on population by proceeding that *"on the other side are those who maintain that population has a tendency [...] to increase beyond the means of subsistence; or, in other words, that, whatever be the existing means of subsistence, population is likely fully to come up to them, and even to struggle to pass beyond them, and is kept back principally by the vice and misery which that struggle must produce."*[71]

However, a large part of Malthus' readership became mentally caught in his first essay on population, inclined to continue interpreting the "tendency" as an "empirical fact".[72] Consequently, when Mill and McCulloch employed phrases like *"that there is a constant*

[70] Malthus (1798), chapter I.

[71] Senior (1836), p. 146.

[72] As has been remarked, even the most recent attempts to resuscitate a "Malthusian trap" seem to refer to a perception of history in which population would permanently and inevitably outgrow production as a "self-evident fact" and not as a "tendency".

tendency in all animated life to increase beyond the nourishment prepared for it, no one can possibly doubt"[73], Senior felt obliged to comment on their linguistic usage and clarified that *"we believe that they [Mr. Mill and Mr. McCulloch] have used it without being misled by it themselves, and, perhaps on that very account, without perceiving its tendency to mislead others. But that those whose acquaintance with Political Economy is superficial (and they form the great mass of even the educated classes) have been misled by the form in which the doctrine of population has been expressed appears to us undeniable. When such persons are told that 'it is the tendency of the human race to increase faster than food.' – 'to people a country fully up to the means of subsistence', they infer that what has a tendency to happen is to be expected. Because additional population may bring poverty, they suppose that it necessarily will do so [...] [Such a doctrine] furnishes an easy escape from the trouble or expense implied by every project of improvement. 'What use would it be,' they ask, 'to promote an extensive emigration? the whole vacuum would be immediately filled up by the necessary increase of population.' [...] It is because we believe these misconceptions to be extensively prevalent that we have ventured to detain our readers by this long discussion. A discussion which some may think a mere dispute about the more convenient use of a word, and others an attempt to prove a self-evident fact."*[74] [75]

[73] Mill (1848), book I, chapter VII.

[74] Senior (1836), p. 149.

[75] The modern economist faces similar difficulties in explicating those assumptions regarding the "tendency" of a homo economicus to display rational behavior or the "tendency" of diminishing returns to the non-economic layman. These abstractions are understood to hold for economic modelling, but they are certainly neither intended nor useful to be observed in every single historical instance.

Fallacy 3: Assuming the "Demographic-Economic Paradox"

A. Marshall[76], one of the founders of neoclassical economics, certainly cannot be blamed for the subsequently arising culture of ignorance with regard to the principle of population. He seems to have understood that the population growth rate depended strongly on the availability of niches, writing that *"country life was, [...] rigid in its habits; young people found it difficult to establish themselves until some other married pair had passed from the scene and made a vacancy in their own parish. [...] Consequently whenever plague or war or famine thinned the population, there were always many waiting to be married, who filled the vacant places."*[77] However, although he seems to have been aware of the mechanism of the great preventive check, he prepared the way to "mislead others" by stating that *"on the whole it seems proved that the birth-rate is generally lower among the well-to-do than among those who make little expensive provision for the future of themselves and their families, and who live an active life: and that fecundity is diminished by luxurious habits of living."*[78] This quote is easily misunderstood in that the implied correlation might induce the reader to generally suspect a negative causality running from income (i.e. productivity) to fertility, which is the opposite of what is stated by the principle of population.

As economies with high productivity tend to display low birth rates, the idea was readily picked up and remains widespread to this day, inducing development policies unintentionally favoring population growth instead of, as they were designed for, growth in productivity.[79] This "demographic-economic paradox" was, however, not a new idea, as it had already been criticized by Spencer as follows: *"The theory which Mr. Doubleday seeks to establish is, that throughout both the animal and vegetable – 'Over feeding checks increase; whilst, on the other hand, a limited or deficient nutriment stimulates and adds to it.' Or, as he elsewhere says, – 'Be the range of the natural power to increase in any species what it may, the plethoric state invariably checks it, and the deplethoric state invariably develops it.' [...] But how, under the alleged law, can a comparatively plethoric state ever be attained to? If the present production of necessaries of life is insufficient for the normal nutrition of the race, and if the resulting deplethoric state involves that the next generation will greatly exceed the present in numbers, then, for*

[76] Alfred Marshall (1842-1924), British professor of political economy at Cambridge University, member of the Royal Commission in 1891, one of the founders of neoclassical economics.
[77] Marshall (1890), book IV, chapter IV.
[78] Marshall (1890) book IV, chapter IV.
[79] See for instance Becker (1991).

anything that appears to the contrary, the next generation will be in a more deplethoric state still. Unless Mr. Doubleday can show that the means of subsistence will increase more rapidly than the unduly fertile people, he cannot prove the existence of any remedial process. Nay, indeed, he must show that his law involves, under such circumstances, a greater increase of food than of people. Now he neither does nor can show this; and thus the alleged law lacks that very property of self-adjustment, which he rightly regards as the test of the real law."[80] In other words, since it has been shown that growth in production does not tend to outperform an unrestricted increase in population, the latter would create a generation even less productive, leading to a vicious cycle of higher fertility and lower productivity. Hence, Doubleday's doctrine, i.e. the demographic-economic paradox, could never display an equilibrium as fertility would, in the long run, diverge to its maximum or minimum value. Finally, from an individual point of view, it appears to contradict every economic expertise that sexual selection should fall on those potential partners exhibiting the greatest possible economic misery. In this case, exertion would indeed become meaningless, as idleness would be a permanently higher rated sign of attraction than economic success.

[80] Spencer (1852), Introduction.

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