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Escaping the Malthusian Trap
Past and future of growth and stagnation

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Introduction

The Malthusian trap has been chosen as the object of this thesis.

In the modern world, the importance of the population growth rate is stressed and brought up very often. It is just in the month of July that the Spanish foreign minister, Josep Borell, claimed how much Europe needed migrants and “new blood” in order to compensate for its low birth rates and maintain a healthy economic perspective for the future. These remarks echoed those made in June by the Italian president of INPS (National Social Welfare Institution), Tito Boeri, who claimed migrants and a positive fertility rate would have been fundamental in the future to be able to sustain the welfare system and pay for pensions.

On the other side of the coin, we can find words and declarations such as those of the French president Emmanuel Macron, who in occasion of the G20 conference of the last year claimed how Africa as a continent was still “Held back by civilisational problems and women having seven or eight children”. Or again, declarations such as the one of Prince William, Duke of Cambridge, in the Tusk Gala of last November, warning about the dangers of overpopulation we risk to incur in the future, and their effects on the natural world and wildlife.

Today, exactly like in the age of Malthus, there seems to be a debate and a plurality of opinions between those who see a positive population growth rate as fundamental to achieve development in a social and economic sense, and those who instead warn about the dangers of overpopulation and think the fertility rate should be lowered worldwide.

Given the conflicting nature of these different positions, a personal interest arose to start researching the mechanics that correlate the population size, and its growth rate, with the economic and social wealth of a given population.

The starting point of this study and research was therefore found in T.R. Malthus, and his population doctrine, in which for the first time, a model has been created that confutes the idea an ever increasing population is necessarily a source of wealth.

From this starting point then, the research was pointed towards the modern theories of growth, trying to explain the factors that concur in a positive increase of the population and its economical wealth.

This thesis is therefore structured in three main Chapters.

In the first Chapter, the theory of the Malthusian population trap is presented, mentioning its historical critiques, and the historical context in which they took place, in order to achieve an organic representation of its importance.

In the second Chapter, the modern theories of growth in correlation to the Malthusian trap have been reviewed. In the past two centuries some nations seem to have been able to come out of the trap, and therefore with the increased precision and availability of data, the academic interest to explain their escape brought to these theories.

In the third and final Chapter, the modern world in relation to the trap and the theories of growth has been investigated, in order to try and account for the factors by which the divergence between different regions can be observed, and what is the future of growth and environmental sustainability worldwide.

For the purpose of this research, a variety of sources has been used, mainly historic texts and modern reviews for the first Chapter, government reports, academic papers and books for the second and third.

CHAPTER I

A review of Malthus' demographic theory

1.1. Malthus' thought

Thomas Robert Malthus (Rookery, 1766 - Haileybury, 1834) was an economist and political economy professor, who went down in history for elaborating the controversial thesis of population growth carrying his own name. An Anglican Cleric, he was convinced that the social unease of his times was not necessarily caused by choices of an institutional nature[1], but rather by natural causes deriving from a structural asymmetry of the (limited) means of subsistence and the (unlimited) growth of the population.[2]

He published for the first time his most famous work *An Essay on the Principle of Population as It Affects the Future Improvement of Society* in anonymous form in 1798. In the Malthusian theory, misery cannot be eradicated because it is due to a natural law. However, it can be mitigated through a demographic control implemented through wage levels that discourage workers from procreating and introducing "moral restrictions". Given its ethical implications and in view of the controversy that the Malthusian theory unleashed at the time, the *Essay* was re-published in other editions. These new editions were no longer anonymous, and enriched by studies on statistical data in support of Malthus' heavily controversial theory.

Although most known for his demographic population theory, Malthus was also an economic theorist. He was among the first to introduce the theory of differential rent[3] and a precursor of Keynes' principle of effective demand[4]. He contributed to the evolution of classical thought together with Adam Smith and David Ricardo. In particular despite having divergent opinions, he maintained a close correspondence and friendship for a significant part of his life with the latter.

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[1] Institutions for Malthus were actually "light and superficial [like] feathers floating on the surface, compared to those deep down causing impurities polluting sources and making muddy the whole human life path" (Malthus T. R., *An Essay on the Principle of Population*, J. Johnson, London, 1798, p.56).

[2] In contrast with what was theorized by W. Godwin in his 1793 work *Political Justice*, in which he claims poverty, was due the pre existing institutional asset.

[3] "The year 1815 saw the appearance in Britain of four publications by West, Torrens, Malthus and Ricardo, each of which independently formulated the theory of differential rent" (Blaug 1985, p. 77)

[4] See Keynes (1933)

1.1.1. The historical context

Malthus started writing his *Essay* at the end of the 18th century, at the start of the industrialization period for England. This was a historical moment characterized by a continuous growth of industrial and agricultural production enabled by technological innovations, especially in the agrarian field (so-called "Agricultural Revolution"), and means of transport (creation of new roads, introduction of tolls and trains).

In these years, Great Britain experienced great changes also in political ways. During his life Malthus saw the independence of the American colonies, the Napoleonic wars[5] and the start of the process of industrialization as already mentioned in the previous paragraph.

Until then, the main policy regarding the population growth was "populationism", according to which, the strength of a state used to come from the number of its inhabitants. More people used to mean ever increasing economic prowess thanks to more manpower, alongside stronger and bigger armies able to defend the nation's interest.

Since this was the case, the vast majority of the policies of that time were taken to try and increment as much as possible the demographic growth. Emigration bans were put in place, while the social public pressured young women and men into trying to have more children. There were also laws put in place to create a welfare system allowing everybody to survive and therefore ensure the population growth even in the lowest classes.

In England, these laws were referred as the "poor laws[6]", prescribing help from parishes to the most unfortunate, such as orphans, elderly and the sick, to try and help them survive. Rules instituted centuries before with which the debate created by Malthus at the time entered fiercely into conflict. According to the Malthusian thought, the helping of the poor and lowest tiers of society was not something to aspire to.

In this sense, the Malthusian thinking and theory was important at the time because it proposed a model that disrupted the way society used to think, challenging the common assumptions. According to this model (as explained in more detail later), the uncontrolled population growth and its boom, represented a threat to wealth.

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[5] The American revolution took place between 1775 and 1783, while the Napoleonic wars instead were a 23 years period that concluded with the battle of Waterloo in 1815 (Encyclopedia Britannica), both are examples of the crumbling of the old world structures of the time, one the British Empire, and the other the Ancien *Regime*.

[6] British legislation. Created under the reign of Elizabeth I, they lasted substantially between 1597 and 1834. In the 19th century, it attracted the attention of classical economists (Such as Malthus and Ricardo who agreed on this point), who claimed the laws fostered poverty and decreased productivity. (Treccani, 2012)

A society that keeps growing without having the means to, is a society destined to fail.

This evolution and change in the common thought and social structures did not regard only Malthus and was strictly related to historical events and institutional changes. As mentioned before, Malthus lived in a period of transition, from the agrarian based society to the industrialized one and with a background of political changes like the crumbling of the Ancien Regime thanks to the Napoleonic wars.

The pre-industrial economy was a subsistence economy, mainly linked to agriculture alone[7], but the birth of the factory model allowed the workers not to rely on the unpredictability of the land, but rather on salaries. The period of industrial revolution immediately successive to Malthus allowed the society to change at unprecedented speed.

The phenomenon of industrialization changed society's attitudes and the way it worked. People started to flee the countryside to flock to the cities for work in the factories, giving life to the process of urbanization and the availability of more services that came with living in said cities.

However, the process of urbanization also brought with it the problem of the poor living conditions of the workers, especially in the factories. On the one hand, the employment conditions in factories were much harsher than those in the countryside, and the relative novelty of the sector meant there was no coded set of rights for these people. This is why, during the 19th century, the first working associations (the Trade Unions) were born, with the aim of practising mutual aid and assisting in the case of illness, for example.

On the other hand, with urbanization the living conditions also rapidly worsened. Viral outbreaks and shorter life spans started to take hold in the parts of Europe seeing the rise of these phenomena; it is only later in the century, with medical advances[8] and improvements in sanitary and dietary conditions, that we can observe a very high population growth and a shift in the demographic regime.

In such a focal part of history, characterized by a continuous growth of wealth, but also by a widespread condition of poverty of the working class, scholars, thinkers and economists of the time (among which, obviously, Malthus), perceived the contradiction that was beginning to arise between the progress of industrialization and the misery of the working class.

[7] Before the industrial revolution 80/90% of the world GDP was due to agriculture (*The economic history review*, 2004)
[8]Discoveries such as vaccines against smallpox greatly reduced infant mortality. (Killoran James, *The key to understanding global history*, 1998)

1.1.2. The core of Malthus' thought: population progression through time

To explain the central core of Malthus' thought we can quote the following passage from his most famous work: "I affirm that the power of the population is infinitely greater than the power of the earth to produce subsistence for man. The population, when not stopped, increases in geometric progression. Subsistence only increases in arithmetic progression. A superficial knowledge with numbers will show the enormity of the first power compared to the second" (Malthus 1798, p. 13).

Malthus' observations start from the study of empirical data on English and American population growth and the existing relationship between demographic development and the development of subsistence resources production.

In the years that preceded the writing of the *Essay*, the English population rose from 6,140,000 inhabitants in 1750 to 9,150,000 in 1801[9], recording an increase of almost 50% in 50 years, while the Americans almost tripled in 40 years passing from 1,200,000 inhabitants to 3,930,000 between 1750 and 1790[10].

Starting from the analysis of these data sets Malthus comes to a generalization: the population tends (if not stopped) to double every 25 years and grows in geometric progression. Therefore, the increase in population follows the logic of compound interest: the increase recorded each year of the population is added to the base for the calculation of the increase to the following year.

To give a mathematical representation, by indicating with C the population of the year 0, r the rate of annual increase of population, n the number of years passed; we obtain the result M of the total amount of the future population:

$$C(1+r)^n = M \qquad (1)$$

At this point Malthus wonders whether the production of subsistence goods is sufficient as to cover such a large population increase. In his essay, he takes the principle of the time[11], according to which subsistence resources used to grow in an arithmetic progression.

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[9] Wrigley and Schofield, *The Population History of England, 1541–1871. A reconstruction*, Harvard University Press, (1981)

[10] United States Census Bureau. (2004),*Colonial and pre-federal statistics*,

[11] Mathematically, population grows exponentially, since every subsequent child will have many more with every generation. For the land instead, there is a limit on possible yield and increase of returns given by the fertility of the soil. Empirical proof until the time suggested the total yield of a piece of land could double every 25 years (Malthus T. R., *An Essay on the Principle of Population*, J. Johnson, London, 1798, p. 7). Roughly speaking, Malthus was correct to claim that until his times the power of population was infinitely greater than the power of the earth.

Indicating now with C the quantity of subsistence goods (in the Essay of Malthus, grain[12]), q the annual increase rate of the availability of goods, n the number of years after which subsistence undergoes variation, and with M the amount of goods available after the n years:

$$C(1 + q \times n) = M \qquad (2)$$

If indeed the trend of population growth can be represented by equation (1) and that of subsistence goods by equation (2) it is clear that, according to Malthus, the growth of the latter will always be accompanied by the growth of poverty and misery (as evident from the graph in fig.1).

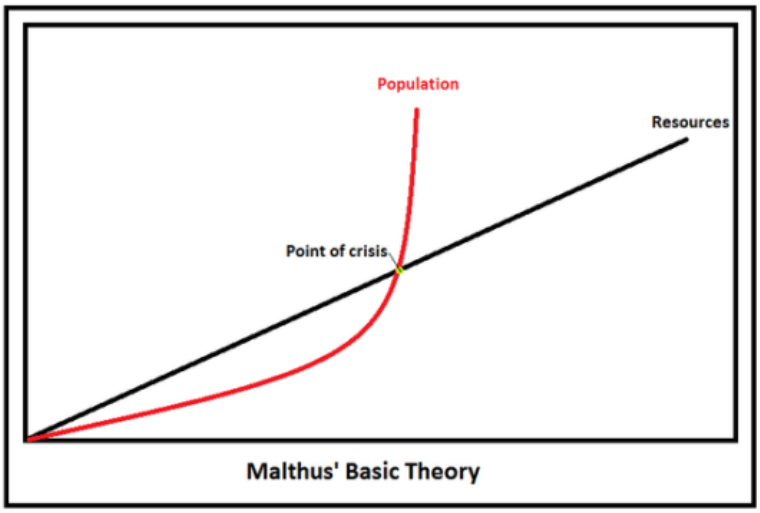

Figure 1: Graph depicting growth of population and subsistence resources in the Malthusian thought. No matter what, the population will outpace the resources at some point triggering a crisis.

At a certain point, the total amount of people will be greater than the available resources, when this happens the total amount of wealth decreases and population growth starts to slow down.

What prevents the population from growing further are measures described by Malthus as "checks"[13]. For Malthus these checks are of two categories: preventive checks, typical of the wealthiest classes, and positive checks, characteristic, instead, of the poorer classes.

[12] At the time bushels of grain were used as unit of measurement for land productivity and yield since they are its basic output. Grain could then be converted in other, more expensive food items, such as cattle, and therefore the most simple and efficient way to keep track of total output was to use grain as unit. To this day, land productivity is measured in total output of one resource for total surface. (Lal Mervin Dharmasiri, 2009, *Measuring agricultural productivity using the Average Productivity Index (API))*

[13]With checks he defines a hypothetical limit on human population, Malthus believed that humans would eventually reproduce in such excess that they would surpass the limits of food supplies; once they reached this point, some sort of "catastrophe" was inevitable to control the population and human resources. (Segen's Medical Dictionary. 2012)

In the highest classes, the checks can be defined as "preventive" as they are related to birth control. The decision not to have a high number of children is free and due to the desire to maintain the same standard of living for the next generations.

These measures are also distinguishable into "morally condemnable" (concubines, contraception) and "morally acceptable" (chastity, extension of first marriage age).

On the contrary, the checks of the poorer classes are "positive" because, besides encouraging a reduction in the birth rate, they also cause an increase in the mortality rate due to the conditions of misery that are generated by the increase in the population.

1.1.3. The trap

With the theory of Malthus it is possible to identify a per capita income of equilibrium with the income that does not generate an increase in population.

In fact, an increase in the population entails in the long run:

- A reduction in wages (due to an increase in labour supply);
- An increase in the demand for subsistence goods

Given that, as described above, subsistence goods increase at a slower pace than the population (arithmetical opposed to geometrical), the assets necessary for survival will be available to a lesser extent for the population, which will result in a price increase.

The decrease in wages due to the greater availability of work also means a reduction in the real value of wages, forcing the worker to more exertion for his own and his family sustenance. The scarcity of income, the worst working conditions, and the impossibility of accessing subsistence goods to a sufficient extent leads to an increase in the mortality rate and a reduction in the birth rate. Moreover, where this does not occur, there are still famines and epidemics or wars.

All these factors, with time, will ensure a return to the subsistence level. What has been described so far in this paragraph is, in fact, the so-called "Malthusian Trap": an increase in income beyond the level of subsistence leads to an increase in the birth rate, which in turn leads to an increase in the supply of labour and a reduction of the salary level, thus bringing income back to the survival rate where it remains forever trapped.

The demographics of the population may swing around the level of subsistence, being higher or lower, but inevitably the set of rules described before will ensure the impossibility to break free from the mechanism.

Malthus, in conclusion to the reasoning, tries to propose the replacement of the natural positive checks correlated with poverty and the excessive amount of people, with those of a moral nature, practising chastity and marriages in adulthood and thus realizing a control on births.

In essence, the Malthusian trap implies that the population tends to settle with the amount of existing subsistence goods, and because of that the conditions of the poorer classes cannot be raised through institutional measures such as the distribution of income or charity. Charity, or trying to uplift these people, will only give them the possibility of having more children, therefore not changing their living conditions. By coming full circle with this theory, we can now understand why Malthus so strongly opposed the poor laws.

This reasoning, means for Malthus that the population grows with the increase of available resources. Therefore, poverty is an inevitable destiny due to the "Avarice of nature[14]", of man trying to maximize his living conditions and not wishing to care about society as a whole, “egoistically” deciding to have more children when there is no grounds for it.

[14]This concept is present also in Adam Smith’s economic thought, only in a very different light. For Smith, greed is something good, since it leads to capital accumulation and investment, for Malthus, it leads to the mechanisms of the trap.

1.2. The critiques of the theory

1.2.1. Classical economists

The theory of Malthus was fairly disruptive with the economic theories that existed until that time; the assumptions of the trap contradicted the claims of previous economists like Adam Smith[15], who believed the increase in population meant the increase in output itself and therefore in the wealth of society.

In Adam Smith's thinking, economic growth is the result of the specialization of workers, and the rate of productive labour. An artisan could produce a certain amount of goods in any given time, but that is not an optimal condition, the best option would be to segment the production process between more people. The factories would have been a much more efficient option since every single worker specializes in his own part of the process, increasing the totality of output.

For Smith, the total amount of output in a society is determined by Labour. As already mentioned the specialization of the workers is what drives the economic process, the land is instead the starting point by which the whole production activity can happen, but often, it is a source of unproductive labour since its profits are redistributed by the landowner in more servants or intangible goods. The landowner is considered as often detrimental to the economic growth according to Smith. As people increase their wealth through their economic activity and savings, they should then use it later to finance other economic processes and, therefore, growth.

The technological process is then another factor as it modernizes the manufacturing process, ensuring a better specialization of workers, saving time and increasing the total product. What allocates efficiently the resources is the "invisible hand" ensuring people will choose the best option for them and, consequently, for society as a whole since this will mean increased economic production.

In this sense, the model proposed implies Increasing Returns, meaning that by augmenting the units of any of the previously described factors of production the total output will increase. By growth of its population, the economy is destined to improve, through the increased number of economic activities and the possibility of more specialised workers.

The previously described model of growth is the reason why Smith clashed with other classical economists. While he focused on the division of labour as the source of increasing returns, the classical economists, and Ricardo and Malthus in particular, focused instead on diminishing returns in

[15]When "*An inquiry into the nature and causes of the wealth of nations (1776)*"was published, Malthus was only 10 years old, it would influence his thought just like the one of the other classical economists only decades later.

agriculture. In this latter sector, they argued, by increasing the amount of labour and capital employed, marginal output would decrease.

Malthus bases his demographic theory on the fact that subsistence resources grow at an arithmetical pace, meaning that the land exhibits diminishing returns, even if more is cultivated and technology allows achieving better processes, it will yield less marginal product with time. This concept is also crucial in the works of Ricardo[16], who emphasized the role of the fertility of the land. The more agricultural production is extended, the more it is necessary to use the existing cultivation more intensively and/or to put into use less fertile land, which means that again, with time, it will exhibit diminishing returns.

The need to cultivate more which is derived from the larger number of people caused by a population increase, will trigger the process of land diminishing yield described before, bringing a society in the Malthusian trap conditions.

In this sense, classical economy stresses the importance of the land owner just as much as the capitalist accumulating wealth. The production of subsistence resources coming from cultivated fields is just as important to balance as the other production processes, as there is the risk that with time, focusing on manufacture will cause a lack of food items.

1.2.2. Marx

With Karl Marx, we can start finding elements of discontinuity with the Malthusian assumptions and thought. In the thought of the German philosopher, there is a great criticism towards the population theories of Malthus.

As he claims in *Das Kapital*, the mechanisms of the trap are nothing but an attempt from the bourgeois to reify the conflict between social classes, even defining Malthus as someone who was entitling the higher classes, whom he adored as a priest[17].

What Marx questions about Malthus, is his attributing to natural laws the processes of exploitation. According to Malthus, the increase in the number of people followed a geometric pattern, resulting in

[16] As mentioned before, David Ricardo(1722-1823) and Malthus kept a correspondence for all their lives, overlapping in some ideas while disagreeing in others. In relation to the Malthusian trap, they both used in their models, the theory of diminishing returns, prescribing the decreasing of marginal value of units of production as their number increased. (*The origin of the law of diminishing returns*, Edwin Cannan, 1813-15)

[17] Marx K., *Das Kapital*, Erster Band, Hamburg, Verland von Otto Meissner, 1867. Pg. 374

resources not being sufficient for them to sustain themselves, causing "positive" checks of grim nature such as famines, wars or outbreaks.

Therefore, the way Malthus proposes to solve the problem is by measures of "moral virtue", such as chastity, increased age of marriage, and desire to have fewer children. According to Marx, this is nothing but an attempt to keep the lower classes in check, since the process behind the impossibility of them sustaining their needs is of another nature.

In the capitalist system, what drives the central figure, the capitalist, is the process of capital accumulation and reinvestment in other fruitful economic activities. This means that as his wealth grows so will the number of activities and the demand for labour.

Since the labour market works in a competitive way, theoretically, the more work is demanded, the more the wages will rise, but according to Marx, this condition does not hold. As the wages grow, so will price levels. As the system grows, the only one accumulating wealth is the capitalist, making profit on the surplus value of the worker itself. The increase in wages will make people reproduce more, creating unemployment and competition between workers, the so called reserve army of labour, keeping wages down.

In this sense, the laws keeping the population at subsistence levels and not allowing them to grow are not natural, but imposed by the market according to the needs of labour demand. The phenomena of positive checks therefore can be blamed on capitalism itself.

The overpopulation described by Malthus, is a necessity of the capitalist system, a concept that ties itself to the reserve army of labour, expressed by Marx as the necessity of having a number of unemployed workers, who will keep wages down at subsistence level by increasing the competition between workers.

1.2.3. Marshall

Just like Marx, Alfred Marshall lived in a period successive to the life of Malthus, allowing him to see the industrial revolution effects on society on the long term. According to him, Malthus' thought was based on three assumptions[18]:

First and foremost, the number of people would be prolific when not checked by events such as war or famines, meaning that by natural laws, human beings would try and increment their numbers. The

[18]Marshall Alfred (1890), *Principles of Economics*, p. 148

second assumption prescribed that in the case of an area becoming thickly populated, the amount of resources producible would have not been able to sustain the number of people. The third and final assumption was that the population would eventually be positively checked in the future, and therefore he encouraged people to engage preventive, voluntary checks by being chaste and having fewer children.

Since Marshall was not a contemporary of Malthus, but was instead placed in the middle between political economy and marginalist economics, he had the chance to see part of the process described by Malthus unravel, and check whether or not his assumptions held.

He thought that while Malthus' first assumption still held, the other two made his theory obsolete. In his opinion, Malthus, through no fault of his own, had not been able to predict the technological progress rate and the inventions that unravelled during the 19th century. The construction of railways, waterways and the invention of engines made an unprecedented speed of travel possible. This is the core of Marshall's Critique on Malthus; he could not predict the increase of transportation efficiency.

This increase meant a variety of factors, first and foremost that an area could grow and surpass its population limits way above its local resource levels. Food could now be transported from the outskirts in greater quantity into the cities, eliminating the risk of famines.

The processes also fuelled urbanization driving people out from the fields and into the cities working in factories, increasing total output and wealth. The living conditions in the countryside up until Marshall's time were economically restricting, and therefore the best people, the strongest people with most drive, in England started to migrate towards urban centres such as London or Manchester[19].

In this sense, Marshall tries to confute the limits imposed by Malthus through the forces of transport and migration, being a bridge between neoclassical economy and the modern theories of growth.

The core of his reasoning was a product of the times he lived in. Malthus created a model that history has apparently confuted in the past 200 years, since both the average wages and the population sky-rocketed. With Marshall we see attempts in an historic sense at creating models describing growth from the Malthusian stagnating conditions, models of growth that would evolve in the modern literature described in the second chapter.

[19]Marshall Alfred (1890), *Principles of Economics*,. p. 115

The models of Marshall could be applied on a world scale as well, stressing at least in theory, the importance of international markets and trade, in increasing the total output of resources and ensuring a growth of wealth above the subsistence level.

CHAPTER II

The Escape from the Malthusian Trap

2.1. The Malthusian thought after two centuries

We have now come to the concept that as "Malthusian Trap", we can define the stagnation of the average per capita income of the population over long term, caused by the corresponding growth in the amount of people themselves. In a society like those of the past (and many others even in modern times[20]), based on agricultural output, an increase in the total amount of subsistence resources automatically corresponded with an increase in the birth-rate, and a reduction of the death rate. Automatically and eventually, the increased amount of resources and the increased number of people resulting by previously listed factors, would balance themselves; and the improved social conditions would disappear, "diluted" by the population growth.

Given these factors and the importance of the argument, it is no surprise that the thesis of Malthus on population was both discussed and brought up by his contemporaries (as discussed in the previous chapter), and in more recent times.

The increased availability and the precision of data we have nowadays, even concerning previous time periods, allow us to have a more educated discussion and debate regarding the dynamics of the Malthusian trap. We have a wider framework upon which it is possible to work, of both days where societies were characterized by constant per capita incomes and the later, modern times of industrial and social revolution, with a seemingly never ending growth that started 200 years ago[21].

From the nature of these conditions, and their implications, many different questions arise: does data support the theories of Malthus? If so, did we escape from those dynamics in the past centuries? Do we risk falling back into the trap? What determines the fact that some parts of the globe were able to come out of the tunnel, while instead others seem to be still stuck inside it?

These questions are among the main reasons why we deem important to keep looking into the theory of Malthus, why it is such a contemporary topic, and why economists and academics engage in studies and discussions exploring its dynamics and developing modern theories of growth.

[20]Countries in Sub Saharan Africa or Eastern Asia exhibit Malthusian conditions to this day; more in detail in the third chapter.
[21]World per capita GDP (Maddison A.)

The data we have and can superficially, easily verify, seem to agree with Malthus[22], painting a picture of stagnation up until his times, and an explosive, exponential growth starting in England with the industrial revolution, propagating then to much of the west.

In this chapter, we discuss the various elements and factors of the "recipe", that allowed part of the world to escape the trap and enter the period of modern growth.

At the bedrock of this development, there are various factors of different nature, such as the role of fertility, mortality and its exogenous shocks in developing the base for the modern man, but also the role of institutions, technology and energy output. These single factors of growth lead later to other modern theories of development, providing a wider framework, not focused on the single element, but more on a thread, connecting different times and ages, the changes in society and the long term impact on the process of escape.

2.1.1. Population, Fertility, Death

The first elements analysed in modern literature to try and give an explanation of Malthusian mechanics, both before and after the industrial revolution, are those concerning the population, its growth rate, and its stratification in a social sense.

As we already know, according to the Malthusian thesis, the exponential rising number of people is the cause of the spiralling downwards of the living standards, "diluting" the newly found wealth by having to redistribute it in the grown population numbers.

We have also already seen how the implications of this were viewed by the society of the time, creating relatively controversial ideas and thought processes. According to the Malthusian thought, in order to create better living conditions, a lesser level of fertility was necessary, which could also be achieved by "cutting out" the weakest parts of society, and engaging in morally sound values and acts, such as chastity, and increased age of marriage.

An example of this are the "poor laws", already touched upon in the first chapter, which aimed at helping the most unfortunate classes, deemed as detrimental by Malthus, an advocate of their abolition, which eventually happened in 1948, before having been redesigned in 1834[23].

[22] Data shows how until the industrial revolution, world population and GDP per capita were indeed stagnating and remaining substantially equivalent (Sharpe A., *Angus Maddison Rewrites Economic History Again*, Challenge Vol. 45, No. 4, 2002)

On the same controversial line of thought we have modern economists like Nico Voigtländer and Hans-Joachim Voth who exposed their thesis of the horsemen effect[24], according to which sudden exogenous shocks reducing the number of the population were actually very beneficial. In their model, these elements create a boomerang effect by which the wealth (previously redistributed in the whole population according to the Malthusian model), could now be divided between a reduced number of people.

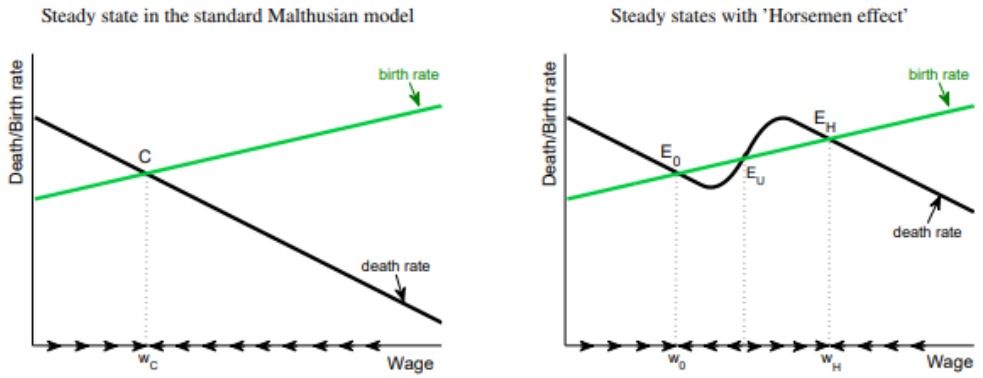

Figure 1: The different steady states of the Malthusian model, the first in normal conditions, and the second with the so called "horsemen" effect. (Voigtländer N., Voth H. J. *The Three Horsemen of Riches: Plague, War, and Urbanization in Early Modern Europe*, Sep. 2007, Review of Economic Studies)

As shown in the graph, in the common Malthusian model, the level of wage, mortality and fertility, equate themselves balancing through time in C with average income equal to W_c .

With the horsemen effect model[25] though, we can see that according to Voigtländer and Voth, exogenous shocks of a grim nature, lowering the amount of population in a sudden way, would engage in a two-step Malthusian model, where the sudden increase in death rate would redistribute the amount of resources bringing the average wage in the transitory state of E_U, and stabilizing in the end at E_H with average income equal at $W_H > W_C$.

A model arguing how at the basis of fortunes, and the escape from the Malthusian trap in the west, there were different grim factors, including the Black Death, urbanization and an increased number of wars.

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[23] The laws were changed cutting off the aid towards poor people, in the hope they would encourage them to work and take beggars out of the streets. (UK Parliament)

[24] Voigtländer N., Voth H. J. *The Three Horsemen of Riches: Plague, War, and Urbanization in Early Modern Europe*, Sep. 2007, Review of Economic Studies

[25] So called to reference the four horsemen of apocalypse: Pestilence, War, Famine and Death; being the triggers for the two step model to take place.

In line with Malthusian thought, violent events do constitute a smaller or bigger step, towards the increase of average living conditions and increase of average income. War in particular alongside Plague, is considered among the great factors of this process. The European states engaging in more frequent conflicts were more exposed to the mechanics of the previously described model.

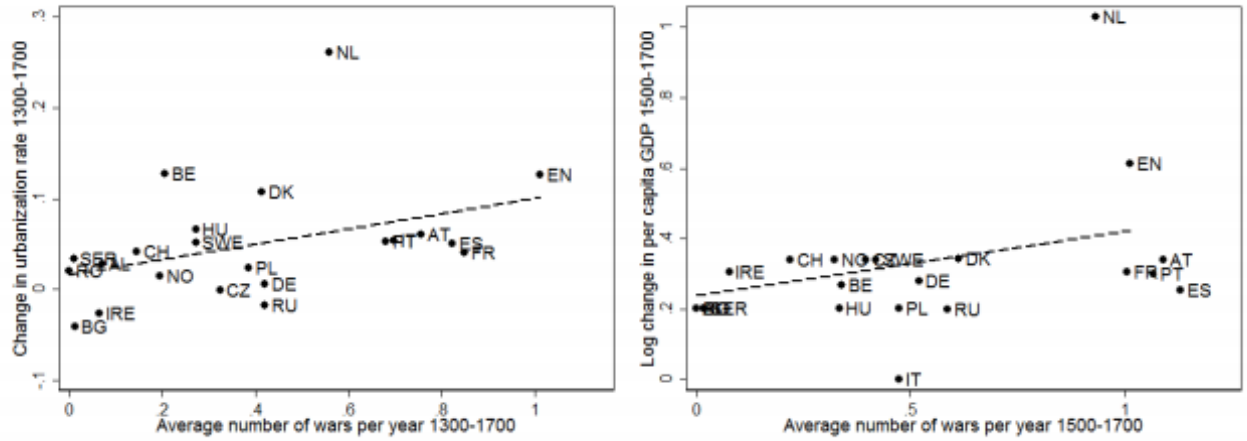

Figure 2: Table showing the relationship between warfare and development in European nations. Voigtländer and Voth, *The gift of Mars*, (2013)

The Black Death serves as a framework demonstrating how beneficial this shock mortality, between one and two thirds of the European population[26], was to the average income per capita and the average output. The plague allowed for the previously existing institutions and society structures to crumble and be reborn anew, in a more efficient way, and with a greater amount of wealth per capita to be redistributed.

It is with the Black Death that we start seeing a small, stagnating process of growth in population and technology in the European continent, which, according to Voigtlanger and Voth, would have also decreed the success of Western Europe compared to Eastern Europe in the long term, left largely unscathed by the Black Plague.

But what about these conditions and the way society itself worked before the modern times and the escape from the Malthusian trap? The way population evolved since the shock of the Black Death and the way it pandered through the centuries is another object of discussion in modern models trying to frame Malthusian mechanics.

[26] DeWitte Sharon & Kowaleski Maryanne (2017), *Black death bodies*, University of Michigan,

A particularly thorough study used as well in the Voigtländer and Voth thesis is the one carried out by economists Gregory Clark and Neil Cummins[27], which takes data from England and Britain. In these countries, before the industrial revolution and its subsequent evolution in hygiene and living standards, there was a very high level of mortality for infants and children. The level of mortality was counterbalanced by the higher fertility society enjoyed at the time. According to the data, the percentage of children who died before reaching adult age accounted for as high as 30%[28], in order to maximize the possibility of having surviving offspring and continue their family line, people turned to more pregnancies, and more births as a result.

Analysing the raw data in this way though, doesn't give a full picture of the reality of the time. The real intuition regarding the existence of Malthusian conditions, from which various implications may arise, is the correlation between income and the number of surviving children reaching adulthood.

Even before the time of the industrial revolution and the consequent evolution of living, social, and economical standards, we can see that the richer a man was, the higher was the chance of his children surviving, causing a deviation among the population growth rate according to the income and wealth of the individual.

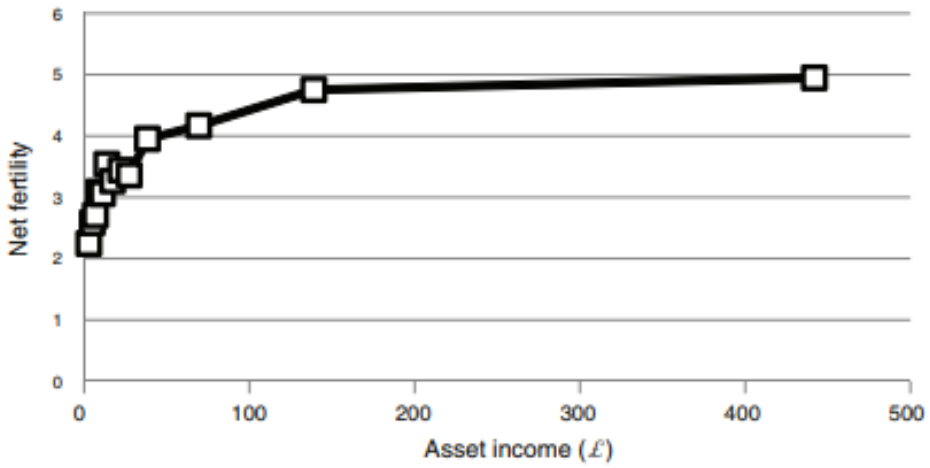

Figure 3: Fertility and wealth relationship in Malthusian England (Clark G., *Urbanization, mortality, and fertility in Malthusian England,* 2009).

[27]See Clark Gregory & Cummins Neil (2009)
[28]See Clark Gregory & Cummins Neil (2009)

In addition to this, the survival rate changed according to the geographic position and the environment in which the child was to grow up. The more developed and thriving areas, big cities like London, suffered a higher level of mortality for children and infants.

Group	Births	Fraction alive at 25	Fraction alive at 25 (males)	Average age at death – testators	Implied male life expectancy at birth
London	445	0.44	0.42	53.4	22.6
Town	1161	0.63	0.60	57.0	34.8
Rural	1628	0.67	0.69	58.1	40.5
Farm	2123	0.69	0.71	59.7	42.8

Table 1: Relationship between place of birth and survival rate as computed by the research of Clark.(Clark G., *Urbanization, mortality, and fertility in Malthusian England*, 2009).

This can be easily explained by the fact that despite being more populated and having more services readily available, the packed spaces resulted in lesser healthy living condition, with its subsequent increase in mortality.

On the other hand though, the opposite was true for the lesser populated parishes in the countryside, where the less demanding living standards and less polluted environment allowed more children to survive and reach the adult age. The difference was so stark that infants coming from a poor family in the outskirts enjoyed the same chance of surviving of those coming from a rich family but inhabiting cities[29].

The first implications coming from this data, is that there was a process in pre-industrial England, by which survival rate was heavily biased towards richer people, who were able to have more surviving offspring. This in turn meant that the social mobility was generally going downwards and not upwards. Children coming from richer families were most likely going to experience a reduction of their wealth as they aged.

This mechanism is an example of how the Malthusian trap worked in the later years of the industrial revolution. According to Clark, one of the first paradigms allowing the western societies to come out of the trap, would have been the change of mentality driving people to have less children, and invest more in them in educational terms, gifting them the capability of carrying on economic fruitful activities.

[29]Clark G. (2007), *A farewell to Alms*, p.105

This is a concept expressed also in the 1968 paper of the tragedy of commons[30]. The individuals will try to maximize their return by having more children, but by doing this nature will punish them since they will not be able to support them. In these conditions, Malthusian catastrophe is inevitable.

With the passage of time, the middle class, coming from the loss of wealth of higher class children, would become the dominant one, more educated and willing to invest more capital in its own successive offspring. Paired with the technological evolution and its requirement in skilled, educated labour, this paradigm would have fostered industrialization and modern economic growth, helping England to emerge from the trap.

2.1.2. Technology and energy

To recompose the puzzle of the factors that have driven Europe and the west out of the Malthusian trap, the understanding of the role of technology is also important. Clark already makes reference to this[31], showing how population and technology have been going hand in hand for a very long time. Despite the ability to achieve a modern growth is a relatively recent result, one should not think the world population has not seen its development before, both technologically and in the increase of people.

The main difference between "before" and "now", was that the growth was not exponential, but extremely slow, achieved through little technological breakthroughs. The "cap" of the maximum possible amount of population, increased with technology itself.

Whenever there was progress capable of augmenting the total output of resources, considering the nature of the agrarian based society of the past, this converted into a small increase in food production that rapidly balanced back to the levels of subsistence.

Examining the data for Europe, this is particularly stark and evident. Over the centuries, the mechanisms relatable to the Malthusian trap are apparently confirmed. The average per capita income did not increase, therefore maintaining the same living standards and conditions, but the population slowly increased instead[32], reflecting its small but existing technological and social breakthroughs.

[30] Hardin Garret,(1968), *The tragedy of commons*
[31] Clark Gregory (2007), *A farewell to Alms*, p. 133
[32] (Maddison A. 2001)

In the same way, similar patterns are observable in the rest of the world as well. In *A farewell to alms* Clark himself makes the example of how aboriginal cultures at the arrival of the first European explorers, possessed only rudimentary tools and technology, that even regressed from ancient times, and their population as a result was not higher than 5000 individuals[33], whereas Britain at the time with only double the land surface, was approaching 8 million.

What really changed around the end of the 18th century was the passage to the industrial revolution mechanics. The switch from the "biological economy" to the "mechanical technology" consisted in the structural change from an agrarian society based on muscle force, to a mechanical based society, where energy is taken from other means, diverting part of the production towards products other than food.

The importance of energy and "fuelling" economic activities in relation to the Malthusian model is explored in more detail by Malanima (2010) and Bartoletto (2012). Only in the last 50 years, the amount of energy consumption has doubled. The total energy output grew exponentially ever since the start of the industrial revolution, outpacing both the economical growth and the population growth. Per capita energy consumption in Europe increased from 15,000 kcal per day in 1800 to 101,882 in 2000[34].

As the times changed, so did the source of energy. In the Malthusian mechanisms, the primary source remained muscle based, human or animal, augmented by timber and coal. Therefore the main sources of output used to be vegetable, from wood, and sheer animal strength.

The main factor that made the exponential growth of energy output and per capita consumption possible, another element in the "recipe" to escape the Malthusian trap, was the slow but relatively constant passage to fossil fuel usage. The passage centred on coal at first, then oil and gas, through a process that saw the substitution of traditional sources over the course of the 19th century.

[33]Clark G, (2007) *A farewell to alms*, p.144
[34]See Bartoletto Silvana, (2012)

Type	1600	1700	1800	1900	1950	2000
Firewood	28.7	13.4	4.4	0	0	0
Food for human beings	27.5	19.9	7.4	2.5	3	1.5
Feed for animals	25.6	16.4	8.8	1.7	0	0
Wind, Water	1.5	1.4	2.5	0.33	0	0
Fossil fuels	16.7	48.6	77	95.5	97	90.6
Primary electricity	0	0	0	0	0	7.9

Table 2: Composition of energy consumption in England and Wales 1600-2000 (% values). The table shows the rate of change between sources of energy during the last centuries. (*Energy and economic growth in Europe*, Bartoletto Silvana, 2012)

This was also because of the increasing value and productive rate of the soil. Thanks to technological progress, less soil was now needed to meet the caloric output required. It represents a land-augmenting innovation. The process of increasing the productive possibilities of the land had already been in place since the 16th century and the introduction of crop rotation mechanics[35], passing to the 18th century with the new non-muscle based machinery.

The ability to create more energy using the same amount of land has been part of the technological/social process of industrialization that permitted the end of Malthusian mechanics and the start of the modern economic growth.

It can be therefore said, that technology allows increasing the output of resources and living standards; while the distribution of technology and its application is rendered possible by the sufficient means of energy. The two elements progress together.

If this process outpaces the growth of the demographic population, we can talk about escaping from the Malthusian trap, as the newly increased output is redistributed in the already existing population. This is exactly the system that we have been living in the west with the modern economic growth.

The technology, energy output, and the increased education of people given by the shift in society paradigms discussed in the previous paragraph, are factors that drove these changes, hand in hand.

[35]Crop rotation is the successive cultivation of different crops in a specified order on the same fields, in contrast to a one-crop system or to haphazard crop successions. In addition to the many beneficial effects on soils and crops, well-planned crop rotations also provide the business aspects of farming with advantages. Labour, power, and equipment can be handled with more efficiency; weather and market risks can be reduced; livestock requirements can be met more easily; and the farm can be a more effective year-round enterprise. (Encyclopaedia Britannica, 2016)

2.1.3. Institutions

Another step in understanding the modern thought regarding the escape from the Malthusian trap comes from the role of institutions.

The factors explored until now were largely not dependent on human will. The desire of humans to invest more in less children, and the growth of technology and energy output, were for the most part things born of circumstance, depending on the availability of resources and the existence of technological breakthroughs, exactly like in the previous great human period of growth, the agricultural revolution. The question that arises now is whether or not institutions play a role in creating favourable conditions for these processes.

This question has been asked and has been part of the economical debate since the times of Malthus, for example by Adam Smith himself, who claimed institutions lead the actions of the individuals into collective actions[36], and therefore played a fundamental role in steering societies in one or the other direction.

Other economists, instead, have different ideas. Clark, for example, thinks the processes of change and escape from stagnation mechanics were largely made possible by changes in values of society itself, as discussed previously.

Institutions of a religious and social nature were just as important as those working with governments. There is the thesis brought up in the past of the correlation between Protestantism and its values being among the contributing factors for the economic and social rise of northern Europe in the past centuries[37].

The protestant ethics of work was discussed by Max Weber[38], according to whom the success of the protestant countries was due to their philosophical thinking. The protestant man works because of the mentality shift from the catholic faith. Where the catholic can be assured of his salvation through repentance or payment to the church, the same cannot be said for the protestant, who must work and "cleanse" himself of sin in order to become an individual worthy of absolution.

In a similar fashion, the protestant man, devoted to work and education, refuses detrimental luxuries and instead focuses on bettering society around him. The stern nature of the ethics of this faith paired with the need for the industrial capitalism, shaping the new world around it.

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[36] Smith Adam (1776) ,*An Inquiry into the Nature and Causes of the Wealth of Nations*

[37] In the past 500 years, the wealthiest part of Europe changed. Previously it was the south, now the north. Also called the "Little divergence". (Pleijt, A. and van Zanden, J. L., *Accounting for the little divergence*, 2014)

[38] Weber Max (1905), *The protestant ethic and the spirit of capitalism*

In this sense, religion and social institutions can have a great impact on the economic wealth of a country and its prospects of growth. They decreed the success and inversion of fortunes between Europe and the U.S according to Weber.

A similar argument can be made for Asia as well. During the past centuries, Japan surpassed other countries in the continent such as India and China, also thanks to its different, harsher values. In 16th century Japan started to be ruled by the Tokugawa Shogunate, instituting very traditional values, which in turn were to have posed a great advantage for the country in the long run, instituting very strong morals and work ethics.

Acemoglu and Robinson[39] explored the differences that have arisen in Europe during the last 500 years. As a matter of fact, the institutions created after the fall of the Roman Empire, like feudalism, were shattered and radically changed after the huge shock of the Black Death, as already explored by Voigtländer and Voth.

This created a new balance of power where the institutions were made to protect and manage commercial enterprises while refusing detrimental state monopolies which were holding the economy back. This is the main topic of discussion according to which the transformation of the market and government created favourable conditions in England and Western Europe to see the coming of the industrial revolution.

The redistribution of power created a "virtuous cycle", by which the economy could benefit. England in particular saw these conditions arising already by the 16th century; the absolute authority of the monarchy was limited, having to ask for parliament permission before ratifying a law[40].

Traders and people involved in commerce were encouraged by low levels of taxation and a huge market, made possible by the international character of the British empire of the time. The incentive to trade thanks to the previously listed factors, paired with the protection of intellectual rights of academics and inventions created a very favourable environment for escaping the Malthusian mechanics.

An example brought up by this thesis, is the one of the deregulation of the wool and textile industry in pre-industrial England[41]. A state ban on foreign types of clothing was in act, prohibiting the general population from wearing products coming from the east, specifically India or China. In turn, through

[39]Acemoglu and Robinson, *Why nations fail?*(2012)
[40] Even before than that, in 1215, the tenants-in-chief secured Magna Carta from King John, which established that the king may not levy or collect any taxes (except the feudal taxes to which they were hitherto accustomed), without the consent of his royal council, which gradually developed into a parliament.
[41]Acemoglu and Robinson, *Why nations fail (*p.212)

time, this provoked several deficits in the market structure. Only through deregulation, and the repeal of these laws, was the industry able to thrive again.

A similar argument could be made regarding the role of institutions and the interference with the free market. It could be even argued that detrimental conflicts like the American Revolution could have been caused by restrictions and monopolies imposed on trade by the central British government[42].

In a sense, the independence of the states shattering absolute authority through revolutions, increasing representation and parliamentarian powers are considered by Acemoglu and Robinson to be part and parcel of the process of modernization.

The conditions of different nature regarding institutions, like the extended size of available markets, the protection of intellectual rights, the lower level of average taxation, the price stability, and the end of state monopolies, were fundamental in achieving optimal conditions that had the consequence of giving life to the industrial revolution, allowing England and then the west to come out of the Malthusian mechanisms and increase the average per capita wealth and output.

In the opinion of Acemoglu and Robinson, even though not necessarily thought out in advance, the role of institutions and the society as a whole was fundamental in creating the conditions for the exponential growth in output of the industrial revolution. Of a different opinion was Clark, for example, who attributes growth to shifts in culture and attitudes of the people.

2.1.4. Geography

On the other hand, the opposing claims of Acemoglu and Robinson have been made.

Instead of the role of institutions, the role of geography and innate advantages has been stressed as the factor decreeing the success of a country. Jared Diamond[43] is one of the main figures in contemporary literature bringing forward this concept, he explored the differences between the different parts of the world and the factors of growth from this point of view.

[42] One of the most famous events leading to the American revolution was the Boston tea party, The Americans were protesting both about a tax on tea (taxation without representation) and the perceived monopoly of the East India Company. (Encyclopaedia Britannica)

[43] Diamond Jared (1997), *Guns, germs and steel: the fate of human societies*

According to him, the start of the divergence between human beings began around 12,000 years ago at the end of the ice age, giving life to the first great period of growth, the Neolithic revolution[44].

Depending on the part of the globe, some regions had an advantage over others, thanks to their different climate. The regions in the middle, between the equator and the poles enjoyed higher land fertility and productivity. It is there, around the Mediterranean that the agricultural revolution first took place to then spread to the east.

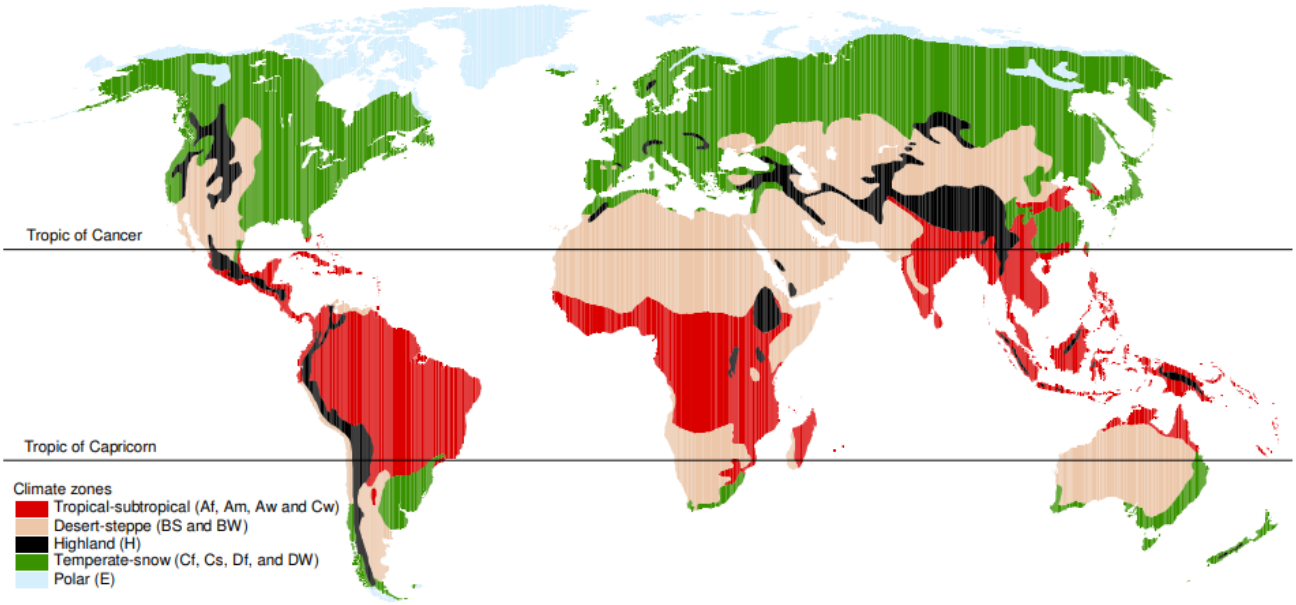

Figure 4: Map showing the different climatic zones. Temperate climate poses as an advantage today just like in the early days of humanity, giving a favourable position to Eurasia. (*Köppen-Geiger climate classification system*, 1936)

The higher output of food and the shift from the hunter-gatherer society allowed humans to focus on collateral activities and therefore drive technological and social progress. With time, the availability of food drove processes of urbanization, and in accordance with the interpretations of Voigtländer and Voth, this created a process of natural selection and redistribution of wealth through events of grim nature.

Urbanization led people to live in more unsavoury conditions, building up their tolerance to germs and illness thanks to frequent outbreaks (the biggest of which, the Black Death). It is no coincidence that most of the recorded pandemics took place in Eurasia, from the typhus of ancient times to the plague of the Middle Ages and the more recent smallpox epidemics[45]. Just how the plague redistributed

[44]The first cultivation of plants and domestication of animals, which took place during the Neolithic period and radically changed the structure of prehistoric society, (Oxford Dictionary)
[45]Hays J.N., (2005), *Epidemics and pandemics, their impact on human history*

wealth, it also created a slow process of growth and with the minor outbreaks made Europeans less vulnerable to infections, which proved very important in the future.

When they started to colonize the rest of the world, they began a process of acquisition of foreign soil, increasing the amount of land per capita and allowing the technological process to take place. To facilitate this procedure and making the natives of the conquered land not a threat, there were diseases carried by the Europeans themselves. It is a matter of fact that it was not the war, but the illness, which wiped out the vast majority of the native populations the Europeans came in contact with[46].

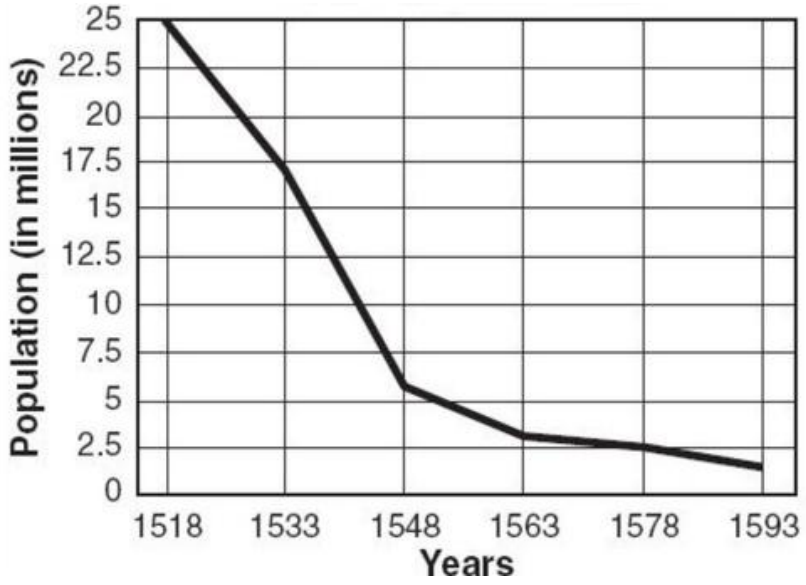

Figure 5: Estimate of the Native Mexican population, showing the impact of smallpox and other diseases on the total number of people.(Killoran James, *The key to understanding global history*, 1998)

Following the claims of Diamond, we can paint a picture where geography was at the base of the Eurasian success over a long term, militarily and technologically.

Still, it cannot account for shorter spans of time and overrule the importance of institutions and their decisions. The proof of this is the fact that even in comparable regions where the same geographical conditions hold, we can find a substantial disparity of prosperity[47].

The role of geography is still recognized as very important to develop further theories, in the framework of Oded Galor for example and his unified growth theory.

[46]Smallpox in particular, decreed the end of Mexican civilizations in the 16th century.(Diamond Jared, *Guns, germs and steel*, 1998 p. 77)

[47]A famous example of this concept could be the dual city of El Paso-Ciudad Juarez, split in two between Mexico and the US. One side of the border (The American) enjoys significantly better living conditions than its counterpart, plagued by crime and homicides. (Morales Maria Cristina, Prieto Pamela and Bejarano Cynthia (2014), *Transnational entrepreneurs and drug war violence between Ciudad Juarez and El Paso*)

2.2. Unified Growth Theory

Until now, many different factors have been studied and analyzed to try and explain the conditions present in Europe both at the time of the escape from the Malthusian trap, but also before. In modern times though, there has been also the desire and subsequent attempt to provide a broader and more comprehensive picture of the factors driving the change of society and economy. The main framework is the one provided by Oded Galor and his Unified growth theory[48].

The disjointed nature of the models of growth, according to Galor, does not provide a clear and convincing picture of the mechanisms of escape from the Malthusian trap, as quoted in his paper[49]: 'It is as though an artist were to gather the hands, feet, head and other members for his images from diverse models, each part perfectly drawn, but not related to a single body, and since they in no way match each other, the result would be monster rather than man.'[50]

The interaction between the population, the technological progress rate, geography, institutions and history, are the objective of this theory. The result of the model deriving from it, unlike its predecessors, allows creating a comprehensive framework analyzing the times of Malthusian stagnation that concluded with the industrial revolution.

It then steers and tries to explain the consequent period of escape from the trap, the emergence of human capital, the exponential population expansion, the modern economic growth, and the divergence in income per capita across countries.

According to Galor, the modern growth of the last two centuries was triggered by various layers of factors, on the first layer the socio-institutional conditions, namely:

- The newly found desire by institutions to foster education and human capital;
- The explosion in wealth per capita, starting a virtuous cycle allowing families to afford education for their offspring;
- The storing of that newly found knowledge and education in basic human institutions (like families);
- The social and ethnic diversity conditions fostering change;
- Geographical elements affecting health and resource availability;
- The increased desire and propensity to trade.

[48] Galor Oded (2011), *Unified Growth theory*
[49] See Galor O. (2004)
[50] (Copernicus, Quoted by Kuhn, 1957).

These different factors connect the interactions between what has been discussed in the previous paragraphs in the research of various economists such as Clark, Acemoglu and Robinson etc. The elements allowing the coming of the "modern man" was both a result of the change in society paradigms, and a result of the part played by institutions in fostering innovation.

The change in survival rate of different classes of citizens, and their growth, fuelled the industrial revolution and its effects, both by providing an ever growing work force, but also more educated citizens that with time, created a virtuous cycle of ever growing output and better living conditions.

To cope and help these processes, the institutions were also important, both political, but also religious and cultural, the first fostering inventiveness, trade and protection of intellectual property, the second steering public mentality and attitudes[51].

On a second layer, the theory argues that geographical variations played a role, in line with what claimed by Diamond. Societies in some part of the globe have always been at an advantage ever since the dawn of mankind, the very first human revolution and exponential growth, was seen with the coming of agriculture, that favoured only certain regions, namely Europe, the Middle East and Asia, giving the people living in them huge comparative advantages, that in turn gave them power and influenced the effects of which can be seen even today.

The climate and its impact on the availability of resources were also important since they determined the level of diversity in society. According to Galor, a good balance was an important factor; the not too great diversity of Asian and European people challenged the steady state of society, but without undermining it. Both the excessive diversity of African people and the too little diversity of the Native Americans were detrimental to their own good.

A good level of cultural, religious, ethical and linguistic diversity meant Asians and Europeans were in constant competition, without seeing each other as completely different and therefore engaging in detrimental wars and ethnic disputes.

Galor exposes in the third and final layer the idea that the different societies and nations can be clustered in "groups", fostering or hindering their growth. Those who enjoyed fast growth tended to interact mainly with similar others creating a virtuous cycle. On the other side of the coin, Malthusian type countries interacted mainly with other poor countries, preventing them to access more beneficial markets.

[51]As already seen the inversion of economic fortunes between northern and southern Europe has been linked to the puritan, protestant philosophy spreading in the north.

This level of variance accounts for the convergence in some parts of the world, that are constantly growing, while also explaining the seemingly stagnation of others.

For example, only some European states engaged in the industrial revolution at first, but those conditions spread to the other western countries they traded with, creating “clusters” of nations and areas of the world destined to grow and interact with each other while others instead lag behind.

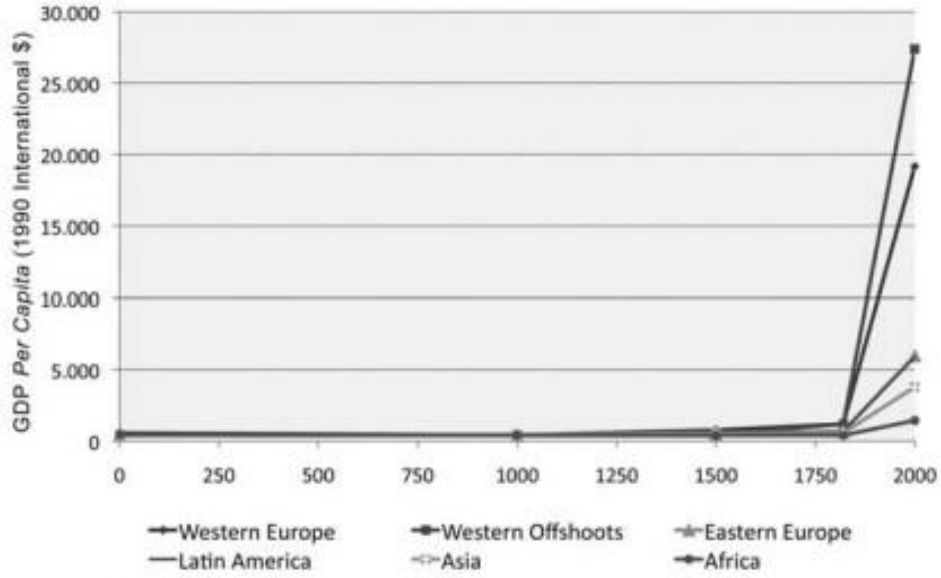

Figure 6: Diagram showing how different areas of the world proceeded in increasing their GDP per capita. It is clear how the main beneficiaries of the industrial revolution have been the west and its offshoots. (Maddison A. 2001)

Galor’s model, tries to create a framework of an organic, continuous change that took place ever since the dawn of mankind creating favourable conditions in some parts of the world while instead hindering it in others. The geographical conditions can account for the start, but the choices related to institutions, and the ideas and value of societies decreed the success of this or the other country. This model explains the difference between the different regions, their growth, and the source of that growth in a scale that was not present in the previous research. In a sense, the model proposed by Galor is the most complete because it takes account of all those proposed before, joining and expanding them.

2.3. Malthusian trap today

In this chapter, we have the chance to explore the modern academic thought on the Malthusian trap, and the elements allowing the escape by it. We should not think though, that its mechanics and the related issues are not present in the current world. It should be noted that while part of the globe thrived and was able to uplift itself (the West and its satellite nations), many other parts of the globe did not live through the shifts of society necessary for the escape. The condition of these parts of the world in the contemporary times, and its relation with phenomena of growth, poverty and migration is the object of the next and final chapter.

CHAPTER III

The Malthusian Trap in the contemporary world and the future of growth

3.1. The Malthusian Trap in the modern day

Until now the role of Malthusian theory has been discussed in relation to the past, trying to weave a thread passing through the past centuries and getting to present day. Economists and researchers tried to account for empirical data and make interpretations of the various factors of growth that allowed part of the world to come out of the trap. This, however, does not mean that conditions attributable to Malthusian mechanics do not exist nowadays.

It is a matter of fact, as already discussed previously, that since the start of the 19th century, the average per capita income and living conditions have increased significantly, leading us to a state of seemingly constant growth, a far cry from the stagnation of the past, which kept humanity down.

At the same time, however, some parts of the world seem to live these effects on a larger scale than others, who could be seen as still stuck into subsistence wages, not allowing living conditions to become better ad making their population sky-rocket instead.

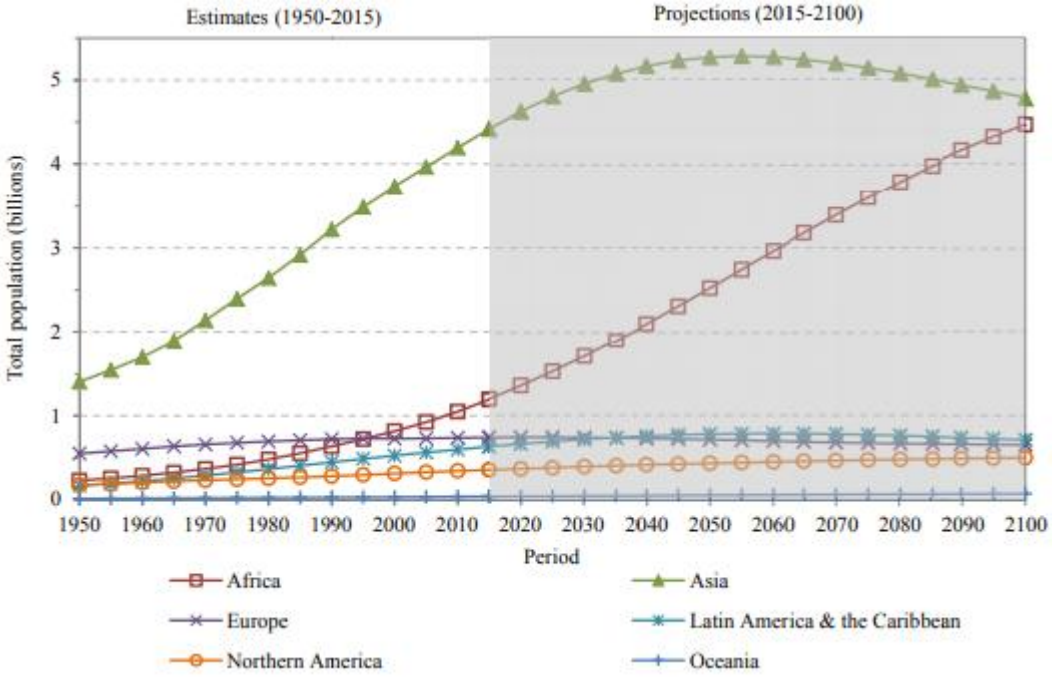

Figure 7: Population by region (1950-2015), and projection (2015-2100), (United Nations, department of economic and social affairs, population division, 2017)

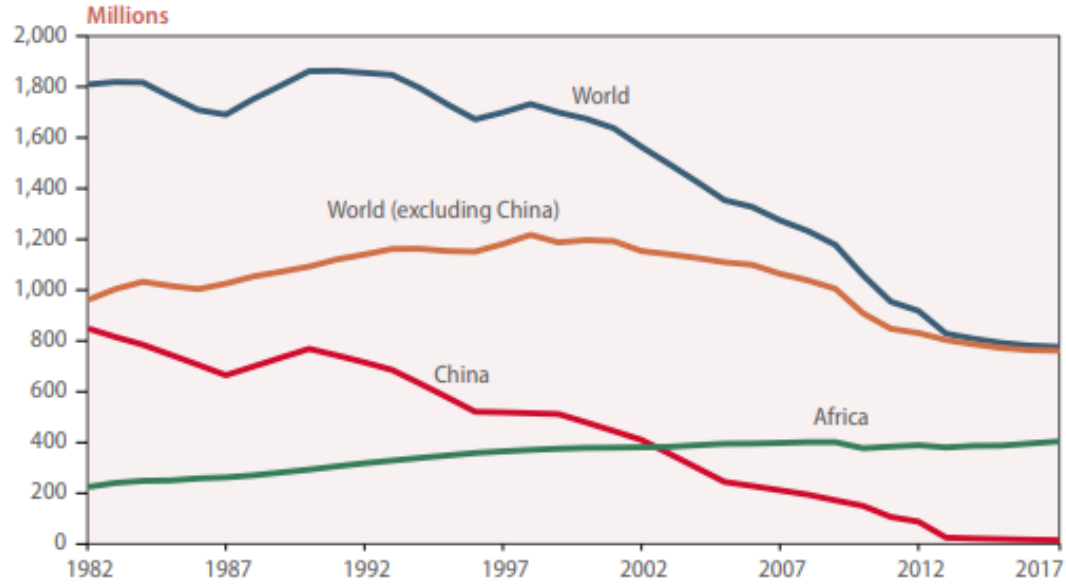

Figure 8: Population below $1.90/day poverty line, World Bank Poverty and Equity Database and UN/DESA estimates (2017).

As shown in the two previous graphs, in line with the Malthusian thought, the growth and fertility of a population are still directly correlated with the average income in some parts of the world, remaining around subsistence level, and just as in the future the population increase is estimated to slow down, so the income is estimated to rise[52].

Whether or not this trend is attributable to the mechanisms of the Malthusian trap is controversial and debatable. Europe and the West seem to have been able to break out, while Africa, India and South Eastern Asia, are still struggling.

All the changes that happened in the west, of a geographical, social, historical and technological nature at the base of modern economic growth over the past two centuries, did not happen in the rest of the world, or happened only in part.

Is there an actual link between the higher levels of fertility and the seemingly stagnating living conditions of the third world? What will happen in the future? Will the rest of the world catch up to the average per capita wealth of the west, or the opposite, will the west return to mechanisms similar to those of the trap?

[52]United Nations: department of economic and social affairs (2011), *Seven billions and growing: the role of population policy in achieving sustainability*

These series of questions are part of Neo-Malthusianism, the contemporary discussion regarding the theory of population. In modern times, it became prominent in the second half of the 20th century, where the future of growth was discussed by the likes of Garret Hardin with his famous essay "The tragedy of commons"[53], Paul R. Ehrlich in his paper "The population bomb"[54], and the club of Rome in the book "The limits of growth"[55].

Whereas Paul R. Ehrlich and The Club of Rome discussed the matter proposing models that inevitably resulted in the depletion of resources and a stop of growth, Garret Hardin instead proposed a more sociological view of the matter, accusing (just like Malthus), the welfare state for giving licence to people to over breed.

The tragedy of commons is the desire by the individual to maximise his own personal utility, by exploiting the common resources not caring about the impact of the community or the long term consequences, in the matter of demography, this is represented by having more children. In these conditions, according to Hardin, the Malthusian catastrophe is inevitable.

Modern economic growth was made possible by the increased technological level, paired with the amount of resources that were not depleted, but instead were continued to be collected thanks to that same technological growth.

So we should also ask ourselves what the future holds, what will happen when resources, be they of an energetic, mining, or alimentary nature, deplete? Can we, as the first world countries, sustain this growth in the future, and if so, for how long?

These arguments and questions, in relation to the theories of Malthus, are the object of this chapter.

3.1.1. The Great Divergence

Before dwelling on the consequences and the potential future of economic growth of the world, we should first ask and explore the factors that account for the great disparity between some regions compared to others.

[53]Hardin G., (1968)
[54]A model that prescribed an imminent Malthusian catastrophe that would have caused massive starvation in the 70s and 80s due to lack of resources. (Ehrlich P. R, 1968)
[55]According to this heavily criticized model, the limits of growth and efficient industrial capacity for earth could have been pinpointed to 2072. Initially disputed in its earliest years only to be revaluated in more recent times.(1972)

In the modern age, we can clearly observe that there are some places wealthier than others. More precisely, Europe and the nations that are more closely related to it (North America, eastern Asia, Australia), have walked a very different path to the rest of the world, generally recognised as being poorer.

Exploring the differences between these different regions has been the object of different studies present in modern economic research and literature. These themes are at the centre of the book of Kenneth Pomeranz[56], in which he tries to account for the factors of difference between the east and the west, the so called "Great Divergence"[57].

It should be noted, that at its initial state, around 1000 years ago, the level of divergence between the different world regions was fairly minimal compared to modern standards. The first data we can compute is that, different to today, the richest part of the world was Asia, where China and India were the two regions with the highest GDP and per capita income. In the same continent, Japan was instead a significantly poorer island[58].

In Europe, less advanced than the east, the richest region was its southern part, with Italy and Spain figuring as the regions with the highest income and northern Europe instead the most depopulated part suffering economic and social struggle.

	UK	NL	Italy	Spain	Japan	China	India
1000	400	425	450	450	425	466	450
1500	714	761	1,100	661	500	600	550
1600	974	1,381	1,100	853	520	600	550
1700	1,250	2,130	1,100	853	570	600	550
1820	1,706	1,838	1,117	1,008	669	600	533
1870	3,190	2,757	1,499	1,207	737	530	533

Table 3: Table showing the estimate of GDP per capita in different regions of the world through the centuries. The value is expressed in AD1990 Dollars. (Maddison A. 2010)

In comparison, the world we can see during the current age seems to be the exact mirror of the one of 1000 years ago.

Not only have the fortunes of the two continents reversed, but also, those of the regions within them. Northern Europe is now significantly richer than the south[59], while instead in Asia, the

[56] Pomeranz Kenneth (2000), *The Great Divergence: China, Europe, and the Making of the Modern World Economy*
[57] Term coined by Samuel P. Huntington in 1996 to describe the different path of economic growth lived between the East and the West.
[58] See Broadberry Stephen (2017)
[59] Eurostat, GDP at regional level, (2018)

eastern regions of Japan and Korea are significantly wealthier than China and India, if we exclude Hong Kong and Shanghai, which were under the British control during the past centuries.

According to the arguments made by Kenneth Pomeranz, the ways in which the two different parts of the world evolved, depended on a variety of factors.

There were first of all geographical differences that favoured one or the other. In Europe, the regions that were at an advantage were the most fertile parts of the south, both because of their increased output in agricultural products (since at the time the vast majority of production was centred on this sector), but also because of their geopolitical position.

At the time, the main trading and exchanging route was the one passing through the Mediterranean, towards the east. China and India were therefore at an advantage compared to the more isolated eastern part of the continent that had far less possibility of trading. Without necessarily noticing it, the trade routes passing between the Silk Road through the Middle East and then the Mediterranean, gave a great advantage to those between these two continents.

Thanks to this phenomenon, we can at least partially explain the rise and thriving of Italian States and western Asia. Even though in the future, these conditions did not hold. As the new routes towards the Americas opened, thanks to its discovery, so did the fortunes and success of other parts of the world, facing the Atlantic and the Pacific Ocean.

Japan and eastern Asia surpassed China and India, while instead northern Europe surpassed southern, and increased the gap with its eastern counterpart. At least in part, these geographical differences explain the divergence.

The second element to be taken account of, is the availability of land and resources, and the possibility of taking advantage of them. According to Pomeranz, with the progression of the first centuries of the previous millennium, England and China suffered the same ecological problem of deforestation, and loss of timber, needed to produce energy. The increased amount of output of England though, was made possible by its larger deposits of coal, which were later to have fuelled the industrial revolution (as already discussed previously in the paper of Malanima), but also through expansion in the Americas.

The expansion of certain parts of Europe thanks to the Atlantic sea meant that they were able to create colonies, and therefore augment exponentially the amount of land per capita. Paired with the new technologies, this meant a higher output of resources and efficient use of energy.

The final argument is the one attributing the divergence of society paradigms and values. Culturally speaking, northern Europe saw the arrival of Protestantism: the correlation with its work ethic and the fortune of the countries adopting it, has been linked more than once. Max Weber[60], as discussed in the previous chapter, saw for example a direct link between the values of Protestantism and the emergence of the industrial capitalistic class, necessary to escape the Malthusian trap mechanics.

In a similar way, eastern Asia and Japan in particular, were stern, harsh societies with roles set in stone and very strong ethical values. Japan in the 16th century, in particular, saw a period of civil war that ended with the institution of the Tokugawa Shogunate[61], instituting harsh policies based around feudalism on one hand, and the closure towards the external world on the other, allowed China to be surpassed, but did not grow at the levels of Europe until the end of the Shogunate and the institution of the Imperial system in 1868.

In turn, the imperial system and the "Meiji restoration[62]" retained much of the ethical values and scarce social mobility of Tokugawa Japan, while also opening its frontiers to the ocean, projecting the country into the future as we see it today.

As claimed by Pomeranz and later studied by Broadberry[63], in a similar fashion to what was discussed by Clark, Galor, and even Malthus himself, marriage patterns and the emergence of human capital were fundamental in the escape from Malthusian mechanics.

	Period	Range	Unweighted average
England	1600-1849	23.4 to 26.5	25.4
Japan	1680-1860	18.8 to 24.6	22.1
China	1550-1931	17.2 to 20.7	18.6
India	1911-1931	12.9 to 13.3	13.0

Table 4: Picture showing the average age of first marriage, correlating it to the emergence of human capital. (Wrigley and Schofield (1987: 255); Mosk (1980: 476); Lee and Wang (1999: 67); Bhat and Halli (1999: 137).

The increased age of marriage meant families had fewer children, which meant a higher investment in time, education and wealth in each one of them, given their smaller number. Both Japan and

[60] Weber Max, (1905) *The protestant ethic and the spirit of capitalism*
[61] Also called Edo period, (1603–1867), the final period of traditional Japan, a time of internal peace, political stability, and economic growth under the shogunate (military dictatorship) founded by Tokugawa Ieyasu.....As part of the systematic plan to maintain stability, the social order was officially frozen, and mobility between the four classes (*i.e.*, warriors, farmers, artisans, and merchants) was prohibited. (Encyclopedia Britannica, Tokugawa period.)
[62] Period of reform in the years after the end of the Tokugawa Shogunate.
[63] Broadberry S. (2013), *Accounting for the great divergence*

northern Europe saw an increase in the average age of marriage over the past 500 years, making it possible for the emergence of more educated children, and the rise of the middle class.

Even though this great divergence regards Asia and Europe, similar arguments can be made for Africa as well. The relative isolation of sub Saharan regions, their lower amount of arable land per capita, given the low technological level and non existing possibilities of interaction with other parts of the world, decreed their fate, preventing a growth phenomenon at the same level as the rest of the world.

In conclusion, we can draw a picture of the state of the globe, seeing whether data confirm or not the theories in modern literature regarding the escape from the trap. The emergence of human capital, geographical position and availability of resources decreed the success of certain regions compared to others, bringing us to the current state, and seemingly agreeing with the modern interpretations of growth discussed in the previous chapter.

In general, we can say that the west was able to come out of the trap, while instead part of Asia and Sub Saharan Africa still remain in those conditions. The increased level of modernity and technological prowess did not translate into an improvement of living standards, but only in an increase of population in accordance with the Malthusian model.

3.1.2. The Migrations

Compared to the situation of some centuries ago, we already have the knowledge of what the current state of the world is. What is though the consequence of this divergence and disparity previously described?

The Malthusian theory is, and always has been, very controversial. In some ways, it has been criticized because of technicalities and faults in the model presented. Among the factors mainly criticized:

- the inability of Malthus to predict the opening of new land, which was a factor described in the previous point, increasing the amount of arable area;
- the inability to predict the technological growth, increasing the amount of output;
- because he neglected the increase in manpower, every new child was a new mouth to feed, but also represented a new worker in the future, able to increase the total output;
- it has been contested that population levels go on par with total wealth and not wealth in food resources.

Among the criticisms, there are also the empirical data that, at least in the west, where both the population and the income per capita rose in the past two centuries, seem to confute Malthus' theory, although this can be explained by the mechanisms of escape from the trap discussed in the previous chapter.

The critiques towards the theory of population of Malthus though, are also of ethical nature, since he suggested how a lower fertility and a process of natural selection cutting out the weakest parts of society were necessary to break the cycle of subsistence wages.

The correlation between productivity and migration phenomena was already made in the 19th century by Alfred Marshall, he claimed that the workers would have migrated to the place where their contribution would have been higher[64]. This was the reason why in those moments workers tended to flock towards the big cities, giving life to urbanization. The sanitary conditions and the harder city life in turn, with time, saw the emergence of the human capital and the middle class, as discussed in the previous chapter.

Besides, migrations to the new world allowed a concrete economical advantage to the nations interested in this phenomenon. The ever-increasing amount of land available to be used kept the per capita land ratio high, allowing a better exploitation of the new technologies maintaining high output.

In the modern context of the globalized world, migration is strictly correlated to the phenomenon of globalization itself. Globalization can be defined as the overhaul process of global price convergence[65]. This is an assumption holding true for goods but also for workers. Countries with a high amount of workers but small means of production will converge towards countries where

[64] Marshall Alfred, *Principles of economics* (1890), 8th edition, library of liberty p. 115
[65] Williamson Jeffrey G. (1996), *Globalization, Convergence and History*

manpower is required and productive means are higher. In turn, with time, the job market will reach an equilibrium, the increased competition in more developed countries will drive wages down, instead the demand for workers in the less developed countries will increase, driving wages up.

This is a model of international trade developed by Hecksher and Ohlin[66]. Empiric proof has been researched with the migration phenomena of the last centuries in order to verify the price convergence.

In the study carried out by Kevin O'Rourke and Jeffrey G. Williamson[67], price convergence between England and the United States is verified, obtaining positive result and confirmation of the model.

Variable	Actual Movement in Factor Prices		Estimated Impact	
	United States	Great Britain	United States	Great Britain
Early Period: 1870–1895				
Nominal returns				
Urban wage	−10.5	+14.2	+6.5	+7.5
Land rent	+19.9	−51.3	+11.7	−34.1
Return to capital	n.a.[a]	n.a.	+2.8	+6.9
Wage-rental ratio	−25.3	+134.4	−4.7	+63.1
R	+213.9		+71.1	
Real returns				
CPI	−31.3	−21.0	+6.4	−2.7
Real urban wage	+30.3	+44.6	+0.1	+10.5
Real land rent	+74.5	−38.3	+5.0	−32.3
Real return to capital	n.a.	n.a.	−3.4	+9.8
Full Period: 1870–1913				
Nominal returns				
Urban wage	+16.8	+30.3	+14.1	+12.0
Land rent	+171.1	−49.5	+28.9	−57.8
Return to capital	n.a.	n.a.	+3.3	+11.1
Wage-rental ratio	−57.0	+158.2	−11.5	+165.4
R	+500.3		+199.9	
Real return				
CPI	−22.2	−11.0	+13.7	−7.8
Real urban wage	+50.1	+46.4	+0.3	+21.4
Real land rent	+248.9	−43.3	+13.4	−54.2
Real return to capital	n.a.	n.a.	−9.2	+20.5

Figure 9: An account of the price convergence between the US and Great Britain during the period of great migration at the end of the 19th century, expressed in percentage. (O'Rourke and Williamson, *Late Nineteenth-Century Anglo American Factor-Price Convergence: Were Heckscher and Ohlin Right?*, (1994))

[66]According to the Hecksher Ohlin model factor proportions theory of comparative advantage, international commerce compensates for the uneven geographic distribution of productive resources. This applies also for the market of workers. (Lamer Edward E., 1995, "*The hecksher Ohlin model in theory and practice"*, Princeton studies in international finance).

[67] O'Rourke and Williamson Jeffrey G., (1994) *Late Nineteenth-Century AngloAmerican Factor-Price Convergence: Were Heckscher and Ohlin Right?*

Price convergence increased the wealth of Europe and the United States, but it started to drive American wages down, giving life to policies of migration control in the States. In the long run, those same policies would have been resulted not necessary as the First World War and its consequences were to cause a general halt to the phenomenon.

In a similar fashion, in the modern world, we can see that the countries seemingly stuck in Malthusian conditions, see increased propensity to migrate (south eastern Asia and Sub Saharan Africa).

As an example the dynamics of eastern Africa are discussed in the paper of Andrey Korotayev & Julia Zinkina[68].

In the paper, a series of data and variables are observed in order to come to a conclusion on whether or not the continent is still stuck in the Malthusian trap. As a matter of fact, much of the institutional changes discussed in the previous chapter necessary to escape the trap, did not happen in the Sub Saharan region.

Fertility, urbanization rate, share of population involved with agriculture took very different paths in different parts of the continent. Northern Africa managed to come out of the Malthusian mechanics, while instead the Sub Saharan regions remained stuck.

The average number of children remains extremely high, even though it has become smaller with time, agricultural productivity and the total number of people involved with it remains at the typical level of an agrarian based society, causing people not to live in cities.

In order to leave these dynamics, Eastern Africa should follow the Bangladeshi example, lowering its fertility rate, and start a process of human capital accumulation with the final objective of increasing the average per capita GDP and living conditions.

Holding the same assumptions as the Hecksher Ohlin model, we can predict that with time the phenomenon of migration could result in price convergence in the different continents for the sectors of competition potentially driving the process.

[68]Korotayev Andrey & Zinkina Julia (2014), *East Africa in the Malthusian trap? A statistical analysis of financial, economic, and demographic indicators*

The future of resources should also be taken into account for these regions, according to UN reports and, as of 2008, African countries relied on an average for 12,5% of their GDP in foreign aid[69]. In many ways, some African regions already exceed their carrying capacity.

It is most likely no coincidence that the countries by which the biggest migration flows come, are the same that are stuck in the Malthusian trap.

3.1.3. Environmental concerns

Another element that must be taken into account when speaking about the modern world and the necessity of certain parts of it to come out of the Malthusian trap mechanics is the environmental concerns coming from the depletion of resources.

Historic examples of the dire consequences of not being able to manage subsistence resources are many, such as the infamous environmental disaster of Easter Island. A situation in which the exploitation of resources led to a Malthusian catastrophe in which the population growth suddenly could not be sustained anymore leading to a resizing of the number of inhabitants and problems of civil social unrest. As stated by Jared Diamond :"In just a few centuries, the people of Easter Island wiped out their forest, drove their plants and animals to extinction, and saw their complex society spiral into chaos and cannibalism.[70]"

Other similar examples include the case of the Island of St. Matthew near Alaska[71], where a population of reindeer was introduced in the forties and left completely autonomous, only being checked through the years. The result was that the reindeer multiplied exponentially outpacing the grass they ate, causing a major Malthusian catastrophe and almost wiping out the colony in the sixties.

[69] Alemu Aye Mengistu, Lee Jin-Sang (2015), *Foreign aid on economic growth in Africa: A comparison of low and middle-income countries*
[70] Diamond Jared, (2005), *Environmental Collapse of Easter Island*
[71] Klein David R. (1968), *The introduction, increase and crash of reindeer on St Matthew Island*

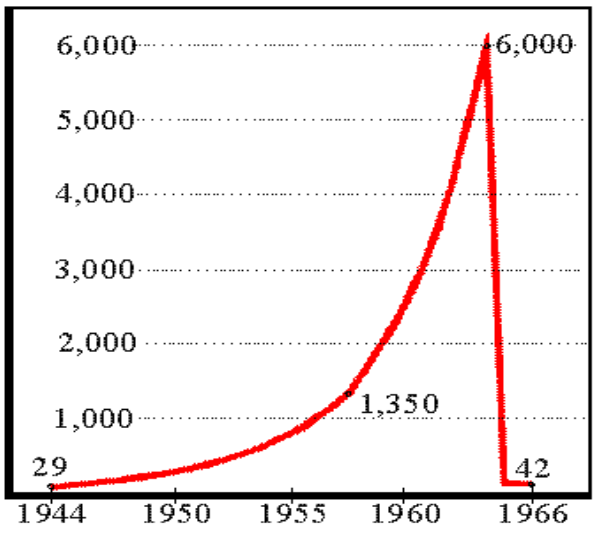

Figure 10: Population of reindeers in St. Matthew island through the years, *The introduction, increase and crash of reindeer on St Matthew Island,* Klein David R. (1968)

These examples highlight the speed by which a Malthusian check operates on the total numbers of a population if subsistence resources are not able to sustain it anymore.

Of course these examples are extreme, since we are talking about isolated parts of the globe, but still, they highlight the risk incurred by countries in which the number of people is constantly increasing and resources are limited.

As said before, as a whole, the African continent already relies on 12.5% of foreign aid for its GDP, even though this figure is much higher in its poorest countries, the real question is whether the population growth is sustainable in terms of primary resources.

As shown in the graph at the start of the chapter, the population growth should slow down in the future, making this issue fade away, but it will happen in many decades from now, and so risks still exist.

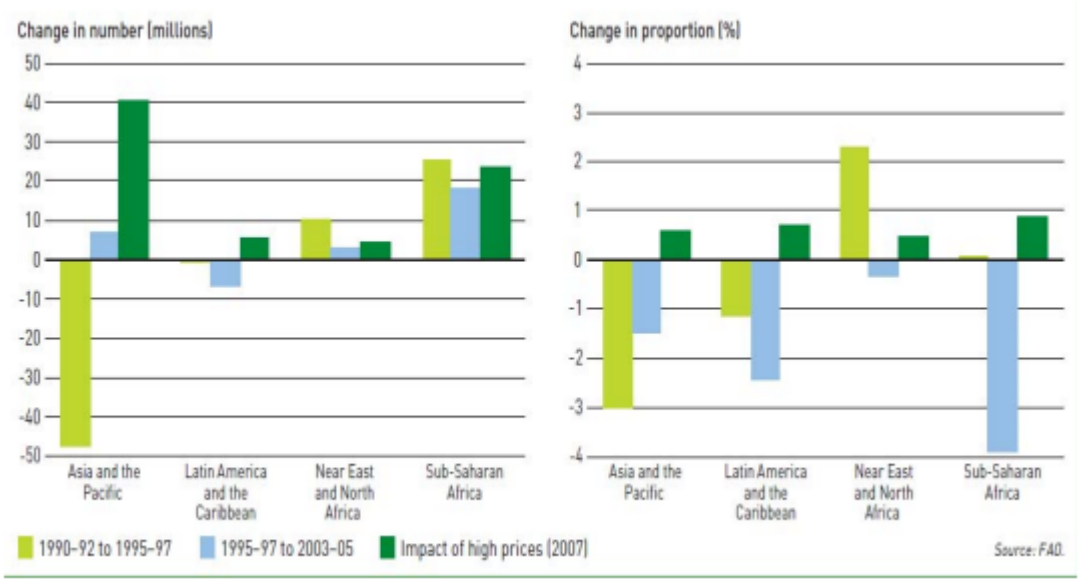

Figure 11: Graph depicting the change in the amount of underfed people in the world during different time frames, FAO (2012)

The problems that could arise in the future are also mainly related to the problem of climate change and global warming.

The consequences of this phenomenon will hit the African and South-eastern Asian regions harder, already under much strain by the decrease of their total output of food and water[7273].

Even though these changes will surely make an impact, hope is not completely lost since in reality, only a small amount of arable land in these regions is used. Sub Saharan Africa in particular sees only 20% of its arable soil currently exploited[74].

On the same line of thought and findings is the SWP paper[75] regarding resource scarcity. As a matter of fact, many of the problems of supply insufficiency in these regions are due to ethnic conflicts, social unrest, or institutional disorganization, preventing resources being used efficiently, whereas they could be, in fact, sufficient to sustain the current numbers.

This highlights how important it will be in the future for these regions of the world to achieve growth, adopting institutional measures similar to those of the west or the "Bangladeshi example", in order to come out of Malthusian trap mechanics and prevent sudden checks of a grim nature, like

[72]Alcamo Joseph, Florke Martina, Merker Michael (2009), *Future long-term changes in global water resources driven by socio-economic and climatic changes*
[73]*How to feed the world in 2050*?, FAO (2009)
[74] *How to feed the world in 2050*?, FAO(2009)
[75]Mildner Stormy Annika, Richter Solveig, Lauster Gitta (2011), *Resource Scarcity, a global security threat?*

famines and droughts. Events that unfortunately, in the current state of the world, still happen in these areas.

In the rest of the West, the industrialized world, given that the population has already stabilized, it is unlikely the future will see the lack of subsistence resources, even though climate change is estimated to take toll there as well. The main topics of discussion are instead the depletion of raw materials and their impact on the output capacity, determining growth overhaul.

3.2. Can modern growth be sustained in the future?

The first insight we can get from the model proposed by Malthus, is that there is a limit on growth. This limit is represented by the fact that for every single individual, a certain amount of subsistence resources must exist, which means that at a certain point, either the population exceeds the "carrying capacity", entering into the mechanisms of the trap, or similarly, resources will deplete.

This second case is an existing possibility when the population stops growing, but wishes to increase its output, or technological level, with time, this will lead to an increased consumption of resources that will inevitably reach a cap.

So, to summarize, what the theory of Malthus prescribes, is that humanity is destined to reach a level where it is impossible to sustain more numbers, but at the same time, if the growth in numbers is stopped, the total amount of output will necessarily plateau at some point without constant major technological breakthrough.

This phenomenon is observable in different moments through the history of mankind, first, with the agricultural revolution[76], which increased the output of resources and changed the paradigms of society. With time, the agricultural revolution caught up in different regions of the world, projecting humanity forward, but once that happened, the world fell to stagnation, the average output increased very slowly, preventing the living conditions from bettering until the last centuries.

The question directly correlated to the Malthusian mechanics, is whether or not in the future we risk falling back in the trap, and if economic growth can actually be sustained long term.

The characteristics of Modern Economic Growth[77] were studied and investigated by Simon Kuznets during the 70s[78]. He tried to more precisely describe the different characteristics over ever-increasing modern economic growth.

This brought him to the concept of the "Six Winds", driving the economy in that direction, he recognized that the growth was driven by:

[76]The change from hunting and gathering to farming, causing the end of nomadic lifestyle and projecting humanity in the next age in a similar fashion to the more recent industrial revolution.
[77]With modern economic growth we define seemingly constant growth of both GDP and population, phenomenon observed during the industrial revolutions. (Kuznets, 1973)
[78]Kuznets Simon (1973 , *Modern economic growth: Findings and reflections*

- First and foremost the high rates of per capita growth,
- The rise of productivity of output per unit,
- The rate at which the economy can transform, very high in the most developed countries and always ready to change,
- The rate of change in socio-cultural phenomena; Kuznets recognizes secularization and urbanization as factors that drive economic growth,
- The propensity of wealthier countries to reach out to the rest of the world creating an advantageous network,
- Finally, the spread of economic growth towards the rest of the world, fuelling itself, although at the time of this writings, ¾ of the world were still in extremely poor conditions.

The six winds described by Kuznets overlap the same factors of growth recognized in modern literature for the escape from the Malthusian trap.

Other economists like Broadberry[79], revisited the claims of Kuznets after decades, coming to the conclusion that his intuitions were right, but in some instances slightly off since he did not have a concrete availability of data like we have in modern times.

In Broadberry's comments, there is the belief that constant increase of output is not as important as not having sustained setbacks, and that having ever increasing amount of population is not necessary to kick-start growth, on the contrary, it can be a setback.

The main concern that rises from the interpretations of economic growth though, is of two natures. First of all, in order to sustain it, we need constant technological progress and breakthroughs allowing us to use our resources more efficiently, but also, we need to constantly expand, using more land, more resources, creating new markets, and engaging more efficient social and ethical values.

For obvious reasons, this perspective is very unlikely, as a matter of fact, despite still being in a process of general growth, empirical data suggest how the slowing down already started.

[79]Broadberry Stephen (2016), *The characteristics of modern economic growth revisited*

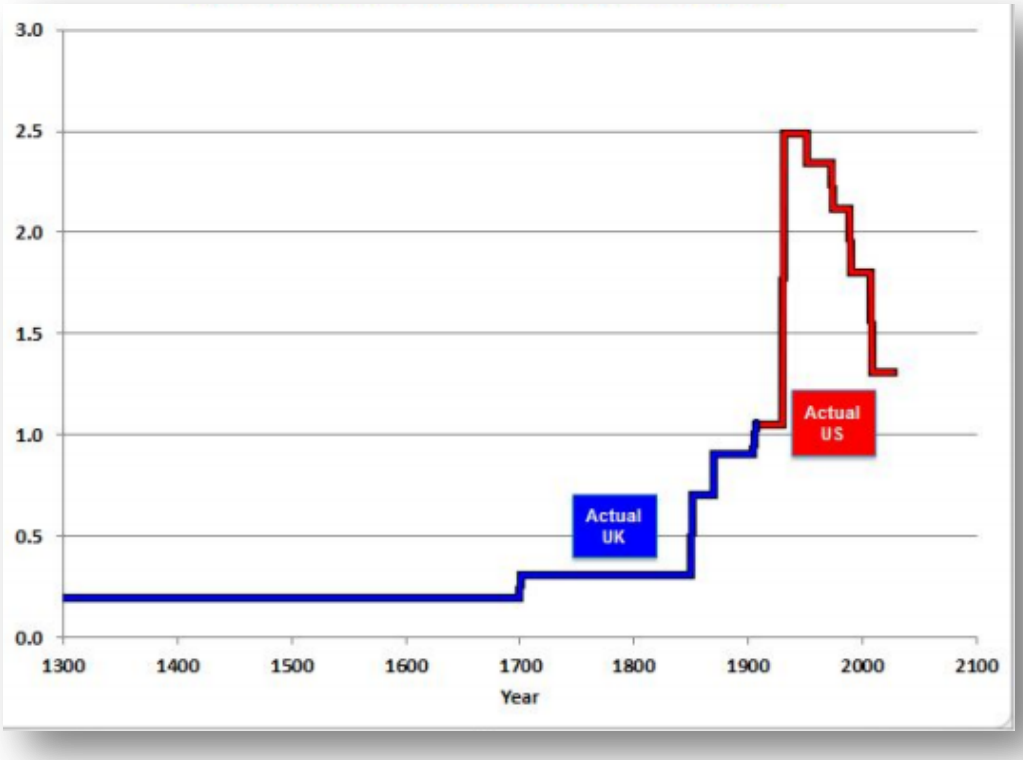

Figure 12: Graph depicting real growth of GDP during the centuries in UK and US, expressed in percentage, (Maddison A.)

The previous graph computes the data from the last centuries, clearly showing that, even though growth is still happening in the western countries, its pace is slowing down.

In his paper analysing and commenting Broadberry's data on great divergence and Kuznets theories of growth, economist Robert J. Gordon[80] draws the hypothetical conclusion and projection of the curve, which would plateau around 2100, painting for the modern age a similar situation to the end of the agricultural revolution, where after the process of catch up, humanity retained a certain wealth until the industrial revolution.

[80] Gordon Robert P. (2012), *Is U.S. Economic growth over? Faltering innovation confronts the six winds*

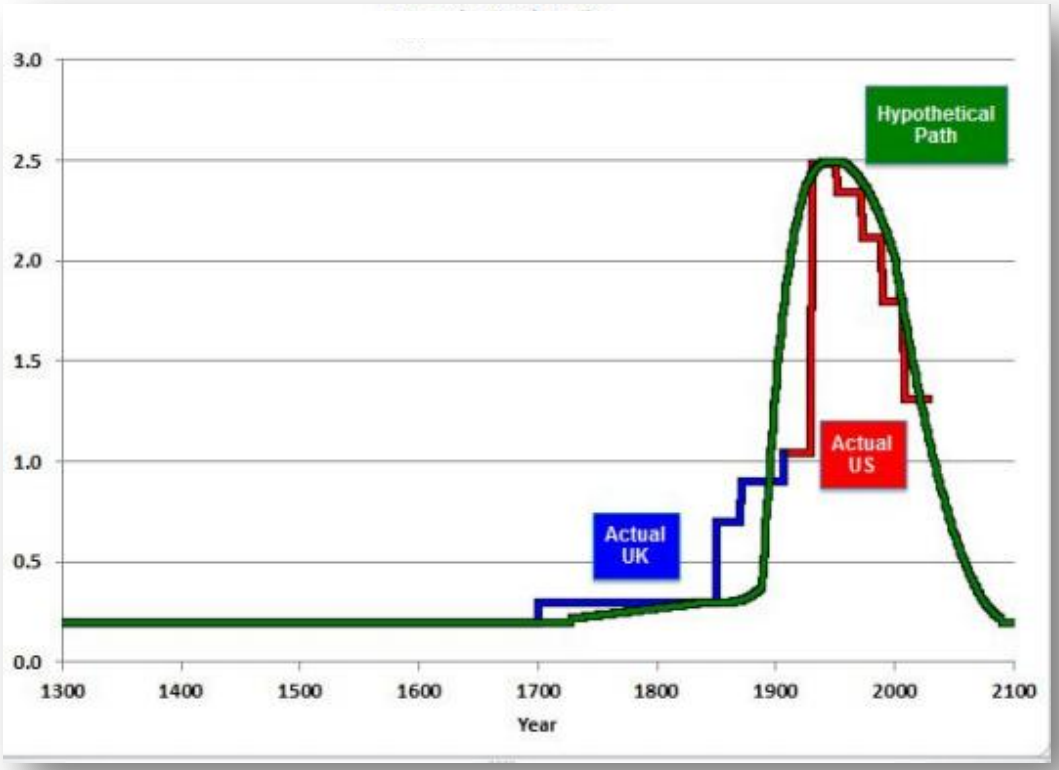

Figure 13: Hypothetical curve of growth as computed by Robert P. Gordon, in which the end of the modern growth period can be computed around AD2100. (*Is U.S. Economic growth over? Faltering innovation confronts the six winds*, Gordon Robert P. (2012))

Predicting the future growth scenarios can be tricky and is absolutely not trivial. Malthusian theory teaches us that at a certain point every people must face either the end of subsistence resources or the impossibility of increasing its marginal product, unless there is a constant technological breakthrough and there is a constant discovery of new land and resources to exploit.

Looking at data, we are most likely not going to deplete our resources too soon[81], but the problem is that even though we might never deplete them, their increased rarity will and already has increased their price, accelerating the process of slowing economic growth.

[81]Mildner Stormy Annika, Richter Solveig, Lauster Gitta (2011), *Resource Scarcity, a global security threat?*

3.3. Final remarks

In conclusion, by analyzing empirical data for the past centuries in the world, we can come to acknowledge some points.

Many differences, be they social, geographical, or political have existed between different regions of the world. These differences through time, gave life to our current condition. Disparities go rampant, even though Europe escaped the Malthusian trap centuries ago thanks to its very unique conditions.

The catching up process between poorer and richer regions is already under way, helped even by phenomena of migrations that drive worldwide price convergence as they did between Europe and the new world during the period of great migrations at the end of the 19th century.

Still, parts of the world such as eastern Africa are still stuck in Malthusian conditions, and in order to grow they would necessarily need to change their social paradigms in a similar fashion to the west or the more modern Bangladeshi example, by decreasing their fertility levels and drive processes of urbanization.

The urgency for these parts of the world to escape the Malthusian trap are especially important since, in the future, the total necessary output of subsistence resources may not be guaranteed, causing major demographic catastrophes in line with the grim mechanics described by the Malthusian Model and its extension as described by Voigtländer and Voth.

In addition, the growth for the future cannot be guaranteed to be strong as it was in the past, or that it will exist at all; every scenario is possible.

It is unlikely that we will run out of raw materials and resources, but they will become rarer, slowing industrial and technological processes, therefore, it is probably very important to reach a level of sustainability and stability in the future, as to make sure that those still stuck in the trap might be able to escape, but also to make sure those escaped will not get back in the tunnel, so as to try and retain the living standards and wealth achieved in the last centuries.

Conclusion

At the end of this research, we can come to a series of conclusions and remarks.

First of all, the importance of Malthusian thought should not be under estimated. As shown by modern research and data, there is correlation between the size of the population, its growth rate, and the economic and social conditions of countries. It must be acknowledged that in the theories of growth, this is a factor deemed to be especially important.

In an historical sense, the assumption that until the age of Malthus the world was characterized by the mechanisms of the trap is seemingly confirmed. Until the 19th century and the industrial revolution, the per capita income stagnated at subsistence levels, corresponding only to an increase in the size of population as the economy grew.

It is only with the modern economic growth, that the total output surpassed the speed of population expansion allowing for certain regions to come out of the trap.

The modern theories and studies accounting for this growth point the finger to different factors as being responsible for the escape.

Be it the survival of the richest presented by Clark, the grim factors such as wars, plagues, famines described by Voigtlander and Voth, the role of institutions presented by Acemoglu and Robinson, geographic advantages or a combination of everything listed before, we can say that the modern academics debate in some points, while agreeing and complementing each other in many others.

The emergence of the human capital, the reduction of fertility rates and technological breakthroughs are universally considered in all the texts studied as some of the main factors accounting for growth in some areas while instead hindering it in others.

By these remarks and theories and growth, we can come to the world as it is today, and conclude that even though the Western regions and their offshoots escaped the trap, the rest of the globe wandered through a different historical path, preventing it to achieve partially or completely the conditions necessary to escape the Malthusian trap.

Even though the technological progress reached the entire world, this does not translate in some regions (especially in Sub Saharan Africa and Eastern Asia), with better living conditions, but instead with an extremely high level of fertility.

It would be therefore very important for these regions to achieve a process of stabilization of their numbers and drive processes of construction of human capital and urbanization, as shown by the recent example of Bangladesh.

The reason why the stabilization of these areas is so important is also because of the future environmental and growth concerns.

Regarding the first, there is not necessarily a unanimous consensus; on the one hand the dangers of the depletion of resources have been at the centre of modern debate, starting by Paul H. Ehrlich and his population bomb, or Hardin and the tragedy of commons, as shown also by real, practical examples of Malthusian catastrophe such as the one of Easter Island or the St. Matthew Island.

On the other hand though, many reports indicate how the total depletion of resources is unlikely, and much more probably, as time goes forward, we will see an increased level of marginal costs, hindering growth, which according to some of the studies presented in this text will plateau and stop around the year 2100.

It is impossible to know what the future holds. Just as Malthus could have not been possibly able to predict the technologic progression rate of the industrial revolution, we cannot know if the future will see constant major technologic breakthroughs.

The only certain thing is that as the decades will pass, it will become increasingly difficult to sustain growth, and therefore, it will be fundamental to achieve environmental and demographic stability by then, if we want to retain our living standards.

The risk we incur once the growth is arrested if we don't stabilize is to fall back in the trap, and suffer the consequences of subsistence level wages until the next period of great technologic breakthrough, like the Industrial or Neolithic revolution.

In a way, one of the main points of Malthus' theory, as later remarked in the 20th century by Hardin, is a pessimistic view of human nature. We are destined to fall back in the trap because according to Malthus humans won't be able to control themselves, it is therefore up to us to make sure we will be able to regulate ourselves and achieve sustainability in the world of tomorrow.

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