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On the causes of industrial revolution.

Abstract.

This article proposes a new theory of industrial revolution based on the concept of the last filling of reservoir. The obtained theoretical conclusion is tested by example of the industrial revolution in England.

The problem of industrial revolution is one of the most important and interesting problems of sociology. The importance of the industrial revolution for any country is enormous because it completely changes the life of society. Such questions as: why industrial revolutions occur, what caused them, why they happen in a particular country and exactly at that time, aroused interest of many scholars since time when the first industrial revolution in Britain had happened. The answers to the questions are numerous and one may even say they are too numerous. However, all theoretical models explaining the causes of industrial revolution, with certain reservations, may be divided into two large groups. Below we will consider some of these models.

1. Theoretical models explaining the causes of industrial revolution.

The models of the first and the oldest group were created mainly by economists. In these models, changes in the material production base are considered as the main cause of the industrial revolution. The earliest model of this group is the Marx model. For Marx, innovation is the main engine of progress. The accumulation of innovations changed gradually the forces of production (elementary factors of production according to Marx - labour, the subject of labour and the instruments of labour: raw materials, tools, machines and so on). Thus the forces of productions have not corresponded to existing relations of production (mainly property relations) that according to Marx is a hindrance for economic development. In this case progressive class would begin class struggle with class who defended old property relations because they are of benefit to them. Then comes the period of social revolution which changed the property relations and new mode of production (stage of society development according to Marx) is formed. In this way progress occurs in every society. However the transition to capitalist (industrial) society is impossible without primary accumulation of capital because industrial production demands large capital input. Thus the Marx' model of industrial revolution is a combination of innovations and capital accumulation.

As it seems to me, the evident shortcoming of Marx' model is absence of explanations for different speed of development of different countries and different time of beginning of industrial revolution. Moreover there are examples of halt of progress and many years of stagnation as it was in the cases

of Italy and the Netherlands. Marx' theory does not provide understanding for such cases.

E. A. Wrigley believes that the main change in the material production base is transition from organic economy to the mineral-based energy economy¹. He rightly points out that almost every industry needs fuel. In organic economy the main fuel is firewood therefore woodland is necessary for development of the economy. Many branches of industry used animal muscle as a main source of mechanical energy therefore development of the industries needed increase in supply of fodder. Besides practically all raw material of organic economy (wool, flax, cotton, leather etc.) are productions of land. As the land surface is in a fix supply then the law of diminishing returns inevitably puts limit on development of organic economy. Only transition to the mineral-based energy economy has made unlimited economic growth, and hence the industrial revolution, possible. For the English industrial revolution the mineral base was coal. Thus England, due to the presence of large deposits of coal, became the country of the first industrial revolution.

It is true; the presence in a country of large enough coal deposits determined its industrial development. France and, especially Italy, give us excellent examples of how insufficiency or total absence of coal can delay or even completely stop industrialization. However, many questions remain unanswered. In particular, why in China, where coal began to be used very early, the industrial revolution began so late? What circumstances determine the time when the possibilities of the organic economy will be exhausted and the transition to the mineral-based energy economy will possible?

Devisers of other models from this group attach decisive importance to increase of capital input. May be the most known model of capital accumulation is the Rostow's model². Walt Rostow thought that for beginning of industrial revolution it is necessary that the rate of investment should rise to over 10 per cent of national income. To make this possible, the emergence of a leading sector as a source of capital growth in the economy is necessary. The leading sector or an industry with a very high growth rate provides high profit by which it is possible to increase the capital input on a national scale. Besides the leading sector creates demand for other industrial products and in such way stimulates industrialisation across rest of the country.

However Rostow did not explain why the leading sector has come into existence in that very country and at that very time. Why so many countries around the world remained pre-industrial while Western Europe has already passed the take-off period?

Similar theoretical approach to the problem of industrial revolution was suggested by Arthur Lewis³. The main prerequisite in his model was the

¹ E.A. Wrigley (1990).

² W.W. Rostow (1960).

³ W. A. Lewis (1954).

presence in the agricultural sector of a large mass of redundant population. In other words, it is population who has overgrown the capacity of land to provide work for them. In this case the capital input in industrial sector creates new workplaces and labour begins to shift from agriculture to industry. In industry the labour productivity is much higher than in agriculture due to higher capital input while wages remain low. It allows for capitalists to obtain very high profit. They reinvest the profit in industry that returns new additional profit and so on. Thus begins the process of capital accumulation which results in industrial society.

The models of capital accumulation, as it seems, give to social reformers an effective instrument to modernize backward societies. However in the overwhelming majority of cases all attempts of industrialization of the agrarian countries through increase of capital input have ended with failure. As it turned out, the rural population did not want to leave their native villages and go to work in the cities in factories and plants. Nevertheless, some scientists continue to believe that the accumulation of capital will inevitably lead the underdeveloped countries to industrialization. They think that the reason for the failure is only that capital investment is small. The big push model asserts that the beginning of industrialization requires large amounts of investments⁴. Although it is not clear how the industrialization occurred in England and other countries of Western Europe where there were no large investments from outside. For example, in England the cotton industry developed mainly from its own profit⁵.

However for the majority of scholars it became obvious that the simple combination of factors of production is not enough for industrialization. People in different countries and at different times behave differently and not always ready to change their way of life no matter how much capital input is. Therefore, scientists began to turn their attention to the behaviour of people and look for reasons of its changes.

The models, which considered as the main cause of industrial revolution changes in the behaviour of population, consists the second group. In this case the theoretical approaches are very different. The oldest of them sees the cause of the industrial revolution in innovations. For many contemporaries of British industrial revolution the main feature of their time were rapid technological changes in industry. Some scholars as well thought that the inventions were to drive the industrial revolution to progress⁶.

But in this case we have to ask ourselves the obvious question: what was the cause for as Ashton wrote about British industrial revolution: “innovations of various kinds... that surged up with a suddenness for which it is difficult to

⁴ P. Rosenstein-Rodan (1943).

⁵ Chapmen S.D. (1972), p. 37-38.

⁶ J. Mokyr (1990).

find a parallel at any other time or place”⁷. Why the Britons had become so inventive in the second half of the eighteenth century and the first half of the nineteenth century? Why later this power of ingenuity passed from them to the Germans, French and the Americans?

Joseph Schumpeter asserted that innovations cluster around certain points in time, each of which is an industrial revolution⁸. He rather disliked the term “industrial revolution” because he did not consider it necessary especially to distinguish this period, if an important one, among others. However, it is difficult to accept that, for example, in England the period 1760-1830 was not fundamentally different from the previous periods, which Schumpeter writes about as industrial revolutions. Schumpeter’s model as well as many other models does not explain the different speed of development of different countries.

One more popular among scholars theoretical approach is institutionalism. They think that rules under which people lived – laws, both written and unwritten, customs and traditions - determine the possibility or impossibility of economic growth. Some scholars think that development of British customs and excise influenced the framework of industrial England and the state regulation and protectionism have enabled the British industry to strengthen and become a world leader⁹. Others believe that the politics of taxation and financial relationship between the state and its citizens were of especial importance for the industrialisation of England¹⁰.

Some scientists believe that the special receptiveness of British society to scientific knowledge has helped to use academic knowledge in practice. The British fertile culture was a cause of its rapid industrialisation, ahead other nations¹¹. This point of view makes us remember Max Weber’s “The Protestant Ethic and the Spirit of Capitalism”, in which he asserted that Protestantism influenced the development of capitalism.

The above list of models of the second group is not exhaustive. However, all these models explain the progress in the economy of different countries with differences of mass consciousness of population of the countries. The obvious question we should have is: what are the causes of these differences? Why English and Scottish people were much more prone to inventive activity than people of other nations? Why peoples of Western Europe had laws which limited power of bureaucracy, secured property rights and encouraged industry and trade while peoples of Eastern Europe had not? Why religion of South Europe rejects worldly affairs especially the pursuit of wealth, while religion of North Europe encourages the pursuit of economic gain?

⁷ T. S. Ashton (1996), p. 48.

⁸ Joseph Schumpeter (1939), p. 253.

⁹ W. J. Ashworth (2003).

¹⁰ M. Daunton (2007).

¹¹ M. C. Jacob (2014).

It is impossible to explain differences in a national mentality based on the mentality itself. All explanations of historical process must eventually be based on factors outside human consciousness, i.e. natural factors such as geography, climate, the biological necessities of the human organism, and so on. Otherwise, inevitably we have to accept the theory that peoples of different nations have different abilities to development from their birth that is genetically. In the 19th century, racial theory was considered a recognized fact, but today we have enough evidence that it is not true.

The difference in the development of different peoples is a result of the action of external for consciousness factors, which the model explaining the causes of industrial revolution should determine. Below I propose such a model.

2. The theory of social progress.

I think it is impossible to understand the phenomenon of industrial revolution if we consider it in isolation. Industrial revolution is a result of social development and only when we understand the progress of society we will understand the causes of the industrial revolution. In other words the model of industrial revolution is part of the theory of social progress. I have outlined my theory¹² and now I shall describe only that part of it that has a direct relation to the industrial revolution.

One of the basic positions of the model of industrial revolution is the concept of filling the reservoir. The land of every preindustrial country may be considered as a reservoir. *The human capacity of such reservoir is determined by the size of the country, its natural conditions and intensiveness of land use.* Intensification of the land use consists in increasing the input of labour and capital in the same land area. In preindustrial societies agricultural intensification occurred by increasing of labour input because for increasing of the capital input the society was not sufficiently developed. Thus, as land and capital are fixed factors, the returns to the marginal increase in the supply of labour will diminish that is known as the law of diminishing returns to land. In other words, *the intensification of agriculture led to diminishing labour productivity*¹³.

When the number of people in the country is equal to capacity of the reservoir the reservoir is filled. It is time when population density reaches a *critical level or the critical population density, which is determined by given natural conditions and a given stage of land use intensity. The ratio of the population density to the critical density is the reservoir's critical coefficient*, which reflects the degree of social tension in the reservoir. Exceeding of the critical population density will inevitably lead to a shortage of means of subsistence. In a preindustrial country that leads to famine. The only way out of the deadlock is intensification of agriculture. However in this case the labour productivity will diminish.

¹² A. Alexakha (2016).

¹³ E. Boserup (1965), p. 4.

Thus man could avoid famine by the intensification of land use but with every stage in the intensification, the population is compelled to be more disciplined, hard-working, and persistent. I propose to call these changes in human consciousness *growth of level of development of population*. From this theoretical perspective, *the level of population development represents the ability to solve life problems*. The progress of a society is the growth of population's level of development. The level of development includes not only knowledge, how to solve a problem but also the willpower to do it. The increase in the population's level of development results from changes in the upbringing of the new generation in conditions of increasing labour complexity, training the child for a new, more complex life. Thus the level of development of a generation is fully formed by adulthood and cannot be changed subsequently. *The more complex people's labour activity the higher their level of development*.

Thus the progressive changes in a preindustrial society will begin only after the reservoir will filled up. But *the smaller the reservoir the more quickly it is filled*. Thus the small reservoirs develop faster. However *the smaller a reservoir is, the less the potential for progress it has*. Therefore, when large reservoirs are filled, they overtake in the development of smaller ones. So the theory that I propose here explains the different speed of development of different countries.

People who practise not intensive land use are not able to more complex labour activity. The Indians who were hunters and gatherers quickly died out when they were forced to work on plantations. Therefore Europeans brought Negroes from Africa to America who were agriculturists in the homeland. Missing stage in the Indians' level of development caused fatal stress leading to death. At the same time, the Indians who have already transited to agriculture have endured all the difficulties and new diseases and today their descendants constitute an absolute majority in many countries of Latin America.

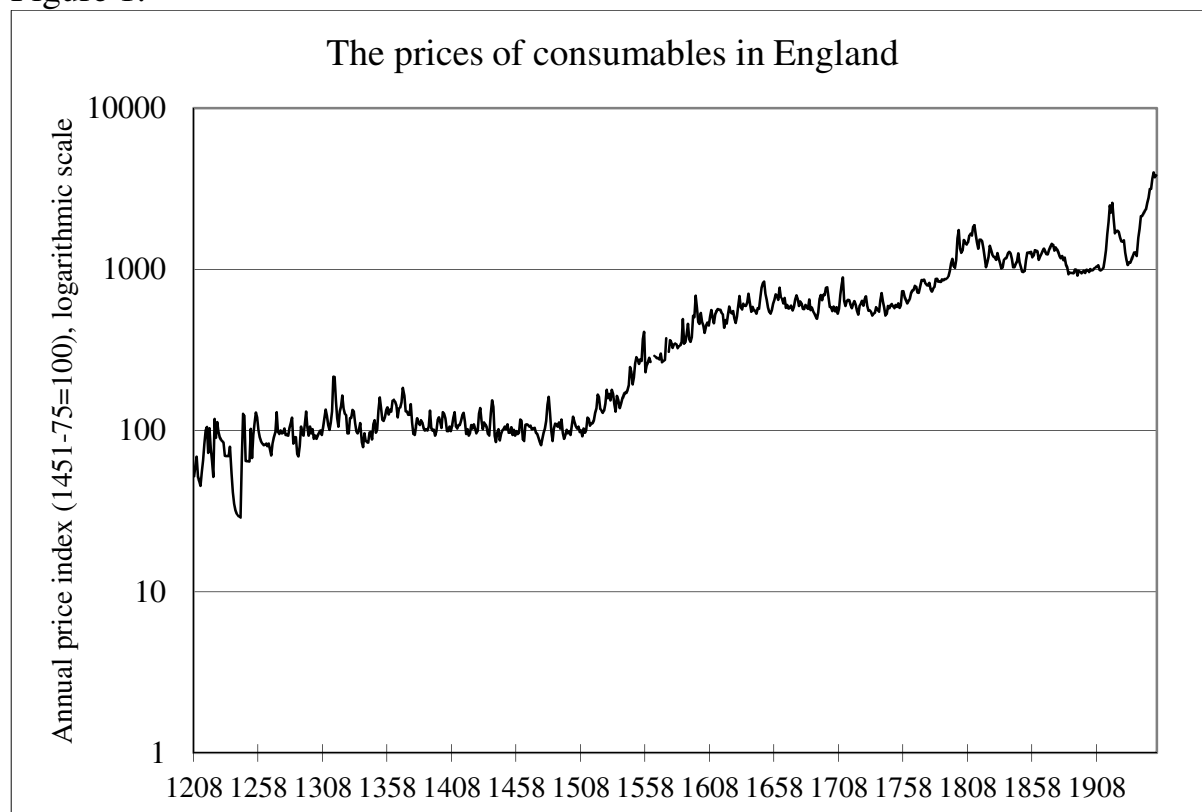
The population's level of development corresponds to the *level of needs* and *standard of living*. This is a very important theoretical position because it is essential to understanding economic development. People will work just to satisfy an achieved level of needs, which corresponds to an achieved level of population development. It makes understandable so called Malthusian trap. If for some causes in a preindustrial society the output will grow, for example due to introduction of a new more productive crop (potato, maize) it will not result in consumption growth but in population growth, so the standard of living will remain the same because they correspond to the achieved level of development of the population. The perfect example is Ireland after introduction potato there.

However, this does not mean that there is no economic growth in pre-industrial society, as some scientists think¹⁴. Economic and social development of pre-industrial societies has some features which I shall consider below.

2.1. Economic and social development of pre-industrial societies.

I think it is best to show the peculiarities of economic and social development of pre-industrial societies by the example of so-called "big waves"¹⁵. Figure 1 shows to us a graph well-known to many economic historians. It is prices of consumables in England during more than seven hundred years. On the figure we can see three waves of prices' growth. The causes of the waves are well-known too, it is population growth. However, it remains unclear why the population growth was intermittent, that created these waves. In addition, it is not clear why the dynamics of prices resemble the steps leading upward.

Figure 1.



Sources: Farmer D.L. table 3 p 213; E.H. Phelps-Brown, S. V. Hopkins, pp. 311-314.

Many scholars think that the waves were formed when after some time the population growth, which drove up prices, outpaced far enough the means of subsistence¹⁶. Then famines and epidemics followed that caused mortality to grow while fertility to fall. As a result the number of people decreased and prices fell. However they did not fall to the level which was before the

¹⁴ G. Clark (2008).

¹⁵ D. H. Fisher (1999).

¹⁶ *Ibid*, p. 35.

beginning of population growth. Thus it could not be demand inflation. This kind of inflation develops from increased need for means of subsistence due to increase of the number of people. However, when the population growth will stop and even turned down, the demand will meet supply and prices should go back to the previous level.

This is really happening, but only on a small scale. When prices reach the maximum on the crest of each wave, then after the beginning of the decrease in the number of people they are also reduced, but slightly and stabilized at this level that is clearly seen in Figure 1. This price reduction can be regarded as a result of demand inflation. However it is only insignificant reduction of prices in comparison with the whole height of the wave.

A monetarist model that explains the growth of prices by increase of money supply does not work because it was time of silver and gold money not paper ones. It was possible to increase the money in circulation only by increasing the mining of precious metals. It really happened thanks to the production of silver and gold in America. However, prices grew when there is no evidence of an increase in the volume of precious metals in Europe. Prices in England and Germany practically doubled during the half century before the silver from America could have significant impact on them¹⁷. Scholars thought there are many difficulties in attempts to correlate the movement of prices with the stock of money¹⁸.

Of course, the amount of money in circulation increased but the volume of goods increased too. Rapid development of industry in the period of population growth is well-known. Besides, money from silver and gold have their own value, as opposed to paper money, so cannot fall in price below this value. If this happens, gold and silver money just go out of circulation, thus the supply of the money corresponds to the demand for them.

The only explanation that allows us to understand such price dynamics is so called cost-push inflation. This is what the model, proposed here, suggests. Population growth caused people to intensify agriculture consequently the labour productivity would diminish. So for each kilogram of farm production it would need more and more labour. Evidently it will push prices up even if the supply of money in circulation would not increase.

It is important that the comparison of the real wage level in England and India showed that in eighteenth-century British and Indian labourers could buy about the same amount of grain with their wages. However silver content of Indian worker's wages were about four times or even less the British levels¹⁹. This difference was a result of more intensive agriculture in England. An English peasant had to exert four times more effort than an Indian one to get the same amount of grain. Therefore the English peasant was four times more

¹⁷ D. H. Fisher (1999), p. 81.

¹⁸ Ibid, p. 337 note 38.

¹⁹ S.N Broadberry, B. Gupta (2006).

disciplined and diligent than the Indian. The productivity of one hour of agricultural work in England was lower than in India, but the annual output was higher because the English peasant worked more. This work did not require more knowledge and intelligence; it required only more diligence and discipline. Therefore, the level of needs of the English peasant was not much higher than the Indian, and he lived roughly as poorly as the Indian.

However, the discipline and obedience of the English peasants allowed the social elite to extract more income from them. This income always led to increase in the proportion of people employed in non-agricultural activity. For example, there was an increase in demand for industrial goods, luxuries, and consequently there were more artisans and merchants. In addition, there were more lawyers, officials, writers, poets, artists and scientists. This increase in complexity of labour led to growth of the level of development of the society. Even if the English peasant lived as poorly as the Indian, the English society of the eighteenth century was much more developed than the Indian one. After all, not the Indians came to the shores of England and subdued it.

Thus intensification of agriculture in pre-industrial society led to complication of social structure. Marx believed that the emergence of social structure in a society which was before classless was a result of coming into being of surplus product. He thought that labour productivity increased over the course of preindustrial history due to innovations. This scheme today is generally recognized, although many scientists who believe in it do not consider themselves Marxists. However, today there are a lot of facts that prove that the productivity of labour during the pre-industrial period decreased. Perhaps the most interesting in this sense is the book of Marshall Sahlins "Stone age economics"²⁰.

Sahlins writes that the primitive economies are underproductive. All of them agricultural as well as pre-agricultural can easily increase their output because labour power is underused, technological means are not fully engaged, natural resources are left untapped²¹. He adduced data from many parts of primitive world that are evidence of the actual production is substantially less than the possible. People of primitive societies work much less than the people of developed industrial societies: their lifetime working span is much shorter²², "their customary working day is short; if it is protracted, frequently it is interrupted; if it is both long and unremitting, usually it is seasonal"²³. It is impossible to refute Sahlins' data but it is impossible to explain it from the generally accepted point of view. However, the proposed here theory explains the fact perfectly. Moreover, from this theoretical perspective it should be so.

²⁰ M. Sahlins (2017).

²¹ Ibid, p. 38

²² Ibid, p. 48.

²³ Ibid, p. 51.

As was said above people will work just to satisfy an achieved level of needs, which corresponds to an achieved level of population development. Thus people *can* produce surplus product but do *not want* to do it. For example, when the tribes of New Guinea, which eat mainly sago, obtained iron axes from Europeans, their productivity increased significantly. However, as a result their working hours decreased and the volume of products per head remained the same²⁴. Not surplus product is a cause of more complex social structure, a state for example. Population do not need more complex social structure because existing one corresponds to their needs for security and order that any social organisation must provide. Only growth of the level of development of population due to further intensification of land use can make more complex social organisation to come into being. So the need to have a state is the cause for the surplus product. Thus such primitive sorts of land use as hunting and gathering, shifting agriculture and nomadism can not generate high enough level of development to create a state though they allow to produce surplus product as Sahlins had showed. Social institution will come into existence only when population will need them, therefore the state always arises only under plough stage of agriculture when people's level of development had become high enough.

So the intensification of agriculture in pre-industrial societies is *economic growth without growth of income per head for the majority of population*. To consider that economic growth is always the growth of capita income, as some scientists do, means modernization of the past. In pre-industrial societies development occurs not as in industrial ones.

Because the intensification of agriculture led to diminishing of labour productivity the intensification is possible only when reservoir is filled. Thus every great wave on the figure 1 is a result of the filling of reservoir. When the population exceeded critical level peasantry was forced to intensify land use. All subsequent changes in society were a result of this intensification. However, there was always a certain limit of intensification, beyond which the peasants did not want to go. This limit led to the fact that the intensification stopped and the population ceased to grow and began to decrease. As a result, prices began to decrease and another great wave was completed. Thus the pattern we can see on figure 1 was formed.

Each step on these steps meant progress, but it made the lives of most people harder. They had to work more and more to provide the same income. At the same time the level of population development grew, therefore society progressed, its social structure complicated, the number of educated people increased. In this way economic and social development of pre-industrial societies occurred.

²⁴ Salisbury (1962), p. 118.

2.2. Industrial revolution or transition to industrial society.

However, agriculture cannot intensify infinitely. Eventually, further intensification becomes impossible. It may be due to natural conditions. For example it was impossible for English peasantry to grow grapes as did French peasantry. Or it is impossible for residents of the Asian deserts and semi-deserts to shift to agriculture, as the climate is too arid. Or it may be due to economic conditions. For example, the peasants of the most developed Greek polities in antiquity grew grapes to produce wine and sold it to buy imported grain. This increased the critical population density by some times and allowed them to live on plots of some times smaller than if they had grown this grain themselves. However, that requires a sufficient market for wine and the ability to buy and import enough grain. If such opportunities are absent, intensification will be impossible.

In conditions when all opportunities for intensification of agriculture have been exhausted the filling of reservoir will be the *last one*. Every time the reservoir is filled there will be social disturbances. But after the last filling a revolution begins. It is peasant revolution caused by the filling up of the reservoir for the last time. This type of revolution may occur only in countries where peasantry comprises the majority of the population (60–90%), or in other words, in preindustrial societies.

So far as before revolution population grows quickly more and more people become redundant in agriculture, they look for jobs in trade and industry, therefore economy of the country develops especially swiftly. The level of development rises, therefore the country's culture, education and art thrive. The power of monarchy becomes absolute. However, when the reservoir is filled last time and the critical coefficient is too high, real incomes of the majority of population decreased often down to biological limit that causes difficulties for economy. Population continues to grow and with every year life becomes worse. Gradually all social strata become discontent and even the highest one. Instead of supporting government, elite opposed it. Absolute power of monarch turned to persistent conflict with society's elite. Now it is enough even small case to begin revolution.

Practically always the revolution begins on the top of the society but very quickly it going down the social pyramid. Every step down caused radicalisation because the lower is a social stratum the more radical it is. The most numerous low social stratum wants to raise its standard of living by political means, specifically by redistribution of property. According to the proposed model, this is impossible because the standard of living could only rise in conjunction with the level of development.

As the low stratum is involved in the revolution process, they begin to force revolutionary leaders to make changes in base economic regulations: redistribution of property, first of all, land; expropriations, the fixing of prices, etc. Such changes lead to civil war, because higher social strata lost their

wealth. As a result of intervention in economics and civil war, living standards deteriorate swiftly. At the same time, political struggle and civil war encourage anarchy and criminality. At this time, the population becomes disenchanted with the revolution as a means to improving life, and society seeks order at any cost. The social need for the centralization of power leads to personal dictatorship, which has power much more absolute than the pre-revolutionary monarch had. Who will win the struggle does not matter. The matter is not personal qualities but social need for strong hand to suppress anarchy. In any case, revolution usually culminates in personal dictatorship and the repression of all the revolutionary liberties achieved. This is end of any peasant revolution. Every peasant revolution doomed to failure because its main aim is unrealisable.

After the revolution, population growth gradually compensates for population losses and the reservoir is filled once more. However, development this time does not go on a revolutionary way. The elite of the society already knows to what disasters this way leads and the lower strata of the society, having suffered defeat in the revolution, became much more disciplined and obedient. Though when the critical density is again exceeded, their life becomes very difficult and some rebellion is very possible.

It was during this period that the industrial revolution could begin. For that it was necessary that in the country there were sufficient and available for mining coal fields because for the industrial revolution an adequate supply of energy is absolutely necessary. If such supply is absent the society will be in a stationary state and progress would stop. The number of people in the country will fluctuate at the critical density level and the prices will change in the same way. But since further intensification of agriculture is impossible the price chart will be similar not steps leading upward but sinusoid. Wrigley is certainly right when he writes about crucial importance of coal for the industrial revolution. Of course in the modern world coal can be substituted by other sources of energy.

But, I want to emphasize, the presence of coal deposits is the second condition for the industrial revolution. The first condition is the last filling of the reservoir after the peasant revolution. *Industrial revolutions occurred only after social revolutions.* Only the last filling of reservoir creates the mass of redundant population in agriculture about which Lewis wrote, and only the inevitable defeat of the peasant revolution makes it impossible for the population to repeat it in the future. Therefore, in China, where coal was used for a long time, the industrial revolution began so late, after last filling the gigantic reservoir and peasant revolution.

The aforementioned conditions are necessary for the industrial revolution. Their absence in the Lewis model means that it is incomplete. This is the reason for the failure to apply in practice recommendations to increase capital investment for successful industrialization.

So, in the country there are a lot of enough disciplined, though unskilled people, ready for any work. There is enough energy to develop the industry but

there is not enough demand for industrial products. The low home demand is the main impediment to industrialization in any undeveloped country. According to proposed here model it cannot be otherwise because the majority of population are peasants which has a low level of development and correspondingly low level of needs. The mainly rural population practise subsistent husbandry. In these circumstances only exports may create big enough market for industrial goods.

Fortunately, countries that are transiting to an industrial society almost always have good export opportunities. If it is a country of pioneering industrialization then it can produce products by advanced technologies that are out of competition. If it is a country that is entering into industrialization later others then it has the advantage of a lower wage level that allows them to produce cheaper goods. Thus, exports for countries that are transitioning to an industrial society are always very important.

That is why, as a rule, export-related industries develop much faster than others industries. In such way the leading sector of Rostow model come into existence. It should be noted that the development of these industries only accelerates the industrialization of the country i.e. it is not an indispensable condition. Export of industrial products also allows to increase the import of food, which contributes to the further movement of labour from agriculture. According to theory I propose all progressive changes in a society are a result of increase of complexity of labour of population. Thus *the industrial revolution is process of transition of labour force from agriculture to non-agricultural activity*. This process is of the biggest importance, because non-agricultural labour is usually more complex than any kind of agricultural labour. When people employed in non-agricultural sectors become more than 50 per cent, industrial society has arisen. This is a definite and precise criterion for the emergence of industrial society and the completion of the industrial revolution

The social processes that take place in the country during the time are of self-reinforcing nature. The more people leave the agriculture, the more the domestic market, because the working class should buy everything unlike the peasants. The increase of the market size both due to growth of domestic demand and due to growth of export creates more possibilities for mechanization owing to effect of scale. Mechanization makes products much cheaper so industrial goods can now be bought by those who could not afford it before. Therefore, the demand for industrial goods increases the number of jobs much faster than mechanization this number reduces. Thus, the share of non-agricultural labour is growing very rapidly.

It is very important to note that this complication is qualitatively different than what happened during the intensification of agriculture. As I mentioned above, the intensification of agriculture required more discipline and diligence from the peasants. Work in industry, commerce or services require more knowledge, that is, the development of intelligence. This need is especially

strong with the development of mechanical engineering, because it is the most complex kind of mass labour. Therefore, in the country a system of mass school education is created and the number of literate people is growing rapidly.

According to the proposed theory, such a completely unprecedented complication of labour for the majority of the population of the country should lead to an unprecedented increase in the level of needs. That is why, for the first time in history, income per head begins to grow. For many scientists, income per head growth is a key sign of the industrial revolution. However, this is a consequence of changes in the employment structure, i.e. the transition of labour from agriculture. This is easy to prove, as income growth always begins 25-30 years after the majority of the population started working in non-agricultural sectors. This time interval is necessary in order new generation have grown up. This new generation has grown and was brought up in quite other conditions as the generation of their parents grew. Most of the generations of parents were born and grew up in villages in the context of rural labour. Therefore they had formed correspondent low level of development. As it was said above the level of development of a generation is fully formed by adulthood and cannot be changed subsequently. The generation of their children grew in the city in very different conditions and formed much higher level of development.

Only when this new generation begins adult life unprecedented changes in the society will begin, which are caused by the unprecedented growth of the level of development and correspondingly by the unprecedented growth of the needs of the population. What are these changes?

First is the change in the standard of living. By these changes growth of needs is implemented. Workers no longer want to work for wages that were quite sufficient for their fathers. They want to live better and standard of living must correspond to the achieved level of needs. Further complication of the labour process leads to a new growth of the level of development, and hence the living standards of the population will grow.

Secondly, it is the decline in the birth rate. It is also a result of growing population needs. The growing level of needs changes the attitude of parents to the upbringing of children. Parents care more about children's health, their education, and strive to better feed and dress them. This means a rise in the cost of raising children, with increased spending on children's health, education, clothing, toys, books, etc. However, the level of needs of parents has grown up too and this clashes with increase of money and time for children. Therefore, the number of children in families is declining.

Third, people demand more political and economic liberty. The development of market relations demands more liberty for business activity. Old state institute were devised for pre-industrial society, therefore, they provide many unnecessary restrictions and arbitrariness of officials. All this creates a nutrient medium for corruption. In addition, educated people want

freedom of speech and participation in politics. This requires a change in state institutions, but many people in power resist because they will lose their privileges. Educated people are in minority but when the economic situation worsens the discontent spreads to the lower strata. In these circumstances, there may be a new revolution, so called “colour revolution.” Unlike the peasant revolution, the “colour revolution” occurs only in industrial countries, i.e. in the countries where the majority of population works in non-agricultural sector.

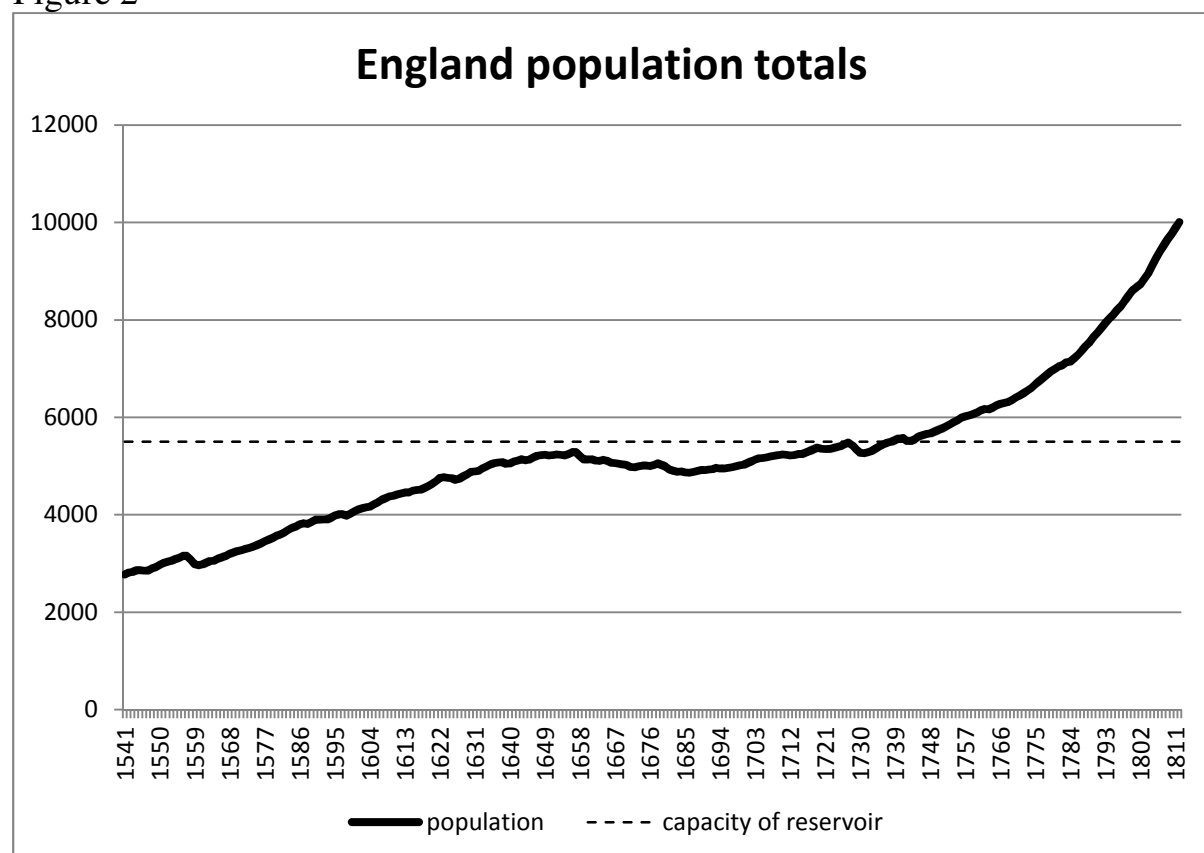
This is the theoretical base I propose for the cause of industrial revolution. The best way to show how the theory works is by practical example. For this purpose the English industrial revolution is the best choice.

3. Industrial revolution in England.

There is a historiographic tradition to name the English industrial revolution *the* Industrial revolution as if it were the only one of its kind. In a sense it is so, the English revolution is unique phenomenon since it was the first on the Earth and occurred spontaneously without any influence from the outside.

So long as the theory suggests that the main driver of all changes in a society is the population growth we will begin with English population dynamics. Owing to the fundamental work of E.A. Wrigley and R.S. Schofield²⁵ we have reconstructed dynamics of the English population.

Figure 2



²⁵ Wrigley E.A., Schofield R.S. (1997).

Source: Wrigley E.A., Schofield R.S. (1997) table A3.3, pp. 531-534.

As we can see on figure 2 English population grew continuously from the beginning of the data available to the middle of the 1650s. Next a decline period followed to the middle of 1680s after which the growth was resumed. The graph gives the impression that the population growth in the middle of 1650s came across the “ceiling”, which it could not penetrate. And only with the second attempt this “ceiling” was broken in the middle of the 18th century after which the population began to grow quickly and unhindered.

Let us compare this population dynamics with the main economic and political events of the period under consideration. According to most scientists, the industrial revolution in England began in the middle of the 18th century, which coincides with the breakthrough of the “ceiling”. The first attempt to penetrate this “ceiling” goes to the period, which included the reign of the late Tudors, the first Stuarts, English Civil wars and practically all time of Cromwell’s Protectorate (1653-1658).

Further we will look at these events in more detail. During the Tudor period the high and further growing critical coefficient forced more and more people out from agriculture. The majority of redundant population looked for means of subsistence in trade and industry. Owing to abundant cheap labour in the second half of the sixteenth century all kind of industry grew especially quickly. Probably the most rapidly growing was coal-mining. Only in the 1550s coal was mined by peasants as a part-time activity. However, by the beginning of the seventeenth century in the coal industry worked thousands of full-time workers²⁶ and output of coal increased several times. Quickly growing in the second half of the sixteenth century was metallurgy - extracting and smelting of iron, copper and lead. The increase in output of salt, glass, alum, soap, gunpowder, in construction of ships was enormous²⁷. The development of English economy in the last two decades of the sixteenth century and two first decades of the seventeenth century was so quick that J.U. Nef compared it with the beginning of industrial revolution in the second half of the eighteenth century²⁸.

As a result of abundant supply of cheap labour, English oversea trade was on the rise in the second half of the sixteen century. Many landless peasant’s sons in the time were ready for dangerous and hard life of seaman. Therefore, English fleet developed very quickly that made possible English victory in the war with Spain in 1585-1605. English merchants excluded foreign merchants from English overseas trade. It is not accident that the beginning of many trade chartered companies (except for the old Staple and Merchant Adventurers companies) occurred in the second half of the sixteenth century: Muscovy company in 1553, African company in 1554, Spanish company in 1577,

²⁶ J.U. Nef (2013), pp. 135-136.

²⁷ J.U. Nef (1958), p. 8.

²⁸ *Ibid.* p. 8.

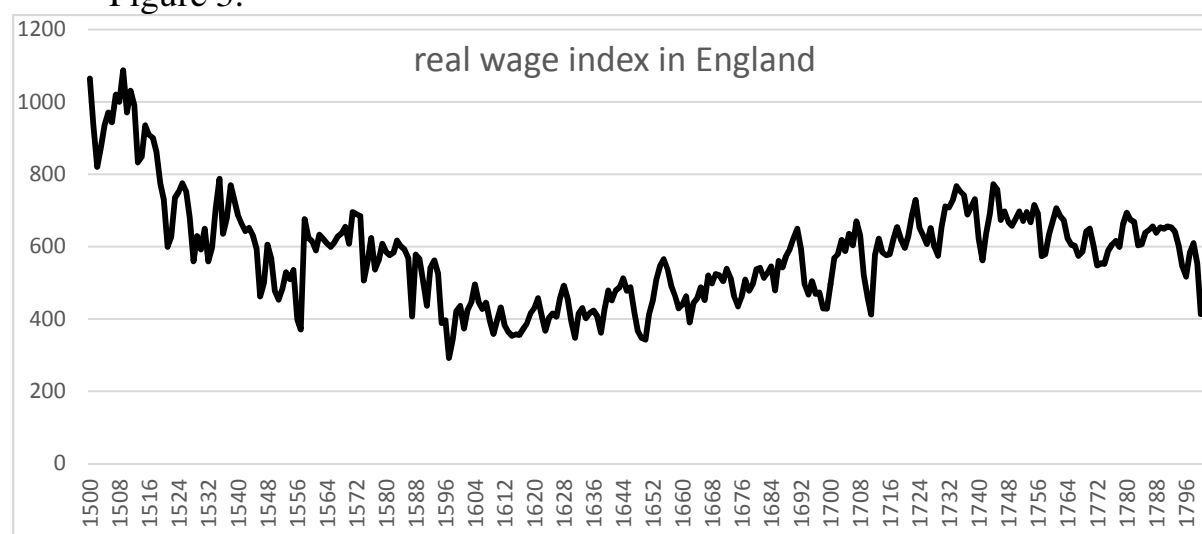
Eastland company in 1579, Levant company in 1581, Morocco company in 1588, East India company in 1600. It is of importance to note that these companies were long oversea trade companies in contrast to Staplers and Merchant Adventurers who exported English wool production to the nearest continental countries.

As a result of quickly growing level of development, more people were going to the universities, the printing production grew quickly. The scholars assert that in the second half of the sixteenth century the number of “petty schools” and grammar schools increased substantially. Overall 136 new grammar schools are known to have been founded between 1558 and 1603²⁹.

The striking illustration of the grown level of development of Englishmen in the second half of the sixteenth century was the “Golden age” of English culture³⁰. It was time of the flowering of literature in drama and poetry, music and architecture. The works of William Shakespeare, Christopher Marlowe and Ben Jonson are the outstanding legacy of the period. Certainly, it is not accidental that such brilliant personalities worked exactly in this time.

However, the successes of England in the development of economy and culture with the beginning of the seventeenth century are replaced by increasingly difficult problems.

Figure 3.



Source: Wrigley Schofield Table A9.2 p. 642-644

We can see on the Figure 3 the deepest fall in real wages was in the end of the sixteen – beginning of the seventeen centuries. The real wages had begun to grow only after the middle of the seventeen century. Was it a coincidence that for forty years before the revolution the wages remained at the lowest level during the entire period in question, probably sometimes below the biological limit? All the facts established by researchers perfectly correspond to the concept of the last filling of reservoir.

²⁹ P. Williams (1995), p. 392.

³⁰ C. Hibbert (1991).

The cause for the deepest fall in real wages in the end of the sixteen – beginning of the seventeenth centuries was exhaustion of possibilities for intensification of agriculture in the given economic and social conditions while the population continued to grow. These possibilities were limited by unwillingness of English peasants to put into practise new more intensive methods of land use because fall of labour productivity. Therefore intensification in the sixteenth century occurred mostly by conversion of pasture to arable because this way of intensification caused much less decrease in labour productivity than, for example, fodder crop growing.

From my point of view the best analyse of causes of the English revolution is one of Jack Goldstone³¹. He showed brilliantly how population growth under high critical coefficient (absence of land reserves) caused dispossession of land of peasantry³²; that growth of critical coefficient and following growth of prices made it impossible for the Crown to carry out its main duties³³ and how the fiscal crisis and attempts of the king to balance budget caused elite opposition to the king³⁴.

Goldstone's answer for the question – was the English revolution inevitable is negative³⁵ because for him demographic crisis of the seventeenth century was the same as, for example, the crisis of the fourteenth century. Certainly, in the 1380s the situation was similar but the Great Peasant's revolt was not a revolution because it was phenomenon of smaller scale in both social and geographical dimensions. The conception of last filling of reservoir allows us to understand the main cause of timing of the revolution. According to it, a revolution would happen when all possibilities for further intensification are exhausted in existent natural, economic and social conditions. We may conclude from the demographical dynamics and trend in real wages that English revolution was inevitable and it must happen in the time when it had really happened.

That English reservoir was filled last time in the first half of the seventeenth century may be assumed among others facts with dynamic of emigration from England. People do not leave their motherland if only forced by extremely poverty and discomfort both caused by unbearably high critical coefficient. Wrigley and Schofield proved that rates of net emigration during period of 1640-1670 were the highest in English history. For the sixty years (1620-1680) about a half of million (10 per cent of total population) had left England for good³⁶. The Elizabethan government formed elaborate schemes in the 1580s to colonize Ireland in order to create English bulwarks in the

³¹ J. Goldstone (1991).

³² *Ibid*, pp.72-74.

³³ *Ibid*, pp. 94-98.

³⁴ *Ibid*, pp. 99-101.

³⁵ *Ibid*, p. 156.

³⁶ E. A. Wrigley, R.S. Schofield (1997), p. 219, table 7.11.

rebellious island but few Englishmen were willing to settle here³⁷. In this same time, English colony established at Roanoke Island in America in the 1580s had disappeared without trace by 1590. The political aims of the colonisation were evident, but there were not enough people ready for emigration. The situation changed in the beginning of the seventeenth century when emigration to Ireland and America had begun that coincided with the deepest fall in real wages.

Thus wages fell to biological limit, social tensions were the strongest, religious controversies were bitter, people emigrated massively, radical religious sects after 1630 spread especially quickly, state budget was unbalanced, the elite of society was in opposition to the king. We may say that all above mentioned facts exactly correspond to conception of the last filling of reservoir.

English revolution had some very important features. The main cause of the specific character of English revolution was importance of cavalry on battlefields which was far most important than infantry because low effectiveness of smooth-bore firearms of the time. The most numerous of all cavalymen were cuirassiers, who were drawn from the nobility and the lesser landowners³⁸. It was needed to have considerable income to buy a battle horse which cost in these days more than any journeyman could earn in a year³⁹, arms, equipment and have enough spare-time for training. Thus, the main military force of the seventeenth century was nobility. The low social stratum was powerless as a military force without noble cavalry as clubmen movement showed, which never was a serious problem for both sides in the Civil Wars. Therefore, the low social strata never had political ambitions in English revolution and it was useless for politics to appeal to them. This is a main difference of English revolution with other revolutions, which happened later.

Thus the most radical stratum of English revolution was the New Model Army, which was recruited mostly by yeomen and yeomen's sons⁴⁰. It was the lowest point to which radicalization of English revolution was possible, therefore there was not redistribution of property, as it was in later revolutions.

Nevertheless, the English Revolution ended with the establishment of the personal dictatorship of Cromwell as well as all the subsequent revolutions. English people had tired from revolution anarchy, therefore they preferred dictatorship.

The death of Cromwell coincided with the change of demographic trend; English population had begun to diminish. According to the theory, the diminishing of the critical coefficient caused decrease of all kinds of activity of population. Scholars write about the general economic depression in 1658⁴¹.

³⁷ P. Williams (1995), p. 29.

³⁸ M. Wanklyn, F. Jones (2005), p. 30.

³⁹ H. N. Brailsford (1961), p. 149.

⁴⁰ *Ibid*, p. 145.

⁴¹ Chapters from agrarian history. v. 3. p. 153.

Trend of food prices turned downward even earlier and Protectorate parliament reversed the policy that prevailed for a century permitting export of food in 1656⁴². Social tension slackened. Scholars calculated that the number of civil litigations after 1660 had dropped by 62 per cent and social mobility declined sharply⁴³. In politics, the broad masses had become less active. Even religious radicals, with few exceptions, had avoided political activism⁴⁴ what strongly contrast with their behaviour in the beginning of the revolution. As a whole, the radical puritanism declined.

However, the fall in the number of population was not deep – about 8 per cent from 1657 to 1686⁴⁵, and not long – thirty years, after 1686 English population had begun to grow again. As a result, industry and trade revived somewhat, wool prices, which fell sharply in 1650s and more dramatically still in 1680s, recovered substantially in 1690s⁴⁶. In economy important changes after 1660s are evident. Structure of English overseas trade began to change. In the first half of the seventeenth century woollens prevailed absolutely in export, for example in 1640 the woollens consisted of about 92 per cent of all exports⁴⁷, and apart from the woollens England was largely dependent on imported manufactures.

However, by the end of the seventeenth century the share of woollen cloth in English export diminished to about 69 per cent, foodstuffs consisted 11 per cent (the most important were fish and grain), 8 per cent were raw materials, the share of other manufactures increased to 12 per cent⁴⁸. Thus, the structure of export is evidence of duality of nature of English development after 1660: from one hand, England was a country after peasant revolution with population much more disciplined and social structure much stronger due to that industries had begun to develop quicker. From another hand the critical coefficient in England was below 1, therefore the share of foodstuffs and raw materials was considerable – about one fifth of all exports.

After 1685 the population growth lasted until 1727. Then there is evident though short decline. The death rates increased to the second largest value during all period since 1541. They were larger only in 1558⁴⁹. As a whole on the figure 2 the period 1700-1750 is very similar to the period 1541-1600. I am sure it is no coincidence. In first case, English reservoir was filled, though not all possible reserves for the intensification of agriculture were exhausted. This intensification was mainly completed by the beginning of the seventeenth century and caused the rapid growth of the level of development of the English

⁴² *Ibid*, p. 129.

⁴³ J. Goldstone (1991), pp. 116, 120-121.

⁴⁴ J. Miller (2006), p. 136.

⁴⁵ E. A. Wrigley and R.S. Schofield (1997), Table A3.3 pp. 531-535.

⁴⁶ P.J. Bowden (1971), p. 220.

⁴⁷ *Ibid*, p. 144.

⁴⁸ *Ibid*, p. 144.

⁴⁹ E. A. Wrigley, R.S. Schofield Table A3.3 pp. 531-535.

population at this time. However in 1550s the filling of reservoir resulted in big mortality crises. The high critical coefficient caused fall in real wages, growth of rural unemployment and influx of hungry and homeless people in towns. The low level of development of population and consequently low level of hygiene made the following epidemic devastating. As a result England's population declined by 6 per cent.

By middle of 1720s English reservoir was filled again and as it was in 1550s big mortality crisis followed. However, the population of England at this time amounted to 5 480 000, while in 1560s it was 3 153 000⁵⁰. It is very important that in 1657, when the demographic trend had changed, the population of England was 5 284 000⁵¹. So the human capacity of English reservoir in time of its last filling was about that value. Since the filling of English reservoir in 1557 its capacity owing to intensification of land use increased by 70 per cent. However since the 1657 to 1720s the capacity increased only by 3,7 per cent. Thus we may conclude that the last time capacity of English reservoir was about 5,2-5,5 million. On Figure 2 the capacity of the reservoir is shown with a dotted line.

When English population again reached the capacity about 5,5 million there was a subsistence crisis with high mortality in 1728-1729⁵² and in 1730⁵³, that decreased English population by 4 per cent. During next ten years population again reached 5,5 million then next mortality crisis in 1741-42⁵⁴ happened.

It was a very hard time for the people of England. In 1756 wet summer pushed up food prices and food riots began. It was the most serious riots the eighteenth century Britain had experienced. Notwithstanding good harvest in 1757 food riots continued⁵⁵. Besides food riots there were militia riots, the population protested against possible enlistment. Virtually every English county experienced some kind of disorder in 1756-1757⁵⁶.

All these events are very revealing to understand the situation in England at this time. The scale of the riots was nationwide; hence their causes were common to all counties. This confirms the assertion that the population density again exceeded the critical level, i.e. the reservoir was again filled. However, it was not a new revolution feared by the authorities. Although the authorities prepared 16 000 soldiers, there was no bloodshed because the peasant revolution of the seventeenth century taught the English people many things, both the upper and lower classes.

⁵⁰ *Ibid*, p. 531.

⁵¹ *Ibid*, p. 532.

⁵² A.B. Appleby (1997), p. 882.

⁵³ E. A. Wrigley and R.S. Schofield (1997), Table 8.12 p. 334.

⁵⁴ *Ibid*.

⁵⁵ N. Rogers (1998), p. 72.

⁵⁶ *Ibid*, p. 84.

Thus, the activity of masses was directed to the economic sphere and the industrial revolution had begun. That is why qualitative changes in the society began from the middle of the eighteenth century. From that time the structure of the British overseas trade began to change owing to increase of share of home industrial production⁵⁷.

It is a second half of the eighteenth century when the boom of inventions and innovations began: spinning jenny in 1764, spinning frame in 1767, spinning mule in 1779, the beginning of canal building in 1761, steam engine in 1776, rolling and puddling processes in metallurgy in 1780s and so on. All these outstanding achievements became possible only because in England a huge army of disciplined labourers ready for any work had come into being. Entrepreneurs could now use this army for profit, which they did. Discoveries and innovations were only a consequence of changes in the structure of employment and population activity. The second condition for the beginning of the industrial revolution was coal. The economic centres during the revolution moved from the south of the country to the north. In the south, natural conditions created a higher critical density and the south had a larger population density in the preceding period. But in the south there is no coal and with the beginning of industrial Revolution the population increasingly concentrates in the north near new industrial centres and coalfields.

All three major industrial regions of the English industrial revolution: Lancashire with cotton production, the West Midlands – iron and production of ironware, and West Yorkshire with cloth production are located near the coal deposits. It is true that Lancashire became centre of English cotton industry due to its geographical location: Liverpool as major English port of America cotton import and Atlantic wet winds provided the Pennine west slope streams with abundant water energy. Richard Arkwright and his partners in their first factory in Nottingham in 1769 installed a horse capstan for their roller spinning machine. However later Arkwright had to move to Lancashire in order to use water power to increase the scale of production⁵⁸. Nevertheless, after 1820, the growing demand for cotton fabrics forced entrepreneurs to use steam engines⁵⁹, fuel for which was coal. In the West Midlands production of ironware in the eighteenth century was impossible without coal as well as industry of Yorkshire where besides the wool textile industry developed production of iron, pottery making and lime burning.

About 1800 less than half of English labour force still worked in agriculture⁶⁰. Factory production, use of machines, work on their manufacturing and adjustment – all this was a qualitative complication of the labour process. The transition to non-agricultural labour on such a scale according to the

⁵⁷ R. H. Davis (1974), p. 20.

⁵⁸ Chapmen S.D. (1972), p. 17.

⁵⁹ Ibid, p. 18.

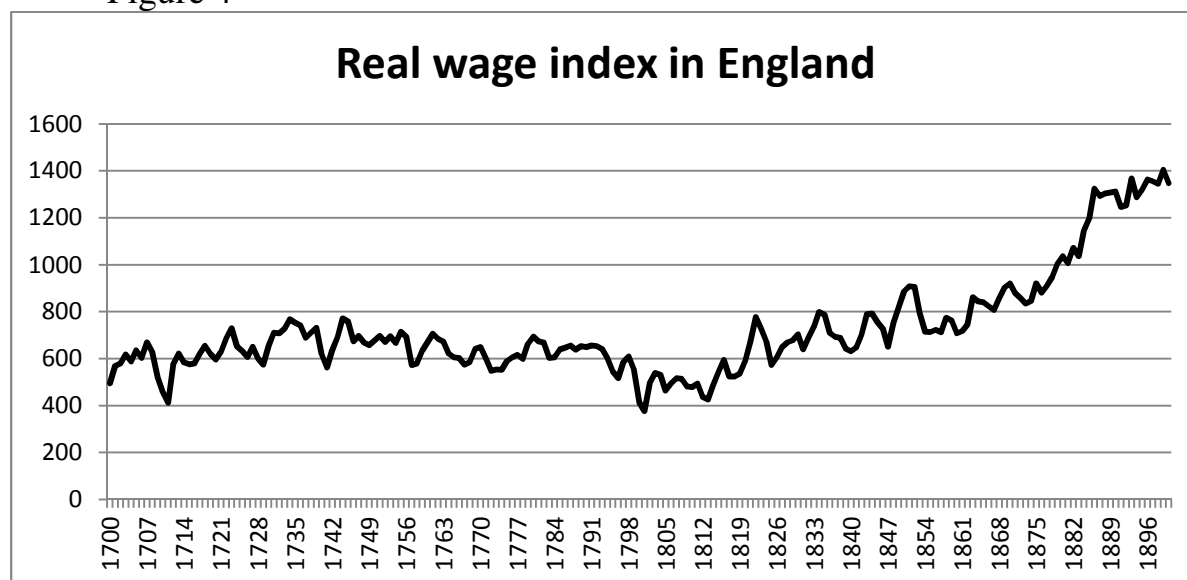
⁶⁰ E. A. Wrigley (1990), p. 12.

proposed here theory should qualitatively change the level of development of the population. However, this happened not immediately, but after the new generation had grew, that is, in 1820s-1830s, which also the theory supposes.

It is interesting that contemporaries were well aware that the working class was changing. One of them in 1820s in a somewhat rough manner notes that factory labourers “from being only a few degrees above cattle in their scale of intellect they became political citizens.”⁶¹. However, there are objective indicators that allow to see the growth of population development. According to the theory, the growth of the level of development should lead to an increase in the level of needs.

For many scientists the large and sustained growth rise in real incomes per head is a distinguished feature of the industrial revolution⁶². On the figure 4 the dynamic of real wages in the eighteenth and nineteenth centuries is shown. The fall of real wages in the end of eighteenth – beginning of the nineteenth century probably is caused by Napoleonic wars. After the wars real wages recovered and began its sustained growth from the 1820s. Certainly there were fluctuations but trend to increase is obvious. Wrigley and Schofield concluded that in England for two and a half centuries there was “...a strong connection between an increasing rate of population growth and a decline in real wages”⁶³. But in 1820s this connection was broken. The population grew rapidly, while wages increased hence per head income.

Figure 4



Source: E. A. Wrigley and R. S. Schofield p. 642-644 table A9.2

Lewis thought that at some stage of industrialisation labour which was redundant in agriculture was exhausted and demand for labour exceeded supply⁶⁴. That pushed wages up and caused growth of incomes per head.

⁶¹ W.B. Willcox, W.L. Arnstein (2001), p. 204.

⁶² E. A. Wrigley (1990), p. 9.

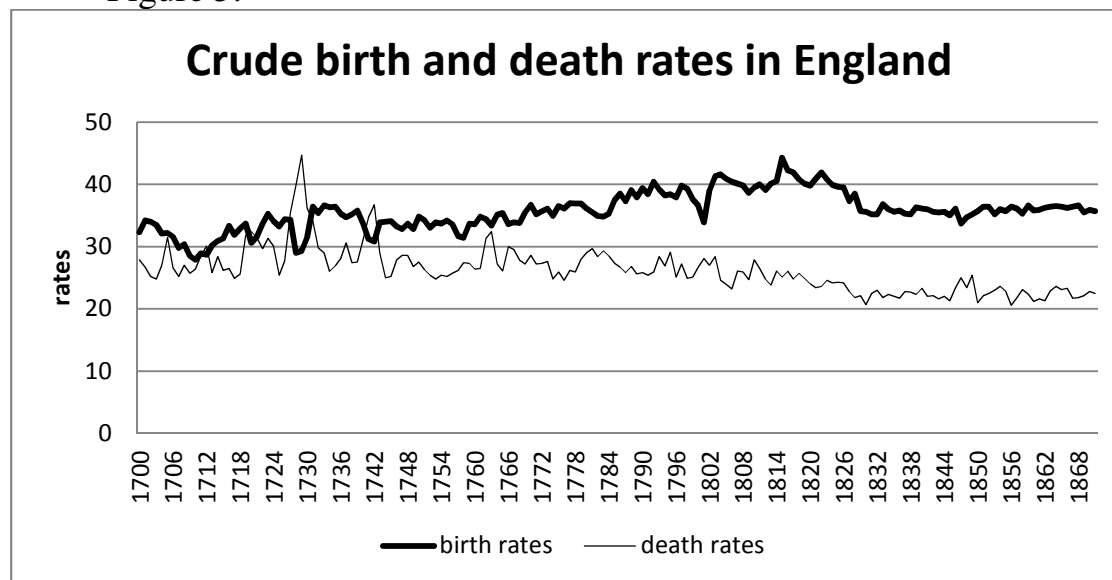
⁶³ E.A. Wrigley (1990) p. 66.

⁶⁴ W. A. Lewis (1954).

However this demand inflation of cost of labour does not explain why wages did not fall to previous level in time of crises and large unemployment.

That the beginning of sustained growth of real wages in 1820s was not accidental can be proved comparing with the dynamics of fertility.

Figure 5.



Source: Wrigley and Schofield pp. 531-535 table A3.3

As we can see in Figure 4 the death rates after last peak in the beginning of 1760s, which correspond to time of filling of reservoir, had begun to decline steadily. It was time of beginning of the industrial revolution and death rates declined owing to better food supply and improvement in housing that correspond to the second stage of the demographic transition. The third stage of the transition begins when the birth rates began to decline. As we can see in Figure 4 in England that happened in the 1820s.

In contrast to the fall in mortality, the decline in fertility occurs against natural instincts. Throughout the previous history of mankind, income growth has led to a rise in fertility. Now income growth is accompanied by a fall in fertility. That the beginning of the fall in fertility coincides in time with the growth of income proves that between these phenomena there is a connection. According to the proposed theory, these phenomena have one cause: qualitative, never before happened in such a scale increase in the level of population development as a result of unprecedented complication of labour for the majority of the population.

People are getting more intelligent and for the first time in history they are willing to work harder to live better. The desire to live better on the one hand leads to higher wages and, on the other hand, to a decrease in the number of children in families. At the same time, these changes occur not when the majority of the population begins to engage in non-agricultural work, but in the subsequent generation, which has grown and formed in the new environment. Therefore, in England both income growth and decline in fertility began in

1820s, as the majority of the population moved to non-agricultural work about 1800.

Another manifestation of the grown level of population development was the struggle for the expansion of political rights. In England these events began in the very beginning of 1830s during the struggle for Reform Act 1832. The powerful people's support for the Reform bill is extremely significant. When the Lords rejected the Reform Bill in 1831 people riots ensued. It is evidently that only popular pressure made possible this bill to be passed. Thus, the growth of the population's level of development proved itself in the struggle for political rights.

However, the Reform Act increased political freedom only slightly, British electoral system remained corrupt. Only about 9-10 per cent of the adult male population had right to vote⁶⁵. The electoral districts were unrepresentative and the open ballot made it possible to buy votes by money or to intimidate them. This was the cause of the Chartism movement. From the point of view of the proposed model Chartism was abortive English colour revolution. While writing his book on the transformation of British popular politics, Charles Tilly noticed that in Britain social movements didn't exist in the mid-18th century but had become a dominant form of popular politics by the 1830s⁶⁶. The revolution did not occur only because the economy of England developed excellently and the educated minority did not have enough support of lower social strata. Walt Rostow showed excellently relations between economic fluctuations and the activities of Chartist in 1830-1840s⁶⁷.

Thus, the concept of the last filling of the reservoir as the cause of the industrial revolution exactly corresponds to the development of England at the time when the first industrial revolution took place there. The population of England during the peasant revolution reached roughly the same number as at the beginning of the Industrial Revolution. This number corresponded to the capacity of English reservoir in time of its last filling. In the first case the result of filling was a peasant revolution, in the second it was industrial revolution as the proposed theory suggests.

In the process of industrial revolution in the English society there were changes that also correspond to the proposed theory. After the majority of the population of England had begun to work in the non-agricultural sector of the economy, what happened about 1800, transition to industrial society occurred. However, changes in people's behaviour happened only after 1820, when a new generation with a higher level of development had grown. This is confirmed by the fact that the growth in per capita income, the decline in fertility and the expansion of political freedoms began from that time.

⁶⁵ J. A. Phillips, C. Wetherell. (1995), pp. 413-14.

⁶⁶ C. Tilly (2015), pp. 284-339.

⁶⁷ W. Rostow (1941), pp.206-221.

Bibliography.

- ALEXAKHA A. (2016). "A model of social progress" in *The Journal of European economic history*. v. XLV, (3), pp. 137-209.
- APPLEBY A.B. (1979). "Grain prices and subsistence crisis in England and France, 1590-1740". in *The journal of economic history* v. XXXIX, (4) pp. 865-887.
- ASHTON T. S. (1996), *The Industrial Revolution, 1760-1830* [Oxford, 1948], repr. Oxford.
- ASHWORTH W.J. (2003), *Customs and Excise: Trade, Production, and Consumption in England, 1640-1845*, Oxford University Press.
- BOSERUP E. (1965), *The Conditions of Agricultural Growth*, London, Allen and Unwin.
- BOWDEN P.J. (1971), *The wool trade in Tudor and Stuart England*. [London 1962] repr. London.
- BRAILSFORD H.N. (1961), *The levelers and the English revolution*. Stanford university press.
- BROADBERRY S.N., GUPTA B. (2006) 'The early modern great divergence: wages, prices and economic development in Europe and Asia, 1500-1800', in *Economic History Review*, 59/1, pp.2-31.
- CHAPMEN S.D. (1972), *The cotton industry in the industrial revolution*. Macmillan 1972.
- Chapters from The Agrarian History of England and Wales: Volume 3, Agricultural Change: Policy and Practice, 1500-1750*, (1990), J. Thirsk ed., Cambridge University Press, .
- CLARK, G. (2007), *A Farewell to Alms: A Brief History of the World*. Princeton University Press.
- DAUNT M. (2007), *Trusting Leviathan: The Politics of Taxation in Britain, 1799-1914*, Cambridge University Press.
- DAVIS R.H. (1974), *A Commercial Revolution : English Overseas Trade in the Seventeenth and Eighteenth Centuries*. [Historical Association, 1967], repr. Historical Association
- FARMER D.L. (1957), Some grain price movements in thirteenth-century England in *Economic History Review*, New Series, Vol. 10, N 2, p. 207-220.
- FISHER D.H. (1999), The great wave. Price revolutions and the rhythm of history, [Oxford, 1996] repr. Oxford University Press.
- GOLDSTONE J. (1991), *Revolution and rebellion in the early modern world*. University of California press.
- HIBBERT C. (1991) *The Virgin Queen: Elizabeth I, Genius of the Golden Age*, Da Capo Press.

- JACOB M.C. (2014), *The First Knowledge Economy: Human Capital and the European Economy, 1750–1850* Cambridge University Press.
- LEWIS W.A. (1954), “Economic development with unlimited supplies of labour”, *The Manchester School*, 22 (2), pp. 139–191.
- MILLER J. (2006), *The Stuarts*. [Hambledon and London, 2004], repr. A&C Black.
- MOKYR J.(1990), *The Lever of Riches. Technological Creativity and Economic Progress* Oxford.
- NEF J.U. (1958), “Not one, but two industrial revolutions” in *The industrial revolution in Britain: triumph or disaster?* P. A. M. Taylor ed. D.C. Heath and company, Boston.
- NEF J.U. (2013), *The rise of British coal industry*. [Routledge, 1966], repr. Routledge.
- PHELPS-BROWN E.H., HOPKINS S.V. (1956), “Seven centuries of the prices of consumables, compared with builders’ wage-rates” in *Economica*. № 23. pp. 296-314.
- ROGERS N. (1998), *Crowds, Culture, and Politics in Georgian Britain*. Clarendon Press.
- PHILLIPS J. A., WETHERELL C. (1995). "The Great Reform Act of 1832 and the Political Modernization of England", in *American Historical Review*, vol. 100, pp. 411–436.
- ROSENSTEIN-RODAN P. (1943), “Problems of Industrialization of Eastern and South- Eastern Europe”, in *Economic Journal*, v 53, No. 210/211, pp. 202–11
- ROSTOW W.W. (1941), “Business cycles, harvests and politics” in *Journal of economic history*, (1), 1941, pp. 206-221.
- ROSTOW W.W. (1960), *The stages of economic growth: a non-communist manifesto*, Cambridge.
- SAHLINS M. (2017), *Stone age economics*, [Chicago 1972], repr. London Routledge.
- SALISBURY R. F. (1962), *From Stone to Steel: Economic Consequences of a Technological Changes in New Guinea*. Cambridge : Cambridge University Press.
- SCHUMPETER J. (1939), *Business cycles* N. Y.
- TILLY C. (2015), *Popular Contention in Great Britain, 1758–1834*. [Harvard University Press, 1995], repr. Routledge.
- WANKLYN W., F. JONES F. (2005), *A military history of the English civil war, 1642-1646: strategy and tactics*. Longman/Pearson Education.
- WILLIAMS P. (1995), *The Later Tudors : England, 1547-1603*. Oxford, Clarendon Press.
- WILLCOX W.B., ARNSTEIN W.L. (2001), *The age of aristocracy*. [D.C. Heath, 1983], repr. Houghton Mifflin Company.

WRIGLEY E.A. (1990) *Continuity, chance and change: the character of industrial revolution in England*. [Cambridge 1988] reprinted Cambridge.

WRIGLEY E.A., SCHOFIELD R.S. (1997), *The population history of England. A reconstruction*. [Edward Arnold, 1981], repr. Cambridge University Press.