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Time Is Money. Theory of Value Depreciation.

Abstract

The article describes “the theory of value depreciation” developed by the author. In accordance with this theory, economic growth takes place using two inter-connected phenomena: (a) reduction in time necessary to produce “the set of goods currently consumed” (first form of value depreciation) and (b) using the free time to produce additional goods, as a result of which a new set of goods is created, a new “living standard” (second form of value depreciation). The theory allows the fallacy of identifying utility with wealth to be proved, for example, the article shows that “marginal utility” is equivalent to the “degree of poverty”. The importance of time is stressed, as well as the interconnection between the free time in natural economy and savings in modern money economy. The theory allows one to take a new view of the economic history, the theory of economic growth, the theory of international trade.

Key words: value, productivity, time, marginal utility, wealth, economic growth

JEL Classification: D01, D60, E40, O10

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Introduction

This work sets forth the theory of depreciation. If one tries to express it very briefly, then it is as follows: the more we «depreciate» economic values existing at this time (decreasing their importance for us), the «richer» we become.

Throughout the whole work, in parallel, the principles of the theory are justified both for the case of natural economy where exchange is non-existent, and for modern money economy in which the majority of goods are acquired for money during the process of exchange. Such an approach does not only allow one to make the conclusions of the theory sufficiently universal. It also allows an intimate linkage to be established and even the equivalence of such concepts as time and money to be established.

The first part deals with the key principles of the theory: existence of two forms of value depreciation and their intimate linkage; the hierarchy in the procedure of producing (acquiring) goods; higher value of the goods which are of later (more recent) origin; the influence of value depreciation on economic growth.

The second part of the article refers to an example of applying the theory to explain England's phenomenal success during the industrial revolution of the 19-th century.

The author sought to make the exposition as comprehensible as possible for a regular reader, some mathematical formulae have been relegated to the footnotes and may be easily omitted without any detriment to the understanding of the material.

A few words about the terminology.

(1) Regarding the name of the theory. As possible names of the theory in the English language, we considered "*Theory of Devaluation of Values*", "*Theory of Devaluation of Worth*", "*Theory of Values Erosion*" and so on. The name "**Value Depreciation Theory**" appeared to be suitable since it helps avoid tautology and has no associations with such a phenomenon as currency devaluation.

(2) In the subsequent text, two pairs of terms are often used as synonyms or as the terms close in meaning:

1. Production – acquisition for money
2. Time – money

As a matter of fact, while working at the theory of value depreciation, from the outset I tried to make it universal, as I have already mentioned above. Universal in the sense that it needed to describe equally well the processes both in the modern society and the primitive society which knew no money.

Therefore, to understand further argumentation better, it would make sense to take a look at a table of analogies (Table1)

Analogies in natural and money economies.

In the primitive world	In the modern world
Natural economy. Goods are consumed by producers	Commodity (money) economy. The economy based on division of labor and exchange. Goods are mostly acquired for money ²
Ancient man, in the course of 8 hours, produced (collected) enough food to last him 1 day	A worker at a manufacturing factory, in the course of 8 hours, made enough money to acquire enough food to last him 1 day
The time spent to produce goods	The time spent making the money necessary to buy goods
Production of goods	Making money to acquire goods
Readiness of the goods for use	Purchase of a good ³
Labor productivity	Level of pay for labor (income)

Such an approach is not uncommon. Gossen⁴, when formulating so-called Gossen's second law, also proposes two wordings – one wording for natural economy and the other for money economy.

Just like in Gossen's theory, in our review, in one case the consumer is limited to the quantity of the time available to him. In the second case, he is limited to the quantity of money available to him.

² To simplify the exposition we shall assume that all the goods in money economy are acquired for money. This significantly facilitates the description without changing the essence. Indeed, as Becker (2003) aptly noted, the majority of goods in modern economy require both a loss of money and time.

³ In natural economy it took the man only one act – an act of production – to obtain an object and have at his disposal. In order to start using an axe, he had to produce it. In money economy it requires two acts: first, you need to make enough money to buy an axe, then you need to purchase it. It is only then that the man is able to use the axe. This «complication» does not affect the course of further argumentation, if we assume that the time necessary for the purchase to be made to be small enough and hence negligible.

⁴ Hermann Heinrich Gossen is a Prussian economist, predecessor of the mathematical and Austrian schools in economics. Gossen's second law (named in his honor after his death) has become one of the fundamentals of the theory of marginal utility.

Part one. Fundamental principles of the theory of value depreciation.

The four fundamental principles of the theory are as follows:

1. **Two forms of depreciation.** The value of the good decreases (devalues) as a result of two forms of depreciation:
 - a. As the quantity of time necessary to produce/acquire the good or a set of goods diminishes. This is the first form of depreciation.
 - b. As the time/money liberated is used for production/acquisition of new goods. This is the second form of depreciation
2. **Hierarchy of goods.** Goods are not produced/acquired in some arbitrary order, they are produced/acquired in keeping with a certain hierarchy from bottom to top level.
3. **Different valuation of the goods.** The goods with a higher position in the hierarchy (they are also the latest in time to appear) are valued higher.
4. **Growth through depreciation.** Economic development (growth of affluence) is driven by either form of depreciation.

Let us try to explain each of these statements.

1. Two forms of value depreciation.

1.1. The first form of depreciation.

How does the value of the good diminish with the diminishment of the quantity of time necessary for its production/acquisition?

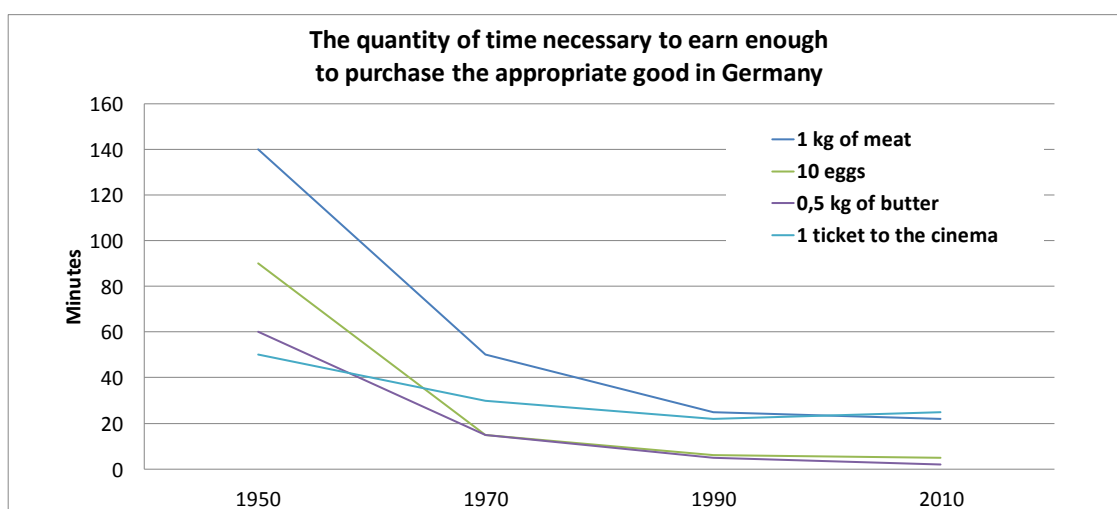


Fig. 1. The quantity of time necessary to earn enough to purchase the appropriate good.

Source: Expert.ru, ©ZAO «Expert Group»,2010 (Sumlenny, 2010).

Figure 1 shows that in 1950, for the money earned during the 8-hour working day, i.e. for his daily pay, an employee in Germany could buy 4 kg of butter. In 2010, for his daily pay, an employee could buy as much as 120 kg of butter.

If we are to resort to our analogy to natural economy, then the employee's «productivity» measured in kilograms of butter has increased 30 times⁵.

⁵ The issue of limiting factors is an important one, i.e. the case where the man has time but he cannot use it. For example, let us imagine that a person cannot find a job. For an agricultural worker or a farmer such a limiting factor could be lack of a plot of land. At this stage, we are not considering the possibility of limitations as it is not relevant for purposes of our exposition.

In the other examples from figure 1 as well for the acquisition of the same goods, one requires less and less time. That is, the proportion of the time spent on the acquisition of the same amount of these goods is falling down.

The less the proportion of the time necessary to acquire the good is, the easier it is for the man to satisfy his need for this good. And hence it is easier to achieve «saturation» with this good or, at least, to approximate this «saturation».

One should not confuse this phenomenon with reduction in marginal utility⁶. In my opinion, “reduction in importance” or “value erosion” are the word collocations which are more suitable for this phenomenon. *Reduction in importance, value erosion are further on denoted by the term «value depreciation».*

The first form of depreciation is the depreciation of the good’s value as a result of the reduction in the time necessary to obtain the good to have it at one’s disposal.

In everyday life, depreciation of the good’s value takes place when we say that «a good has become more available», «has become affordable», i.e. it has become possible to buy it or there is an opportunity to buy more of it than before. This is exactly the way it is in the example about butter having become more available which was given above. This may happen for two reasons: the prices for the goods go down or/and wages go up.

There is a concept well known to economists and, more so, to market researchers who study prices. It suits well to describe this phenomenon. This concept says that a buyer is less sensitive to price rises for the goods, the lesser proportion of the buyer’s total costs is accounted for by the costs incurred on this good.

Golubkov (1998, p.346) refers to it as «the effect of cumulative costs». «Buyers are less sensitive to the price if the price of the goods amounts to a small portion of their income».

Another author (Lipsits, 2004) calls it «the effect of the goods expensiveness». «The effect of the goods expensiveness – the higher the costs incurred in acquiring the goods in absolute value or in percentage of the buyer’s income, the greater the buyer’s sensitivity to the price level is»

Similar conclusions are also drawn by Kotler (1999), in which he states that “...customers are most price sensitive to products that cost a lot ...; they hardly notice higher prices on low-cost items ...”

The notion of a cheap good in this context should be understood as being cheap relative to the income of a specific buyer. Since for someone a car at 50 thousand dollars is just a small portion of his yearly income while for someone else this is a huge amount exceeding the yearly income several times.

Here is an important note: value depreciation for a specific consumer does not mean automatic price reduction in the market. Just like in the example given above, if somebody got so rich that buying a car for him at 50 thousand dollars is no big deal, this does not mean that it results in price reduction for such cars. It does not mean either that for less well-to-do people this good has now come to be perceived as something more accessible.

⁶ In the classical theory of marginal utility each subsequent unit of the good, when it is consumed, gives *lesser satisfaction* than the previous one. While what we are saying is that increasing productivity allows a good to be produced in *a shorter period of time*. It will be shown further below that the term «marginal utility» is not entirely adequate. In fact, one would be better off to call «marginal utility» «a degree of need» for a particular good or even «a degree of poverty» with respect to this good.

1.2. Second form of depreciation.

The second form of depreciation takes place when the time, hitherto free, begins to be used to produce goods. As a result, a new set of goods arises, we can even say that a new «standard of life» is established. Let us now consider this depreciation using an example.

Input conditions: let us imagine an isolated group of people, who produce grain only and things that can be made from grain (bread, etc.). Let us make an assumption that the number of people working in this group does not change and equals 100 persons ⁷. In the initial condition, the grain produced is enough to feed the people and to sow for the new crops. All the working time is used to produce food, therefore there is no free time left.

What will happen if labor productivity (as a result of new methods of land cultivation or starting to grow a higher yield culture) is to double? Actually it will mean liberation of half the working time which used to be spent on production of the same quantity of food. Scenarios for the use of this free time can be different.

Let us assume Group Zero (it is also the «Control» Group) as the Control Group, who prefer using the liberated time for leisure. Using the example of other groups (Group One through Group Four) we shall show what other scenarios there are for using the liberated time.

0. Group Zero («Control Group»). Prefers to devote the liberated time to leisure. This is value depreciation of the first form described in section 1.1.

Value depreciation of the second form occurs if the group prefers to use the liberated time to produce additional goods. There arises a new set of goods, as it were, a new «living standard» of the Group. Examples:

1. Group 1. Prefers producing twice as much grain and uses it, just as before, for food. In this case, this Group will increase its ration, will have its stock of grain for unforeseen circumstances, etc.⁸
2. Group 2. Prefers producing twice as much grain but the Group uses its additional part «to convert it» into other goods derived from grain: meat (by using grain to feed domestic animals and birds for growth), beer (grain is the initial ingredient of beer), etc.

The limitations which we set at the beginning, i.e. the Group being isolated and only grain economy (with meat and beer derived from grain), do not allow us to use other possibilities for value depreciation of the second form. However, given such limitations, there are possibilities for such value depreciation as can be seen above.

If we remove these two limitations, other ways of value depreciation of the second form become possible:

3. Group 3. We remove the condition of the «Group being isolated» and it becomes possible to produce grain for exchange with the other groups for non-grain goods (such as, for example, clothes, footwear, etc.).
4. Group 4. We remove the condition «of grain economy only» and it becomes possible to use the liberated time to produce other non-grain goods (the same clothes, footwear, fabrics, etc.)

Any of the four methods of value depreciation set forth above (Groups from 1 through Group 4) results in a higher «living standard» of the Group compared with the Control Group. This is

⁷ Please pay attention to this assumption. In reality, it means lack of pressure exercised by the so called «Malthusian trap» which very often does not happen in life. The assumption has been made only for the cited example of the second form of depreciation and does not affect the final conclusions.

⁸ This means that saturation with grain in this group has not happened and the marginal utility of grain is higher than that of the alternative goods known to the group.

especially obvious if we consider that when calculating the GDP the man who produces something twice as fast but in the same quantity will not add to the GDP with all the other conditions being the same.

Any of the members of the Group with higher «living standard» (Groups 1-4), can well perceive the living standards of the people from the «Control Group» (Group 0), which is lower, and of lower value, to have depreciated⁹. What has actually depreciated? Is it indeed the previously available set of goods, in other words, the «living standard» that has depreciated? No, this happened as part of value depreciation of the first form. If we take a more careful look at the example, it is *the value of free time that has depreciated*, that is there have emerged some goods which are valued higher than free time.

Thus, we arrive at the following definition: **the second form of value depreciation is the depreciation of the value of free time** (spare money) as new goods emerge or «old» goods increase in value.

Let us now try to «compose» an example from modern life related to money.

- **Initial situation:** a man has a certain salary and he has established a certain standard of consumption. There is no spare money, i.e. expenses equal his income. He has an opportunity of working more but he prefers leisure.
- **Changes:** Suddenly this man (himself or on his wife's advice) realizes that everyone has had a car already for quite a while (other possibilities: a country home, computer, a dish washing machine, etc.), while he has none of these items yet.
- **Reaction:** It is entirely possible that the value of these new goods will be assessed by him to be higher than free time and he will take the advantage of the opportunity of working more to earn enough to be able to acquire these goods. And this would be the second form of value depreciation.

A very **important conclusion** follows from the example cited above: **savings are the equivalent of free time.**

In the example considered above, the man did not have any savings but he had free time. The very same will happen if a man has savings (what he has saved, or income exceeding expenditure) and does not spend them initially while later, when new goods emerge, he starts spending them. The important conclusion is as follows: *savings are the equivalent of free time which are not used until a certain time, i.e. the equivalent of "the time set by"*. This is one of the reasons why the title of this article mentions the famous expression of Benjamin Franklin «Time is money».

1.3. Interconnection of the two forms of value depreciation.

The following question arises: to what extent is it fair to talk about two forms of value depreciation as being one phenomenon? Are they not the categories absolutely unconnected with each other? In order to determine the interconnection of the two forms, it is enough to establish that value depreciation of the first form can «pass» into value depreciation of the second form and vice versa. Let us consider this using an example.

- **Initial situation:** the same as in the previous example. That is a man has a certain salary and he has established a certain standard of consumption. There is no spare money, i.e. his expenditures equal his income. He has opportunities of working more but he prefers leisure.

⁹ In real life it is not only the group of people living in the neighborhood that can act as the «control group», i.e. the group with whom people can compare themselves. As comparison, one's own group can be used, the way it was several years (decades, centuries) ago.

- Changes: Suddenly his salary falls down (or the prices for the goods he regularly acquires shoot up). The value of the «old» goods (compared to his income) has appreciated. That is, instead of depreciation in its first form, there has occurred a «revaluation» or appreciation, i.e. growth in value.
- Reaction: Let us assume that, in order to maintain his (and/or his family's) customary level of consumption, the man takes the opportunity of working more. This will mean that the value of free time has diminished, has depreciated. However, it also means that appreciation of the first form has been compensated for by depreciation of the second form.

Conclusion: value depreciation manifests itself in two forms which are inter-connected with each other.

Thus, we have considered above the two forms of value depreciation: the first being the one when time is liberated, the second form is when the time begins to be used to produce additional goods.¹⁰

2. Hierarchy of goods.

The fact that people will be using the goods available to them in accordance with certain hierarchy rather than in an arbitrary manner was spoken about by even the classics of marginalism. Thus, for instance, Carl Menger in «Principles of Economics» (Menger, 2005, p. 140) says:

«If a quantity of goods stands opposite needs of varying importance to men, they will first satisfy, or provide for, those needs whose satisfaction has the greatest importance to them. If there are any goods remaining, they will direct them to the satisfaction of needs that are next in degree of importance to those already satisfied. Any further remainder will be applied consecutively to the satisfaction of needs that come next in degree of importance» (underlined by me, S.B.)

The same can be said to be the case with the man's time if this man provides everything he needs for him (subsistence economy). First of all, he will spend time on production of the goods which he deems to be important, then he will find time to create other goods.

If the man's budget is limited (the same can be said about his time budget), he does not acquire all the desired goods but only the most necessary ones.

Which goods are indeed first priority and which ones can be acquired as second, third, etc. priority? The ideas about the priority in satisfying the needs (and, consequently, acquiring the goods connected with these needs) are well reflected in the theory of human motivation by Abraham Maslow (2012). This theory is known as Maslow's hierarchy of needs.

«We can quite definitively say that the need for safety is stronger than the need for love... Physiological needs ... are more vital than the need for safety which is stronger than the need for love which, in its turn, is stronger than the need for esteem, which is stronger than the needs to express one's self identity which we sum up within the framework of one need, i.e. the need for self-actualization... It is exactly this sequence in which the human system makes choices or gives preference» (Maslow, 2012)

From the economic point of view, Maslow's theory means that if the needs of the lower level are not satisfied, then time/money will be spent primarily on satisfying these needs. The needs of the

¹⁰ A thoughtful reader can surmise immediately what follows from this in modern terms: for the living standards to be improved, first one needs «to create unemployment» by raising productivity and then giving the unemployed a job of producing new goods. There is also a less painful option: you need to make sure that people have savings and then come up with something for the people to spend their money on.

higher level will be satisfied if time/money has been enough to satisfy the needs of the lower level.

Thus, for example, if a person does not have enough money even for food, he will not be spending it on sumptuous clothes, jewelry, etc. We shall not dwell on this subject too much as it is obvious enough.

3. Goods of higher position in the hierarchy are valued higher.

Let us try to show that the goods of higher order in the hierarchy are valued higher. Please pay attention to the contradiction: *the goods of higher order are less required, however they are more valuable*. That sounds like a paradox. And we shall consider it now.

I would say this premise is central to the whole theory proposed here. If we are to use metaphors, we can try to prove that with the increase in the quantity of a certain good at the man's disposal, his wealth grows at a constant or even ascending rate rather than at a descending rate (ref. Fig.2).

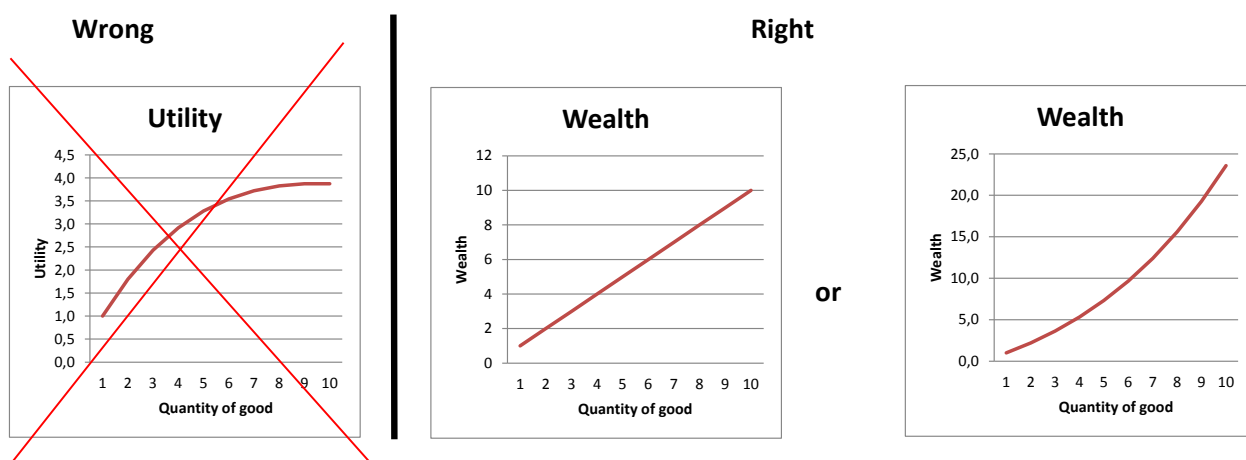


Fig 2. Wealth (unlike «utility») does not diminish with the increase in the quantity of the good available. To use utility to assess wealth is incorrect.

Suppose you need to evaluate the degree of wealth of two peasants who live in isolation, one of whom annually gets one measure of grain, while the other gets 5 measures annually. The simplest answer is that the first peasant is 5 times poorer than the second one! (linear dependence of wealth on the quantity of the good, i.e. the middle part of Figure 2). We shall attempt to prove that wealth does not grow linearly, it grows the way it is shown in the right hand part of Figure 2 (accelerating growth)

3.1. Proof One – through the marginal utility theory.

Let us try to prove it first using the marginal utility theory. We shall use an example similar to those which the classics of marginalism use in their constructions.

We shall consider four peasants who are running their farms in isolation. Each of them annually gets different harvests: the first peasant gets one measure of grain; the second one gets two measures; the third one gets three; the fourth one gets four. Let us assume also that one measure is the exact quantity of grain that the peasant needs to survive.

We shall now introduce a new indicator, i.e. the «degree of necessity». The less the peasant is ready to give away (donate, lose) one measure of grain, the higher this «degree of necessity» is. Let us assume the maximum «degree of necessity» to equal unity (or 100% which is the same thing) – this is the case where a loss of one measure of grain would result in disastrous consequences for the peasant, i.e. in his death of hunger.

For the first peasant who has only one measure of grain, the «degree of necessity» is 100%, or unity. That means that the only measure available to him is needed by him for survival. For the second peasant who has two measures of grain, the «degree of necessity» would be less. That is, under certain conditions, he can sacrifice one of the measures of grain available to him. The third peasant will have a still lesser «degree of necessity» as the third peasant gets three measures. The most minimal «degree of necessity» will be that of the fourth peasant who gets four measures of grain every year.

The «degree of necessity» in our case will be the function of the quantity of good which is decreasing, tending towards zero. It is surprising but this precisely coincides with the manner in which the “marginal utility” function behaves. Marginal utility also decreases with the growing quantity of the good available (Fig.3).

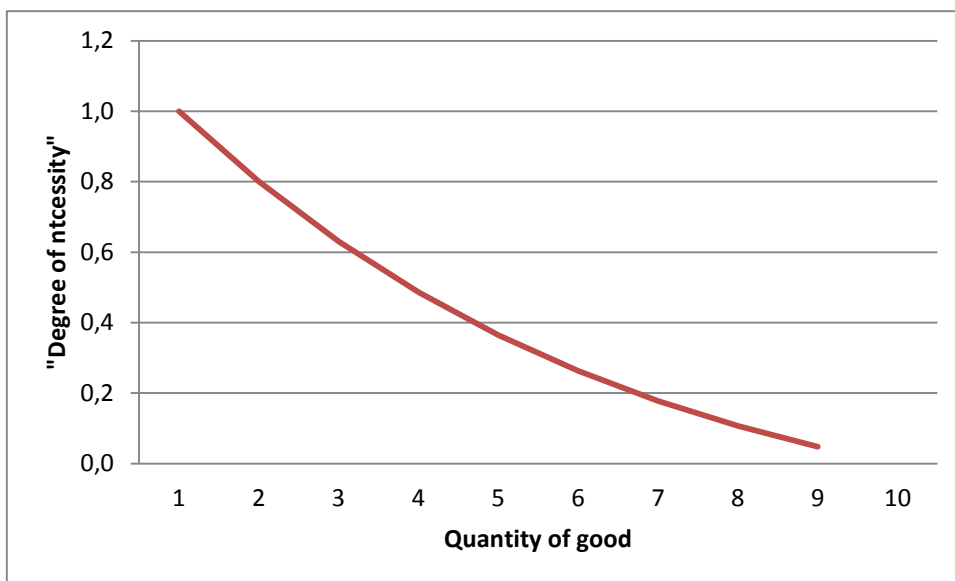


Fig. 3. «Degree of necessity» decreases with the increasing quantity of the good available the same way as «marginal utility».

Now let us think the term «necessity» through. In the Russian language (incidentally, just as in many other languages) this word is synonymous with «poverty», «squalor». For example, the English word, apart from other meanings, means both «necessity» and «poverty»¹¹.

In our example with the peasants, the meaning «poverty», «squalor», «shortage» is quite applicable. The terms “badly in need”, “in great necessity”, or “in dire need” can be an apt description of the first peasant’s situation from our example, who barely makes ends meet in order not to die of hunger. While «poverty» of each next peasant is less and less.

Using this, let us evaluate the wealth of the peasants discussed in our example. While, as the parameter which characterizes «degree of wealth», we shall try to use the value inverse to the «degree of necessity».

$$\text{«Degree of wealth»} = 1 / \text{«Degree of necessity»}$$

Taking into consideration the type of the «degree of necessity» function, shown in the figure above, we find that the «degree of wealth» function will be increasing. And at least in certain cases, its increment will be increasing rather than decreasing. (Fig. 4).

¹¹ «In Latin *desiderium* means both shortage and desire», points out Montanari (2009, p.203).

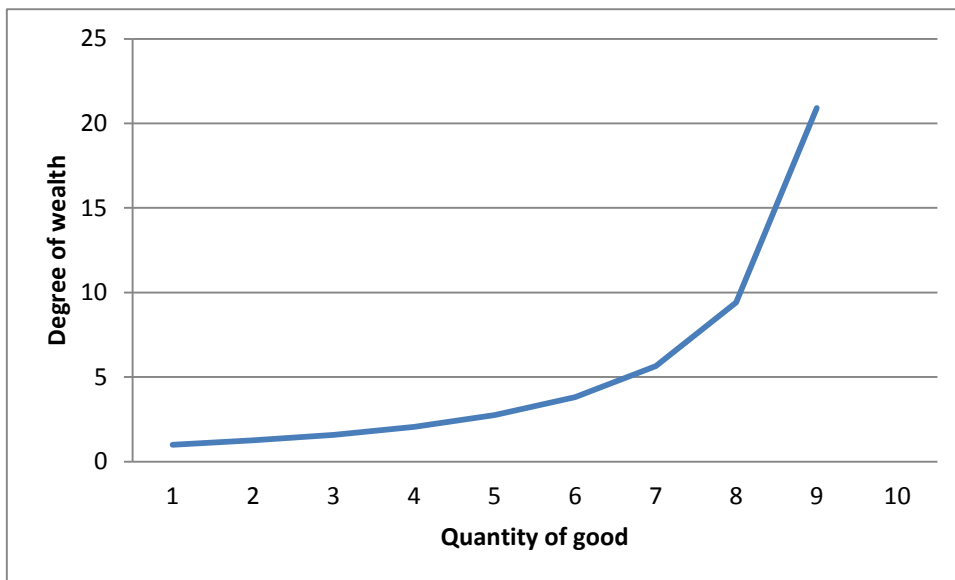


Fig. 4. «Degree of wealth» grows at an accelerating pace because the «degree of necessity» decreases.

3.2. Proof Two – using Becker’s Theory of the Allocation of Time.

So, wealth, unlike «utility», grows at an accelerating pace rather than at a diminishing pace when the quantity of good available to somebody grows. We shall try to prove it using a different approach.

Suppose a man develops a need to do certain work at home (the example of that may be minor repairs or hanging pictures on the walls). The work does not require any special qualifications and can be done on one’s own therefore the man is faced with the following two alternatives:

- Alternative 1. To do it on one’s own. The costs will equal 1 hour of time
- Alternative 2. To call in (hire) a specialist. The costs will equal 100 Rubles.

Which of the alternatives will an economically and rationally minded person choose?

In accordance with Becker’s theory of the allocation of time¹², this depends on «alternative costs», which would enable one to evaluate one’s free time (speaking in simplified terms, «alternative costs» of leisure correspond to the amount of money which the man could gain if he worked instead of this leisure).

Let two persons find themselves in the situation described above: the first person with an hourly income of 20 Rubles an hour, and the second one with an hourly income of 500 Rubles an hour. The first person who makes 20 Rubles an hour, would prefer doing this work at home on his own to avoid paying 100 Rubles. This is logical because in the case of this person using the services of a specialist, he would then have to work 5 hours to compensate for the 100 Rubles spent on paying for the service. To spend one hour to do this work on his own is 5 times more beneficial. The person who makes 500 Rubles an hour would prefer to call in a specialist. And this is also logical because a 100 Ruble charge for the service would be compensated for by working on his regular job for only 0.2 hours (12 minutes). For him it is 5 times more beneficial to pay the specialist than do it himself.

¹² In a less obvious context and without any linkage to the time, this was described by D. Bernoulli (ref. Galperin, 1993) as early as 1738: «For a poor man an income of one thousand ducats is of greater value than for a rich man while the monetary value is the same for both». Or «... in the majority of cases the same gain gives the poor man more benefit than to the poor man».

Now let us present it all in productivity terms. The «productivity» of the first man on his regular job is 20 Rubles an hour. He will do the work himself because that would mean that his «productivity» goes up 5 times up to 100 Rubles an hour. The «productivity» of the second man is 500 Rubles an hour. He would prefer not doing the work on his own as his «productivity» in this case would drop down 5 times to 100 Rubles an hour.

Important corollary: free time is substituted for work if the productivity of its use is no lower than the labor productivity already achieved.

I mentioned above that I was trying to make conclusions as universal as possible. Such conclusions could be applied not only to modern money economy but to ancient natural economy as well. If we try to present our case in terms of ancient economy, then the analogies would approximately be as set out in table 2:

Table 2.

Choice of productivity in money economy and natural economy¹³.

Monetary economy	Natural economy
	Input data:
Rich man, salary is 500 Rbls. an hour	Rich man collects 8 measures of food in 8 hours
Poor man, wage is 20 Rbls. an hour	Poor man collects 1 measure of food in 8 hours
	Alternatives:
To work for 1 hour	To work for 4 hours for 1 measure of food
To pay 100 Rbls. (not to work)	Not to work for 4 hours for 1 measure of food
	Rational choice:
Rich man – to pay 100 Rbls.	Rich man – not to work extra
Poor man – to work for 1 hour	Poor man – to work extra

It is easy to calculate that «the poor man» will begin considering the possibility of extra work when the pay or result from work equals no less than 1/8 measure per hour (1/8 is his current «productivity», obtained by dividing 1 measure of food by 8 hours).

«The rich man» will begin considering the possibility of extra work when the pay or result from work equals no less than 1 measure per hour (this is the «rich man's» current productivity)

Conclusions:

- As the income/productivity goes up each subsequent unit of free time is valued still dearer and dearer.
- Goods acquired/produced in each subsequent unit of (previously free) time, are valued still higher and higher.

Without going into mathematical details, let us note that this means exponential growth, i.e. the growth which at each subsequent moment of time speeds up¹⁴. A graphical representation of this is given in figure 5.

¹³ Assumptions: 1) There are no factors which limit the possibility of working with set productivity (for example, shorter working hours or limited plot of land, etc.). 2) Basic physiological needs have been satisfied, i.e. we presume that the person in the initial situation prefers free time to extra work. 3) By free time we understand the time free from sleep, meals, etc. and physiological needs (discretionary time)

¹⁴ For those keen on mathematical corroborations here is a small model.

1. Let a man, at the moment in time t_1 , work for 11 hours and the production volume for this time equals V_1
2. Before the moment t_2 comes, two events take place
 - a. First, due to a rise in productivity, the man produces the same volume V_1 in only 10 hours. One hour passes from the working time into free or spare time.

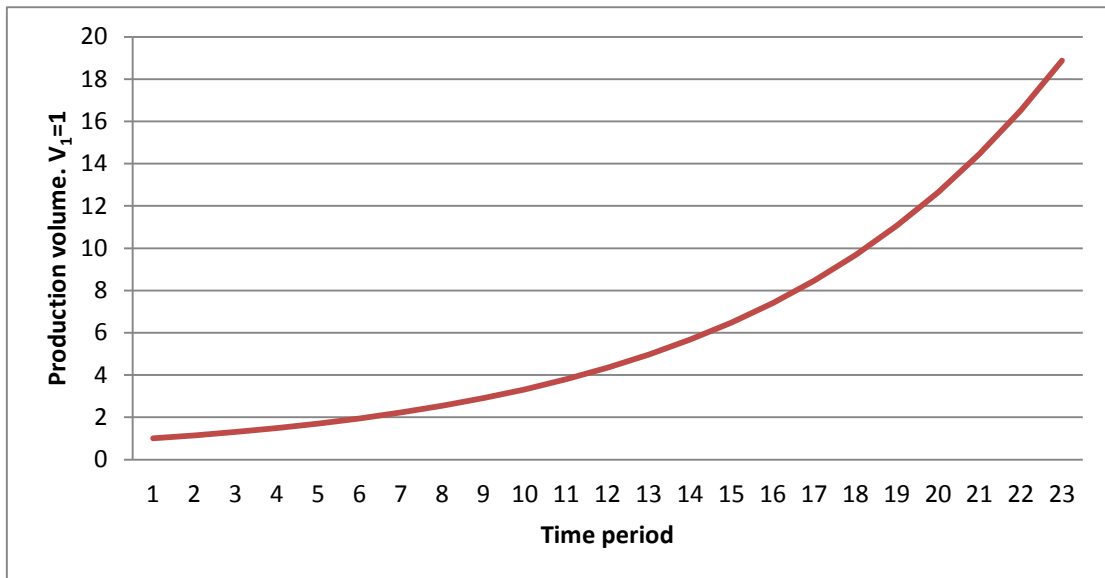


Fig. 5. Exponential growth of productivity.

The production volume in this diagram also reflects the growing wealth. Once again, using a different method, we have shown that the diagram of marginal utility does not reflect real growth of the man's wealth¹⁵.

-
- b. Then, the man finds use for this free time and gradually fills up this hour with work by producing an extra volume ΔV_1 .
 3. At the moment in time t_2 the man is again working for 11 hours. The production volume amounts to $V_1 + \Delta V_1$
 4. Since labor productivity during this extra hour must be no lower than the one achieved earlier (as was previously determined), then

$$V_1 + \Delta V_1 \geq 1,1 * V_1$$
 (coefficient 1.1 shows the ratio 11/10, i.e. it reflects the work during the hour freed earlier from work).
 5. For the general case, the production volume during the time period t_i will satisfy the following condition:

$$V_i \geq V_1 * 1,1^{i-1}$$
 6. In the case of minimal productivity (when instead of the sign «greater than or equal» we shall put the sign «equal») $V(i)$ – this is the exponential function.
 7. In other words, we have shown that growth of wealth/production can be an accelerating rather than a fading one.

¹⁵ An attentive reader will have noted that, strictly speaking, the function is exponential not of the time t , but of i , i.e. the sequence number of the period. For the function to be exponential of time, the time periods between any two adjacent t have to be the same ($t_{i+1} - t_i = \text{const}$). However strange it may be but for purposes of our discussion this does not matter. It does not matter in what time the freed hour of working time will be used to produce goods. It is important that this hour be used with rising productivity.

3.3 Proof Three, empirical.

Using the example of specific goods (grain, meat and beer) let us discuss how a slowing down growth (according to classical textbooks) turns into accelerating growth.

One of the examples of diminishing marginal utility referred to in the textbook of Carl Menger, the classic of marginalism (2005) reads:

«An isolated farmer, after a rich harvest, has more than two hundred bushels of wheat at his disposal. A portion of this secures him the maintenance of his own and his family's lives until the next harvest, and another portion the preservation of health; a third portion assures him seed-grain for the next seeding; a fourth portion may be employed for the production of beer, whiskey, and other luxuries; and a fifth portion may be used for the fattening of his cattle. Several remaining bushels, which he cannot use further for these more important satisfactions, he allots to the feeding of pets in order to make the balance of his grain in some way useful».

The gist of Menger's further thought process is such that the first portion of the grain produces the greatest satisfaction of the farmer's needs, while each next one gives lesser and lesser satisfaction. If we are to use established terminology, we are talking about marginal utility (the term "marginal utility" was thought of later). That is, each subsequent portion of grain has smaller marginal utility than the previous one.

Let us check the value of the equivalent goods at the present day prices. In the cited quotation the first part of grain which is used to feed the farmer and his family is described as the part which is of the greatest marginal utility. The grain used to produce meat and beer is of less marginal utility. But this absolutely is not so if we talk literally about the monetary value of meat and beer!

Table 3.

New methods of using grain increase the monetary value.

Grain and its derivatives	Value of 1 ton of grain's equivalent
1 ton of grain	appr. 6500 Rubles
1 ton of grain = appr. 120 kg of meat at 95 Rbls. per kilogram	appr. 11500 Rubles
1 ton of grain = appr. 2500 liters of beer at 14 Rbls. per liter	appr. 35000 Rubles

The prices are quoted from advertisements in the Internet, Russian data, 2013.

Table 3 shows that the use of grain to produce meat or beer gives a better economic result rather than a worse one!

That is **«greater marginal utility» as a result of a simple check turns out to be quite inconsistent with «great wealth»**, on the contrary: **greater «marginal utility» corresponds to greater poverty!**

«Greater marginal utility» \neq Greater wealth

Using different methods of proof we have arrived at the conclusion that utility is not absolutely indicative of wealth. If with the growth of goods available to somebody marginal utility decreases, wealth, on the contrary, grows at an accelerating rate.

It is not only the utility curve that unwillingly misleads us that it is not indicative of the level of wealth at all. Maslow's pyramid, well known to everyone¹⁶, has the same drawback to it.

Please mind that Maslow's pyramid, for some quirk of fate, visually reflects «utility» (as it is understood in the theory of marginal utility), rather than wealth. That is, the viewer willy-nilly perceives the area of the triangle (into which the pyramid transforms, having been reflected on the plane of the sheet) as some measure of well-being (utility? wealth? happiness?). But this representation shows that each subsequent level brings less to the common pot. That is, having reached the topmost level, we achieve a very small increment. As a matter of fact, this is all exactly the reverse. And having proved the non-declining nature of wealth, we have thus shown that the pyramid will be better indicative of wealth growth if it is turned upside down and looks like a funnel.

I have spent a fairly great amount of this article in order to prove something that would appear to be quite obvious to an ordinary person. It would be especially obvious to those people who had previously had a small income and their income subsequently started to increase. These people understand that we do not buy certain goods *because "we need to have more money for that"*(meaning *"we need to be richer"*) *rather than because «we need these goods less»*.

¹⁶ Let us make a qualification at the outset that Maslow himself does not give the pyramid in his work; that pyramid may have been devised by some of his interpreters.

4. Growth due to depreciation

Let us now proceed with the fourth and last of the key principles of the theory of depreciation. It says: **economic growth is helped by both forms of value depreciation**. We shall now try to illustrate this (Fig. 6)

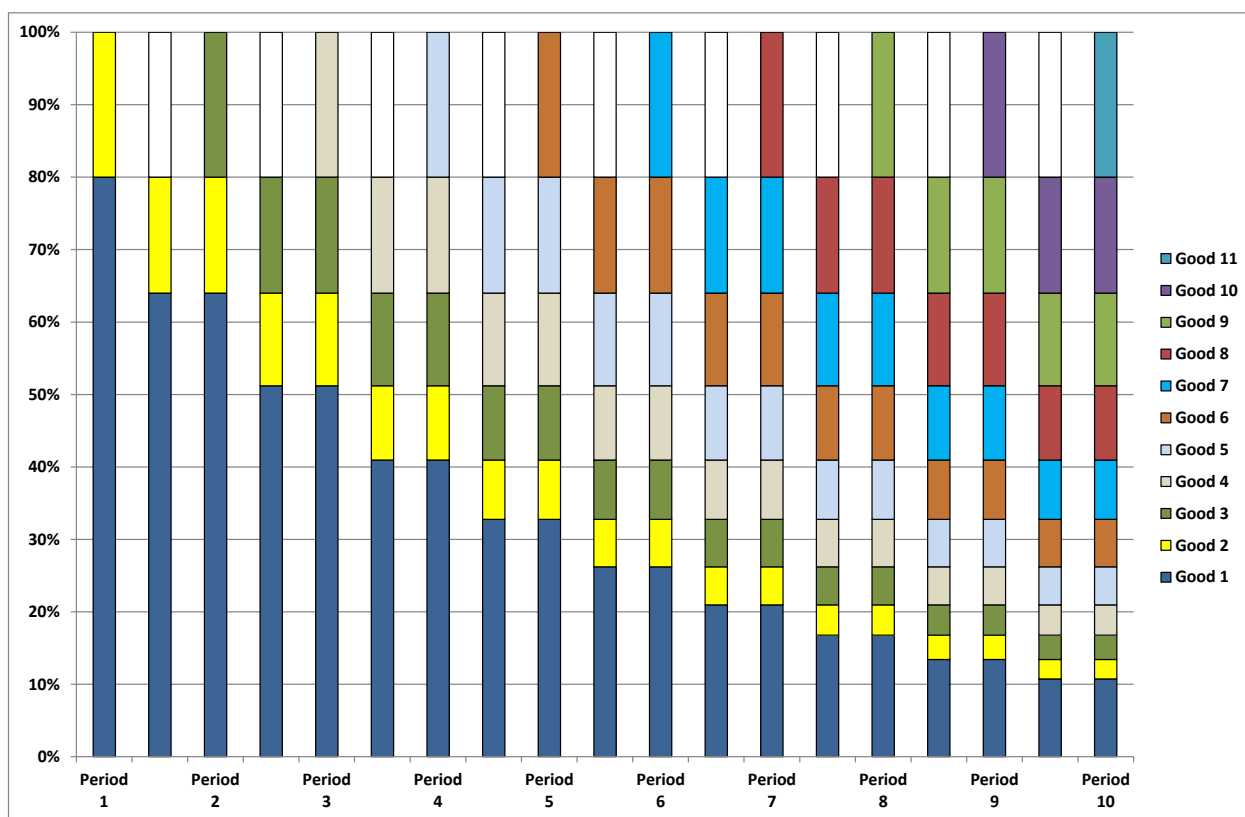


Fig. 6. Depreciation in two forms in the diagram. White color stands for the time liberated due to growth in labor productivity.

This figure assumes a 10 hour working day as 100% (though if you assume an 8 hour working day as 100%, it will not change anything fundamentally).

- In the first time period only two goods are produced (Good 1 and Good 2).
- Then, as a result of growing productivity, one can produce these goods in 8 hours only, while the two hours that are thus liberated are devoted to leisure (leisure is shown in white).
- During the second period, the man starts to produce Good 3, using for that purpose the 2 hours of time liberated earlier.
- Then again, as a result of growing productivity, the time necessary for production of the three goods decreases and two hours of time are liberated.
- During the third period, the two hours liberated for this started to be used to produce Good 4.
- Then this «two stroke» cycle repeats itself.

Each subsequent good (i.e. a «later», «newer» one) in this model has a higher relative value, relative to the goods «acquired» earlier. In a surprising manner this coincides with the way Maslow describes the lowest and highest needs: «From the ... evolutionary perspective, a higher need constitutes a later formation. Whereas the need for food is common to all the living organisms, the need for love is inherent in man only and, possibly, in the highest human like apes, while the need for self-actualization is undoubtedly typical of man only. The higher the need, the more specific it is to man»

It is clear that any model is only a simplified representation of actual reality. Therefore, several important qualifications ought to be made:

1. **«Flexibility» of free time.** In the model described above, the man, in order to start producing the next good, absolutely has to liberate (as a result of growing productivity) the time inside the time period allocated for work (10-hour period in the example). In the long term perspective, this is so indeed. However, in the short term perspective, the man is able to begin to produce an additional good outside the limits of this (10-hour) time period, just by re-distributing the leisure time in favor of work.
2. **Disproportional reduction of the time spent.** In the model, at each subsequent step, the time spent on the goods produced earlier decreases proportionally. In reality, everything may also happen in a different way. Time savings may be achieved by reducing the time spent on just a portion of the goods or even on one good instead of all the goods.
3. **Importance of saturation.** In our model, everything looks as if any good started to be produced in the volume sufficient for saturation. Actually, if saturation with a specific good has not happened, then with further growth of productivity, the time (money) spent on the good may increase rather than decrease. This is precisely why, if the man had previously only lived from hand to mouth, he will not stop hunting for (acquiring) food, if his productivity (income) suddenly goes up. He will continue increasing production of food until he has reached greater saturation.

Let us imagine that Good 1 (in figure 6 it is shown in the blue color) is food. Then, the 1-st period will approximately correspond to the society in which about 80% of the time is spent on producing «daily bread». While period 10 will approximately correspond to modern developed countries, in which food costs account for approximately 10% (in the USA this indicator is slightly less than 10%, in West European countries it is a little higher). On the whole, the tendency for reduced proportion of food costs with rising income is Engel's law, well known in economics (or Engel's effect).

The model, very close «in spirit», in his work “Future of paper in the telematic world” was elaborated by Jan Rennel. Unfortunately, I was not successful in finding this work. Here the model is given per www.fao.org (Fig. 7)

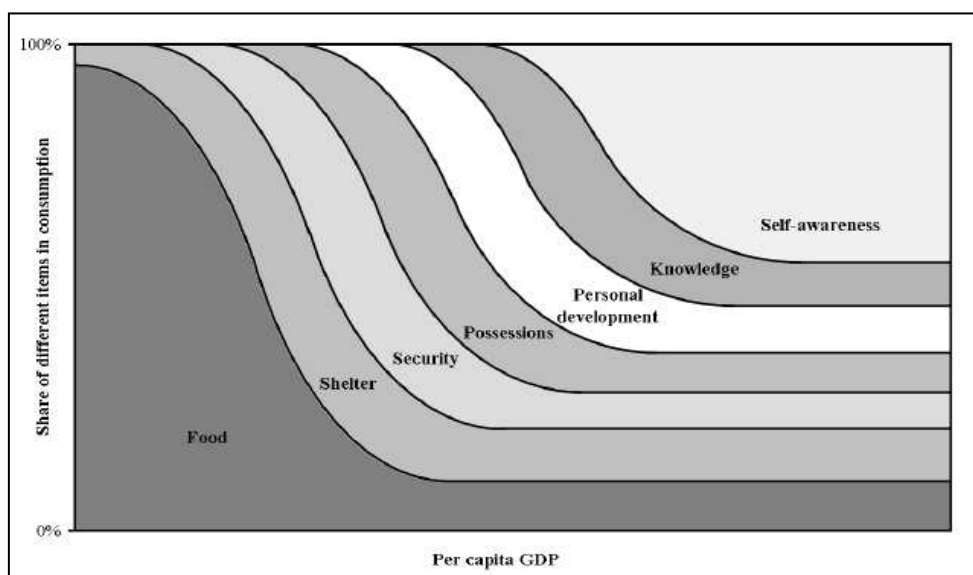


Fig. 7. Jan Rennel's model.

Source: <http://www.fao.org/docrep/008/ae428e/ae428e03.htm>

Jan Rennel’s model differs slightly from the model proposed by me (ref. Fig. 6), but I have not been able to find anything closer than that.

In Table 4, let us continue with our analogies (ref. above Tables 1 and 2), based on the materials that we have just discussed.

Table 4.

«Two stroke» cycle of growth in the money and natural economy.

First stroke: availability of extra free time as a result of growing productivity. Second stroke: filling up the free time by producing additional goods (greater value).

Ancient natural economy	Money economy
All working time is used	All the money earned is spent
Growing productivity of individual labor	Growing wages and salaries and/or price reduction
Additional free time becomes available	Options (their combination is possible): <ul style="list-style-type: none"> • Unspent (spare) money becomes available (savings) • Working day gets shorter. • Unemployment increases.
Free time is used to produce new goods	Options (their combination is possible): <ul style="list-style-type: none"> • Money is spent to purchase new goods • Working day gets longer • Unemployment decreases

So, we shall recapitulate the principal postulates of the value depreciation theory:

1. Values depreciate:
 - a. as the amount of time, it takes to produce/acquire these values, decreases
 - b. as the liberated time is used to produce additional goods.
2. Goods are produced/acquired in accordance with a certain hierarchy from the lowest to the highest level.
3. Goods with a higher position in the hierarchy are valued higher.
4. Economic development/growth is helped by any depreciation of the value.

Part two. Practical examples showing how the theory is applied.

1. Causes of the British Industrial Revolution.

Despite the fact that the British Industrial Revolution took place about 200 years ago, its causes have been under discussion ever since. I shall not list all the causes which are mentioned by many authors as there were more than just one reason why it had happened. I shall just refer to the two inter-related causes which are explained by the theory of value depreciation: the advantages of exchange and depreciation of the value of textiles.

1.1. Advantages of exchange.

Suppose there are two countries: Country *A* and Country *B*, where 5 million people in each country are engaged in productive labor (the balance being children, family members, etc.).

At the first stage, in both countries the food produced is just enough to keep the population fed and there is no surplus, with all the people being busy all their working time.

At the second stage, there occurs a leap in productivity. In each of the two countries, the work done by four million people is already enough to provide enough food for the country. One million people capable of work are made redundant in each country and can now produce additional goods. According to the theory of value depreciation, these goods will be valued higher. But as between the countries there is a possibility of exchange, two extreme scenarios for role distribution are possible between them (the remaining multiple scenarios are intermediate ones).

Scenario 1: the countries begin producing the goods of the next level on their own, independent of each other, without using the opportunity of exchange. This scenario presupposes parity in the economy of the two countries (with everything else being equal). We will not be considering that.

Scenario 2: one country (suppose, Country *A*) begins specializing in production of new goods. Let us consider this scenario. To facilitate understanding, let us assume that country *A* begins specializing in the manufacture of fabrics (new good), while country *B* continues specializing in production of food and all the surplus food is exchanged for fabrics as part of the process of trade with country *A*. The key factor in the exchange will be the working time spent on production of the goods taking part in the exchange.

Let fabrics in the quantity of *X* be equivalent in the exchange to food in the quantity of *Y* (units of measurement in this case do not matter to us). Suppose production of fabrics in the quantity of *X* in country *A* takes 10 hours of working time. At the same time, production of food in the quantity of *Y* in country *B* takes 20 hours of working time. This ratio (productivity in country *A* is twice that in country *B*, if they are reduced to the equivalent), in particular, will play a decisive role in the well-being of the countries after the exchange.

During the process of exchange, the food (the product of work done by 1 mln. people in country *B*) will be exchanged for fabrics (the product of the work done by 0.5 mln. people in country *A*).

After the exchange, there will be the following distribution of goods between the two countries:

Country *A*:

- Food (product of the work done by 4 mln. people) – the country's own production.
- Fabrics (product of the work done by 0.5 mln. people) – the country's own production
- Food (product of the work done by 1 mln. people) – obtained as a result of exchange with country *B*.

Note: fabrics (product of the work done by 0.5 mln. people) transferred to country *B* as a result of exchange.

Country *B*:

- Food (product of the work done by 4 mln. people) – the country's own production
- Fabrics (product of the work done by 0.5 mln. people) – obtained as a result of exchange with country *A*.

Note: food (product of the work done by 1 mln. people) was transferred to country *A* as a result of exchange.

In this example, where two countries are considered, any further exchange is impossible as country *B* has fully used up the free resources (food – the product of the work done by 1 mln. people) for exchange.

It is clear that country A, as a result, is the winner: it has additional food – the product of work done by 1 mln. people. Country B has turned out to be in a less advantageous position as a result of the seemingly equivalent exchange.

Country A can use the food obtained additionally by one method only: by making redundant 1 mln. people (out of four million engaged in country A in production of food) to produce additional new goods, may be more valuable than fabrics. Key to the success of country A has been higher productivity of one hour of time¹⁷.

Suppose there are other countries like country B which have surplus food (or can produce surplus food). Or country B has a population of 30 mln. people rather than 5 mln. Then country A can relocate one million people made redundant (due to the food import) from food production to the same production of fabrics for exchange with these countries. More highly productive labor (fabrics) in country A will be replacing less productive labor (food) and the country will be gradually producing less food and will be more and more specialized in producing more and more valuable goods.

If you now imagine that country A in our hypothetical example is England, you will see several key coincidences with the actual picture of the British Industrial Revolution of the early 19-th century.

1. England continuously increased the percentage of import in the food consumed. England's own production of food (particularly, grain) was invariably falling down, especially as a result of cheap imports. At the end of the day, import started to cover 75-90% of England's requirement for key foodstuffs.
2. There were countries which had surplus food (due to growth of crop yield and acquisition of new lands) and ready to supply it to England (Russia, U.S.A., Germany, Poland and others). Competition in the grain market developed to such an extent that at the end of the 18-th century there happened the so-called «grain» crisis, when the prices for grain fell sharply, primarily due to deliveries of cheap grain from the USA.
3. The countries unprotected from supplies of industrial products from England started to fall behind England significantly in terms of economic growth rate. The benefits of exchange were responsible for England's noticeable acceleration in growth which took place after the end of the Napoleon wars and the lifting of the so called «continental blockade», which impeded the English trade in the continent.

Clark cites the following data (2013, p.442): «In 1913, the percentage of the population engaged in agriculture in the U.K. was 8% . In Romania this number was 80%, whereas in Bulgaria it was 82%».

¹⁷ Please try to examine a modern example: If an inhabitant of a developing country, who makes 1 thnd. dollars a month, buys a tablet computer at a price of 1 thnd. dollars (the labor intensity of manufacturing which equals, in the most extreme case, several hours, while it is most likely to be measured in minutes), one can easily imagine how disadvantageous for the buyer country such international trade is (monthly working time fund with an 8-hour working week equals approximately 150-160 hours).

1.2. Depreciation of the value of textiles.

Underlying England's success was significant reduction in production time of manufactured products, primarily fabrics. This is value depreciation in our terminology.

Throughout the entire Middle Ages, fabrics in Europe were very expensive. And this applied not only to the fabrics from India and China which were a luxury. Common people used to wear home woven clothes, sometimes throughout the whole life a man would change only 3-4 sets of clothes. While dress clothes, people's best wear would pass on from parents to children as heritage.

England, thanks to mechanization of spinning and weaving processes and the use of steam energy, was the first to be able to change this situation. It is exactly this advantage in productivity that made it possible for England to use the advantages of trade with other countries.

The following is what Friedrich List wrote about England in 1844 (2005, p. 68)

«Its factory and plant industry, in terms of its importance, surpasses some of all the other nations. Despite the fact that, since Jacob I its cloth manufacturing industry has multiplied more than ten times (44.5 mln pounds sterling), another new industry which has been developing during the last century — cotton making industry — reached still greater dimensions, i.e. 52.5 mln pounds sterling. Not being content with that, it now intends to elevate its flax industry in which England has been, for a long time, lagging behind other nations, to the same level, if not higher, as the two above mentioned industries; its productivity in this respect already reaches 15.5 mln pounds sterling... It is now producing more silk than all the Italian Republics of the Middle Ages taken together, i.e. 13.5 mln pounds sterling's worth of silk»

What is the result? England, having significantly increased the productivity of textile industry (and not only that industry), created growth opportunities inside the country. This is consistent with the value depreciation of the first form.

However, while supplying these goods to other European countries which were agrarian at that time, it performed in it value depreciation of the second form. In other words, these countries (as represented by their aristocracy), which previously did not have any incentives to produce more food, obtained these incentives in the form of possible exchange for English goods. They started to prefer "work" to "leisure". This was consistent with value depreciation of the second form.

Opportunities for exchange considerably boosted England's growth having operated, as it were, as some kind of leverage.

Conclusion.

The example given above goes to show that the theory of value depreciation can be applied to shed light on a number of issues pertaining to the economic history, the theory of economic growth, the theory of international trade and many others. It may be successfully applied to explain the so called «Solow residual». Using the theory of value depreciation one can explain the fallacy of the «declining marginal productivity» in macroeconomics. However, these are the topics for further articles.

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