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ТЕОРЕТИЧЕСКИЕ И МЕТОДОЛОГИЧЕСКИЕ ПРОБЛЕМЫ

Analysis of marginalism. Part 2

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Abstract. In recent years, based on the traditional theory of value — the labor theory of value and the theory of surplus value, as well as the hypothesis of Jevons, Tesla and Foley, — Chinese and Russian scholars have further adopted the mathematical paradigm of theoretical mechanics for reference to establish a mathematical model system for economics, which is called the New theory of value. Compatible with the traditional theory of value, the new theory of value puts forward the idea that the value depends on the force of labor expended in the process of commodity production, and the value appreciation depends on the labor gravitational force generated by the improving dexterity of workmen. That is to say, during the process of production, constant capital and variable capital as kinetic energy and potential energy of value, convert into each other under the value conservation theorem, playing a dominate role in generating value and surplus value of products. In addition, the law of diminishing marginal utility is not an axiom, but a special economic law under unbalanced supply and demand. Obviously, these theoretical conclusions are of great significance, which not only make the traditional theory of value a self-consistent logical system, but also complete the New theory of value by absorbing the rational components from both the classical economics based on the labor theory of value and the theory of surplus value, and the neoclassical economics based on the law of diminishing marginal utility. In this paper, we will analyze this problem by investigating the origin of the law of diminishing marginal utility.

Keywords: new theory of value, force of labor, labor gravitational force; law of value equilibrium; law of diminishing marginal utility; self-consistency.

JEL Classification: C62, D46, D58.

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3. INFLUENCE OF MARGINALISM ERRORS

3.1. Leading mainstream economics into the wrong direction of subjective utility theory of value

The marginalism also completely denied the traditional theory of value, which led the mainstream neoclassical economics into the wrong direction of the subjective utility theory of value, and also misguided the entire human economic practice into the quagmire. Specifically, after the marginal revolution, neoclassical economics gradually established an economic theoretical system based on the utility theory of value that was first proposed by Wieser, the successor of the Austrian school founded by Menger. According to F. von Wieser (Wieser, 1889, Preface), the value of commodities "comes from the satisfactions of wants which commodities assure" and subjective psychological evaluation of the utility of commodities, and the utility

value is determined by marginal value. Clearly, from the basic axioms to theoretical conclusions, the utility theory of value is sharply polarized from the labor theory of value, so that the latter must be completely denied. However, this was the error of Wieser, the subjective utility theory of value, even the marginalism. In fact, the theoretical conclusions derived from the basic axioms formed on the subjective utility theory of value are inconsistent with the objective economic reality, leading to unreasonable economic consequences in the social economic practices.

However, according to Axiom 1 in the new theory of value, a commodity with value is required to have use value first and then to be a product of labor. In order to meet the natural need of the physical body, man has to consume external useful things, which realize the utility of external useful things, then man will transform the utility of useful things into the force of labor consumed in the production process through the physiological metabolism of his body, and then compensate the force of labor consumed in the production process by consuming the useful things one again, so as to maintain the force of labor and to satisfy the needs and utilities.

It can be seen that the ultimate measure of use value will not be human's subjective wants, but instead the rational demand. Here, men have direct and indirect needs. The former refers to the natural needs for the means of subsistence, where the natural needs come from human physiological body (Aristotle, 1999, p. 24–25), while the latter refers to the needs related to working process and political activities. All indirect needs are ultimately rooted in direct needs. Down to natural needs that must be expressed in the form of certain subjective wants, they are either rational demands or irrational delusions. However, subjective wants should be within the upper and lower bounds of rational demand in any case, otherwise there will be subsistence crisis. Also, various subjective wants, deviating from the rational demand, no matter in what different forms, will always fluctuate around the rational demand, with the weighted average value ultimately tending to the rational demand (Wu, 2012, vol. I, p. 142–143). Therefore, rational demand is the only measure of utility value.

It must be pointed out that, if subjective wants were used as the measure of value of commodities, it would allow the harmful products to endow with market value, so that these products like drugs, weapons, common products and so on would become legal commodities. In this case, wrong economic theory would induce harmful consumption habits and irrational demands and desires, such as drug abuse, alcohol abuse, sexual indulgence, excessive diet, excessive medical treatment and so on. In particular, guided by Keynesian economics that extra work also creates value, on the one hand, it encouraged production of surplus products, on the other hand, it implemented quantitative easing policies to stimulate consumption and create false demand, resulting in huge waste of human labor. Just like a magic broom in a fairy tale, that went out of order one day, it kept providing endless extra services, and ultimately brought a disaster to its owner. The subjective utility theory of value regards satisfactions of the illusory and irrational subjective wants as legal means of capital profit, including the huge profits gained by the military-industrial complex of a country in launching a foreign war at the expense of the lives of other countries; the excess profits obtained by biochemical companies at the cost of harming the health of consumers through the production of low-quality foods to reduce production costs; the excess profits earned by pharmaceutical companies at the cost of endangering the life safety of patients by producing viruses and drugs at the same time, and so on, which finally makes itself an economic theory that misguides more silly and disastrous mankind behaviors.

3.2. Hindering the study of the universal measure of value in economics

The subjective utility theory of value attached great emphasis to the utility on value, complementing the overlook of use value in the traditional labor theory of value, which indeed has contributed to a theoretical progress. However, it was absolutely correct by mistakenly rejecting the traditional labor theory of value. According to the subjective utility theory of value, the utility value depends on satisfactions of wants, which will vary in evaluation of the same commodity by different people, so that it is impossible to find a universal subjective measure of the utility value. Therefore, it was concluded and acknowledged by the utility theory of value that the utility value cannot be measured (Say, 1803, p. 26). Henceforth, the study of the universal measure of value in economics was seriously hindered.

It must be acknowledged that in the history of economic theory, the universal measure of value was always an outstanding issue. In the period of classical economics, A. Smith (Smith, 1776) tried to use labor as a universal measure of value. However, D. Ricardo (Ricardo, 1817, ch. 1, sec. 6) found that labor productivity is always changing. So, it is difficult to find the universal measure of value. In addition, K. Marx (Marx,

1894) pointed out that the concept of labor value defined by Smith was ambiguous[1] and could not unify the measure of value under the assumption that labor determines value and labor creates surplus value and profit. However, Marx's opinion on the solution to production price that spontaneous capital competition can average the profit rate and eliminate the difference between the surplus value rate and the average profit rate of industries with different organic compositions of capital was questioned, arising a well-known long-term debate on "value transformation" in the history of economic theory. Therefore, E. von Böhm-Bawerk (Böhm-Bawerk, 1896) believed that there was a contradiction between the first volume and the third volume of "Das Kapital", which was hard to convince. Then in the period of neoclassical economics, in order to complement the deficiencies of the traditional labor theory of value, L. Walras, W. Jevons, K. Menger and F. von Wieser proposed the utility theory of value based on the law of diminishing marginal utility. Although the existence and stability of the general equilibrium price can be proved, due to the individual demand preferences, individuals vary the measures for evaluating the utility of the same commodity. Then according to K.J. Arrow (Arrow, 1951), there is an "impossible theorem" of the utility value order relation converting from individual preference to social preference. On this ground, the relative universal measure of value for satisfactions of different individual demands can only be found in partial order (Debreu, 1959). Finally K.J. Arrow and G. Debreu (Arrow, Debreu, 1954) drew a conclusion that the utility value could not be measured by a universal measure of value, which in the following time was gradually acknowledged by neoclassical economics.

Is it true that the value of commodities cannot be measured? This is not the case. We believe that just as the forces in the physics can be accurately measured, so can the values of commodities. According to the new theory of value (Wu et al., 2020), the value of commodities consists of labor value and use value, which depends on the forces of labor consumed and compensated, formulated by the three basic quantities of value — quantity, quality and time — in the form of acceleration of economic motion during the production and consumption of wealth.

Here, the production and consumption of wealth are cyclical economic process. Then, a value complex variable function of ordinary differential equations was established, including labor value and use value with the three basic quantities of value — quantity, quality and time. That is to say, if investigating both quantity and quality of products in the ongoing production process, also considering the consumption and compensation of the force of labor, both labor value and use value, then the functional form of commodity value will be converted into the complex form of an ordinary differential equation of value, — that is, the value of wealth has both real and imaginary parts, where the real part is the labor value, and the imaginary part is the use value. Therefore, the value of commodities is expressed in the form of an independent function. Also based on the above discussion, the complex variable function of commodity value was strictly proved to be second-order differentiable under the conditions of the first-order differentiable holomorphic function and the second-order differentiable harmonic function. In this case, the complex variable function of commodity value will have global optimal solution (Wu J., Wu Z., 2021).

Comparing the subjective utility value function based on the law of diminishing marginal utility with the value complex variable function based on the new theory of value, we can easily find that the latter is more reasonable. Here, the theoretical progress is seen in two aspects: one is the value of commodities depending not only on the quantity, but also on the quality of products. The other is the force of labor, derived from the quantity and quality of products, able to convert into both labor value and use value. In this case, the new theory of value absorbs and integrates the rational components from both the labor theory of value of classical economics and the utility theory of value of neoclassical economics.

3.3. Misunderstanding Marx's theory of production price

Production price is an important component of Marx's theory of surplus value. According to Marx, production price is a transformation of commodity value in the process of capitalist social production. In the production process of a single product, the value of constant capital is converted into cost according to the original price, but variable capital — "living labor power" (Marx, 1867, vol. 1, ch. 10) — creates surplus value on the basis of the original price. In particular, in the process of simple reproduction, the circulation of capital not only brings about surplus value, but also maintains the conservation of value. Therefore, let c be constant capital, v be variable capital, m be surplus value, I be products of Department I, and II be the products of Department II. Then in the process of social reproduction, the conservation of value in simple

[1] According to A. Smith (Smith, 1776), the value of commodities depends on three factors with ambiguity: 1) the quantity of labor spent in the production (ch. 5); 2) the quantity of labor which enables the laborer to purchase or command (ch. 5); 3) wages, profit and rent (ch. 6).

reproduction will be expressed as: $I(c+v+m)=I(c)+II(c) \Rightarrow I(v+m)=II(c)$. Similarly, in the production of multi sectors (multi industries), surplus values and the rates of surplus value, profits and the rates of profit will vary in different sectors according to different composition of capital (Marx, 1894, vol. III, ch. 10). In fact, the economic laws in the total production of multiple sectors are the same as that in the production of a single product. Also, the theoretical logic of Volume I of "Das Kapital" is consistent with that of Volume III, demonstrated in details by F. Engels (Marx, 1996, vol. III, Supplement; first published in 1867). Later, over the past 100 years, Marxist scholars represented by L. von Bortkiewicz did a lot of work comprehensively and deeply on this problem and made positive conclusions[2].

Looking back into the history of economic theory, the theoretical difficulty of value transformation lies in the understanding of the economic law of conservation of value in the capitalist social production (Marx, 1894, vol. III, ch. 10, Supplement). Marx clearly pointed out that in the process of capital movement, the production price of commodities fluctuated around and tended to the labor value; the result of the whole capital operation is: the sum of surplus values = the sum of average profits; and the total production price of all commodities = the total value of all commodities. Therefore, this led to the conservation of value in the capitalist social production. That is to say, in the social production, on the one hand, capitals in different sectors yield surplus values; on the other hand, the social production does not increase the total value of commodities. In this way, it seems to be a logical contradiction of "square circle": since the value of commodities depends on the average labor necessarily consumed in the production, as well as a value appreciation, namely surplus value,— why this value appreciation does not bring an increase to the total value in the simple reproduction. For this conclusion, some marginalists like A. Loria are difficult to understand, and exclaimed that it is a logical contradiction that labor determines value and creates surplus value (Marx, 1894, vol. III, Supplement), that is, Volume III of "Das Kapital" denies Volume I. This is obviously wrong.

Probably, the conservation of value in the process of value transformation is one of the most abstract and misleading economic problems in the history of economic theory. While in theoretical mechanics, the conservation of energy is a common sense, although which still had to overcome many difficulties was recognized and understood during the history of scientific development. For example, two objects with different weights falling from the same height will reach the ground at the same time, the Brachistochrone line is an arc, and etc., which is proved by scientific experiments. However the objective laws hidden behind them are all against human daily life experience, so that there was a long journey full of tortuousness and controversies to understanding these objective laws. To be specific, in the process of free falling, the potential energy of the particle is converted into kinetic energy, so that the particle reaches the ground with acceleration still under the law of conservation of energy.

So does Marx's theory of production price reveal the economic law of conservation of value. That is to say, according to the axioms of surplus value, value and surplus value depend on the force of labor and the labor gravitational force respectively, then in a conservative system of value, there is conservation of energy of value, expressed as the value Lagrangian function (Wu et al., 2020, Axiom 4): *the first derivative of value kinetic energy + the first derivative of value potential energy = 0.* Therefore, although the simple reproduction yields surplus value, its total value always maintains constant. Here, it should admit Marx's genius in independently deducing the conservation of value for production price from surplus value theory without reference to the Lagrange function. However, some economists such as Loria and Böhm-Bawerk (Böhm-Bawerk, 1896), without any patience to understand the connotation of Marx's theory of production price, rushed to conclude that the Volume III of "Das Kapital" negates the Volume I, which was close to Marx's system. Unfortunately, although the conclusions by Loria and Böhm-Bawerk were wrong, the traditional theory of value was forced to leave the center of the world economic stage for more than a century. It can be seen that in the history of economic theory, there were more twists and difficulties to understand the conservation of value than those in theoretical mechanics to understand the conservation of energy.

Here are four key points for better understanding the conservation of value in value transformation.

A. *The relationship between the force of labor and the labor gravitational force in the formation of commodity value*. It is noted that when Marx put forward the theory of surplus value in the first volume of "Das Kapital" (Marx, 1867, ch. 5–6). He pointed out that "surplus value" is the product of workers' unpaid labor, i.e. the value created by "living labor" exceeds "the value of labor power", which we call "Marx's second law". Here, it is controversial that "surplus value" is the product of workers' unpaid labor — which is not a conclusion deduced from

[2] (Bortkiewicz, 1952, first published in 1906–1907; Bortkiewicz, 1949, first published in 1907; Sweezy, 1942, 1949; Winternitzv, 1948; Meek, 1956a, 1956b, 1961; Seton, 1957; Morishima, 1973, 1974a, 1974b; Zhang, 2001, 2004; Bai, 2006; Ding, 2012) and other scholars analyzed this problem from different perspectives.

any certain axiom. But a large number of cases of capitalists exploiting workers as evidence for the theoretical proposition that labor creates surplus value. In this way, it fell into a logical contradiction of circular argument in theoretical deduction. Scientifically, any proof should clarify the logical relationship between theoretical propositions and cases. However, Marx did not clarify this in the Volume I of "Das Kapital". In order to make up for this deficiency of Marx's theory of surplus value, the new theory of value put forward Axiom 4, that there must be a labor gravitational force in the labor process (Wu et al., 2020), so as to logically prove the theoretical conclusion that the force of labor creates value and the labor gravitational force creates surplus value.

Accordingly, we can further draw two conclusions: one is the labor productivity of a certain commodity always increasing under the labor gravitational force — the acting force of improving skill and dexterity of workmen. The other is the value of commodities always being equivalent in any period of time under the law of conservation of value that the values of labor products in different periods of time will not change with the labor gravitational force, but change only the composition of value, i.e. the rate of surplus value — the ratio of labor cost to surplus value. In other words, in the simple reproduction, production prices of commodities are constant. Here, the average force of labor necessary consumed for the same commodity will not change with the improvement of labor productivity. Because the force of labor saved by the improvement of labor productivity is used to produce more surplus products, and the production price of the commodity consists of cost and surplus value[3].

B. *The improving skill and dexterity of workmen*. Only understanding that the labor gravitational force does not change the value of commodities, can we comprehend the compatibility between Marx's two axioms that value and surplus value depend on the force of labor and the labor gravitational force respectively. According to the law of conservation of value, the labor gravitational force creates surplus value due to the mankind intelligence and wisdom, which helps improving skill and dexterity of workman as the production of a single commodity repeats and continues. Therefore, labor can create surplus value. However, there is no value appreciation during this process since the labor gravitational force does not require more labor cost of a workman[4].

There is inverse ratio between the spent force of labor and the improvement of labor productivity. Here, the rate of surplus value, or the average rate of profit of this commodity (Wu et al., 2020, Theorem) changes. In other words, in the scenario of the same division of labor for the production of the same commodity, although the measure of commodity value is the average of forces of labor necessary consumed by all workmen, which does not prevent someone with higher intelligence and wisdom than the average from getting more remuneration by producing more products within certain labor time. In this case, with the same organic composition of capital, the forces of labor are located in the same inertia system of capital quality. Although there are both complex and simple labors in the consumed average labor necessary, one unit force of labor consumed in the complex labor process can be converted into times of that in the simple labor process[5]. Despite this, it does not mean that complex laborers pay the same force of labor to generate more labor value. To obtain corresponding labor capacities to complete their work, complex laborers pay more price — training and learning costs — than simple laborers, for complex labor requires higher proficiency and qualification.

C. *The universal measure of value.* According to the law of conservation of value, under the ever-changing labor productivity, there is a universal measure of value of commodities. To be specific, from the axiom that the force of labor determines the value, it can further conclude that the size of the module of vector of the force of labor is the measure of labor value and use value of commodities (Wu J., Wu Z., 2021). Then, we can construct a Riemannian metric manifold of commodity value in the complex domain. In this case, the Riemann metric of the complex domain is the universal measure of value[6]. In the complex Riemannian metric space:

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[3] See Theorem 1 in new theory of value (Wu et al., 2020) for mathematical argumentation and analysis. Actually, it is not easy to understand the logic relationship implied in the above conclusions. In this regard, Ricardo (Ricardo, 1817), drew a contradictory conclusion that wealth increases but value decreases. This is essentially "an apple falling from the tree" in economics. Everyone knows that when the apple is ripe, it will fall from the tree. However, in the thousands of years of civilization before I. Newton, no one explore that the apple falls due to a profound law of gravity. Here, for value transformation, the real difficulty lies in the fact, that the labor gravitational force improves labor productivity and creates surplus value, without spending more labor costs,— just like the gravity attracting the apple falling down with acceleration but without any other force.

[4] The basic nature of labor gravitational force is that it does not come from the force of labor. Just like the conservation of energy during the free falling movement, with the labor gravitational force, the labor productivity improves in the labor process, yet with no more force of labor.

[5] It should be noted that in industries with different organic compositions of capital, the mutual conversion between complex and simple labors will never be so simple, which needs to be in line with the below principle of equivalence of value.

[6] The core of post-Keynesianism is Sraffa's theory of value. According to P. Sraffa (Sraffa, 1960), the traditional labor theory of value failed to solve the problem of universal measure of value under the ever-changing labor productivity, then even worse, neoclassical

• if the quality or quantity of commodities is a constant, and the Riemannian curvature is zero, the measure of commodity value is an Euclidean metric, under the constant labor productivity. Here, the commodity value is a convex function in the Euclidean metric space and a normed linear function in the normed linear space (Wu J., Wu Z., 2021);

• if the quality or quantity of commodities is a constant, and the labor productivity changes under a second order homogeneous condition, the measure of commodity value is a Riemann metric of the Riemann metric space in the wealth value differential fiber bundle of the real domain. Here, the commodity value function is Lie groups in various forms (Wu, 2012, vol. II, p. 38–70);

• if the quality or quantity of commodities is a variable, and the labor productivity changes under a second order homogeneous condition, the measure of commodity value is a Riemannian metric of the complex Riemannian metric space in the wealth value differential fiber bundle of the complex domain. Here, the commodity value is a complex variable function in the complex domain, consisting of the quantity, quality, labor value and use value of commodities (Wu J., Wu Z., 2021).

The above research results helped to provide a preliminary solution to the problem of universal measure of value with ever-changing labor productivity pointed out by Ricardo in the early 18th century[7].

D. *The equivalence of value.* Although there are different organic compositions of capitals in different industries, the effects of work done by the forces of labor in the inertia systems of capital of different qualities are equivalent. Here, the equivalence principle of value always plays a dominant role. Specifically, for any theory developing to a certain height, it needs to study the equivalence of the theory. For example, in physics, it needs to study Galileo transformation, Lorentz transformation, Hamilton principle, universal field theory and so on. In the history of economic theory, the equivalence of value actually was studied, for example, by Ricardo on the exchange between the labor value and the gold and silver coins in Bullionist Controversy; and by Marx — on how to realize the average rate of profit among industries with different organic compositions of capitals under the premise of equivalent forces of labor in the social production. In fact, it is assumed that the amounts of labor are equivalent in all economic fields.

We know that, the absolute space-time concept is the basis of the entire axiomatic system of Newtonian mechanics. That is to say, the basic laws in Newtonian mechanics are established relative to the inertial frame of reference.

In this inertial frame specified by Newton's absolute space-time concept, time and space are uniform and isotropic, and the Galileo relativity principle holds, the kinetic equation is required to maintain the form under Galileo transformation

$$\begin{cases} r = r' + Vt; \\ t = t' , \end{cases}$$

which indicates the change from the inertial frame K to the inertial frame K' with a motion of constant velocity V relative to K, where V is constant velocity; r is the initial velocity; t is the initial time.

As we suppose, the basic axiomatic system of the new theory of value is comparable to that of Newtonian mechanics. Therefore, for the new theory of value, there is also a phenomenon in economics that satisfies the kinetic equation maintaining the form under Galileo transformation. Specifically, in industries with

economics took a wrong concept of subjective "marginal utility" to explain value. In response, Sraffa designed a "standard commodity" to serve as the measure of value. Since the rate of profit depends on the inverse ratio between the quantity of surplus products and wages, as long as the quantity and wages of the standard commodity are known, the cost, profit, and production price of the commodity can be attained, where the quantity depends on the production technology, and not on the supply and demand. Wages also depend on the results of negotiations between capitalists and trade unions. Therefore, the value of commodities is ultimately determined by labor productivity. The post-Keynesian school believes that Sraffa's principle of "reduction" not only adhere to Ricardo's labor theory of value, but also solves Marx's transformation from value to production price. Obviously, Sraffa's opinion is similar to the conclusion by the new theory of value according to which "acceleration determines the value of commodities". In other words, Sraffa's research results are close to scientific conclusions. However, Sraffa's theory of value did not give the mathematical expression of labor productivity that determines the value of commodities, and the basic axiomatic system that deduces this mathematical expression. This is the fundamental difference between post-Keynesianism and the New theory of value.

[7] With in-depth theoretical study, the new theory of value will further complete its mathematical model with the measure of wealth value on Kähler manifold based on complex domain in more general modern differential geometry. In recent year, there were major breakthroughs in the field of differential geometry of Kähler manifolds (Chen, Wang, 2020) that successfully proved the Hamilton–Tian Conjecture and the Zero-Order Estimation Conjecture, offering solutions to the constant scalar curvature metric and Calabi extremal metric variable with time. Obviously, the economic research in the universal measure of value will be greatly improved by introducing the mathematical achievements of modern differential geometry.

different organic compositions of capitals or countries with different levels of development, there are equivalent commodity values obtained by consuming equivalent forces of labor. Just as in the inertial systems with different velocities — on a table at a fixed site or on a table of a running train — the same object will move along the same distance under equivalent forces. Analogous to Newtonian mechanics, Marx's axiom that labor creates value, as well as the axioms of the new theory of value that the force of labor determines value and the labor gravitational force creates surplus value, are actually "apples falling from trees" in economics. Hence, there is also a "law of universal gravitation of value" in economics, that is, a force generated by improving skill and dexterity of workmen from mankind intelligence and wisdom, so that men will always obtain a "value inertia" in the process of labor production, leading to equivalent wealth created by equivalent forces of labor in different organic compositions — the inertia quality — of capitals in different industries, that is, equivalent forces of labor create equivalent commodity values and surplus-values. Obviously, the same logic applies to countries with different levels of development.

Here, it should be noted that the degrees of complexity in force of labor are different in industries with different organic compositions of capitals and countries with different levels of development, where accordingly the forces of labor consumed in unit time will be different. Here, under the law of average rate of profit, the quality potential energies of forces of labor in industries with higher organic compositions of capitals are higher than those in industries with lower organic compositions of capitals, and ultimately bring about an average rate of profit equivalent in all industries[8]. To be specific, assuming that the total amount of advanced capital in each industry is equivalent, given the amount of constant capital and the quality potential energy coefficient of each industry, there must be a set of linear equations, which can attain the coefficient of average degree of complexity in force of labor in each industry. Under the constraints specified by Marx that the sum of surplus values and the sum of average profits are equivalent so that the sum of production prices and the sum of values are also equivalent. Then there will be an average profit rate in the industries with different organic compositions of capitals (Wu et al., 2020, Case 2). In other words, the inertia quality of variable capital composed of complex labor is greater than that composed of simple labor. Therefore, although in the same labor time, the labor cost of complex labor during the production in industries with different organic compositions of capitals is equivalent, to that of simple labor, yet the surplus values they create are different. Obviously, the conservation of value also plays a dominant role in Marx's theory of production price, and proves the compatibility between the new theory of value and Marx's theory of surplus value.

We must admit that Marx's argument on production price (Marx, 1894, Vol. III, Supplement) is not perfect, where Marx ignored the equivalence of value and the quality inertia of capital, and attempted to explain production price through spontaneous adjustment mechanism of capitalist competition. This argument was questioned a lot, yet Marx's theory of production price is still essentially correct. In fact, if there was the equivalence principle of value in Marx's "Das Kapital", then it would be never difficult for people to understand value transformation according to Marx's theory of production price as we discussed above.

To sum up, the new theory of value and the traditional labor and theory of surplus value — are consistent as one scientific theoretical system. If the criticism of "value transformation" by marginalism was to correct some partial errors in Marx's theory of production price, then this criticism would be of certain significance. However, regrettably, this criticism was an attempt to completely deny Marx's theory of surplus value, which was unacceptable. Specifically according to marginalism, the study of economics starts from the law of diminishing marginal utility, which applies to all historical stages of human society, and the capitalist mode of production is the eternal and ultimate rational social form of mankind. Therefore, under the spontaneous capitalist competition, the natural law of the jungle, including the wealth distribution system in which all surplus values belong to the bourgeoisie, also applies to all stages of human history. Such view of marginalism is obviously wrong.

In human history, there were various distribution systems, including the "natural distribution system" of the primitive commune; the slave distribution system of surplus products belonging to the slave owners; the feudal distribution system of rents belonging to the landlords; the capitalist distribution system of surplus values belonging to the capitalists; the socialist distribution system of "from each according to his ability, to each according to his work", and the communist distribution system of "from each according to his ability, to each according to his needs". According to Marx's historical materialism, at different historical stages,

[8] Complex and simple labors are labor costs paid by laborers with different division of labor in the production of the same product. Although the force of labor cost by complex labor in unit labor time can be converted into several times of that by simple labor in unit labor time, complex laborers pay more training and learning costs for higher proficiency and qualification, then the variable capital formed by complex labor has higher quality inertia, with capacity to create more labor value. Here, the basic axiom that labor determines value still holds.

there are distribution systems of wealth that adapt to the level of productivity at that time. Therefore, the capitalist distribution system of wealth is just one that adapts to the level of modern productivity, which is a relatively rational existence. Here, the error of neoclassical economics is based on marginalism, it regards the rational existence in the historical stage of capitalism as eternal rationality, leading to two fatal drawbacks in the 21st century:

• the irreconcilable contradiction between the pursuit of true equality and liberty by the vast majority of countries and nations in the world with the rapid development of the global economy and the pursuit of hegemonism and unilateralism by neoclassical economics for maximizing the interests of the bourgeoisie, especially the monopoly bourgeoisie;

• the ideology composed of modern capitalist civilization and bourgeois values that hesitates or even rejects to adapt to a higher level of communist mode of production improved by a coming qualitative leap — artificial intelligence technology taking place of the most of human labor — of modern productivity, which was proved by historical facts to be the blocks in the progress of modern society and even threats to the survival of mankind[9].

4. SIGNIFICANCE OF ANALYSIS OF MARGINALISM

The analysis on marginalism will be a revolution of negation of negation in the history of economic theory. Since the marginal revolution denied the traditional theory of value, economic science was gone astray. In order to return economics towards the highway of science, it is of great historical significance to reanalyze marginalism with the new theory of value.

4.1. Helps to distinguish right from wrong and realize the truth

Through the above analysis, it is clear that the traditional theory of value is a scientific system of economic theory that can accommodate marginalism. In particular, in recent years, through great efforts the traditional theory of value made significant progress in mathematization and computerization, that is, the theoretical paradigm of mechanics to become a mature science. However, it still faces a major challenge: how to eliminate the opposition and divergence from neoclassical economics and bring itself back to the mainstream, which is an important work for the development of modern economics.

We believe that reanalyzing marginalism, distinguishing right from wrong and learning from each other is a shortcut to make the traditional theory of value return to the center of the economic historical stage. To be specific, neoclassical economics and the new theory of value share some common conclusions in some aspects of the mainstream general equilibrium theory, including convexity of value function (Wu J., Wu Z., 2021, Theorem 3.1), fixed point of equilibrium price (Wu J., Wu Z., 2021, Theorem 3.2), etc. In this case, the traditional theory of value should critically inherit the rational components of the general equilibrium theory, especially the various research achievements in mathematical category of neoclassical economics, which certainly will achieve twice the result with half the effort in mathematization and computerization for the traditional theory of value.

In the same way, the traditional theory of value should also critically absorb the rational components of various minority branches of neoclassical economics, for example:

• the market adjustment mechanism that deviates the market price from the labor value compatible with the rational components of disequilibrium theory of Keynesian economics;

• the social wealth redistribution theory compatible with the rational components of welfare economics;

• the theory of the state compatible with the rational components of institutional economics;

• the monetary theory compatible with the rational components of monetarist economics;

[9] Unfortunately, the marginal revolution finally pushed the traditional theory value — Smith's labor theory of value and Marx's theory of surplus value — out of the center of the world economic stage for more than a century. This has not only seriously affected the normal development of scientific economic theory, but also led to overcapacity, the gap between rich and poor, vicious competition and periodic economic crisis, which were lingering nightmares of human society. In fact, according to the inference conclusion in this paper, scientific economic theory can fundamentally eliminate these long-term social parasitic warts that threaten human survival and development. At present, against the background of the confrontation between China and the United States and the Russia–Ukraine conflict, facing the threat of the Third World War, mankind moves on the verge of survival. Saving mankind requires not only optimized economic development and strong military support, but also the truth. In particular, what mankind lacks now is not money and weapons, but truth.

• the mathematical model compatible with the rational mathematical components of neoclassical economics, including the research method of differential topology applied by Debreu;

• the computer model compatible with the rational components of computable general equilibrium model, econometrics model, system dynamics model, and the agent-based computational economic model, and other neoclassical economic models.

So, to be a mature scientific theoretical system, the traditional theory of value with the paradigm of mechanics should include all branches of neoclassical economics, absorb its essence and discard its dross. Only in this way can the traditional theory of value rapidly develop and give full play to its due role.

4.2. Help to transform the traditional theory of value into science, technology and productivity

According to Qian's system theory (Qian et al., 1990), any transformation from scientific theory into technology and products should go through system engineering, which is composed of conceptual model, mathematical model and computer model. So does the traditional theory of value with the paradigm of mechanics:

• the conceptual model (Wu, 2012) refers to the use of qualitative analysis to explain the research object. Therefore, as a theoretical system dominated by qualitative analysis, the traditional theory of value comes from Smith's "*An Inquiry into the Nature and Causes of the Wealth of Nations"*, Ricardo's "*On the Principles of Political Economy and Taxation*" and Marx's "*Das Kapital"*;

• the mathematical model (Wu, 1999a, 1999b; Wu, Qin, 2008; Wu et al., 2020) refers to the paradigm of mechanics;

• the computer model (Wang et al., 2022) established by agent-based modeling follows the mathematical model with the paradigm of mechanics.

In recent years, China has made some progress in the research and development of computer models based on the traditional theory of value, and has begun to apply them in scientific research and economic practice[10].

In economics, the basic function of computer models is to combine theory with practice through computational experiments. Specifically, the economy is a social system with participation of mankind. Without an economic laboratory, it is vulnerable to irrational factors, and of high cost of trial and error through actual social economic practices to verify whether various economic theories and plans are correct and feasible. While with an economic laboratory, economic theories and plans will not be implemented until the verification through computer simulation experiments, so as to improve the feasibility, success probability, even benefits of economic decisions. In fact, one of the main reasons for the serious setback of the international communist movement in the 20th century is that the traditional theory of value was not yet a system engineering, insufficient to formulate scientific production plans for socialist countries, and through scientific experiments to guide social economic practices and improve labor productivity. Now we have preliminarily established such a economic laboratory, which in the future will certainly play an important role in the economic construction of all countries around the world.

To sum up, it is of great theoretical significance to reanalyze marginalism. Looking back to history, any change in the mode of social production, including the economic base and superstructure, went through a long and tortuous journey. The capitalist mode of production began from the "enclosure movement" in Britain in the 15th century to the success of the bourgeois revolution in France at the beginning of the 19th century, which went through more than four centuries and suffered numerous setbacks and hardships. Until today, the modern capitalist society is still suffering from the negative influence of errors of marginalism, and cannot get rid of the nightmare of the huge gap between rich and poor and the periodic economic crisis. The fundamental reason for this situation is that mainstream theory in the field of modern economics goes wrong. We believe that the scientific theory of value is the guidance for the development of modern society and economy. Adhering to the mathematization and computerization to the theory of value and the scientific experiment to assist the macroeconomic management, will help to better develop economies in the world, even beyond the level of current developed countries. In particular, in this historical process, economics will eventually develop into a more profound, advanced and mature scientific theoretical system than physics at the peak of modern science. We have no doubt about this.

[10] The computer model is a system simulation model of social economic dynamics (SED). At present, the SED model has been successfully applied in the simulation analysis of the international economy, macroeconomy, industrial economy, and regional economy (Wang et al., 2022).

REFERENCES / СПИСОК ЛИТЕРАТУРЫ

Aristotle (1999). *Politics*. Transl. by Benjamin Jowett. Kichener: Batoche Books.

Arrow K.J. (1951). *Social choice and individual values.* 2nd ed. N.Y.: John Wiley & Sons. Reprinted by New Heaven, CT: Cowles Foundation, Yale University in 1970.

Arrow K.J., Debreu G. (1954). Existence of an equilibrium for a competitive economy. *Econometrica*, 22, 3, 265–290.

Bai B. (2006). *Research on value transformation problem*. Peking: The Commercial Press.

Bortkiewicz L. von (1949). *On the correction of Marx's fundamental theoretical construction in the third volume of capital.* Appendix. Clifton: A.M. Kelly. Originally published in 1907.

Bortkiewicz L. von (1952). Value and price in the Marxian system. Transl. by Kahane J. *International Economic Papers*, 2, 36–51. Originally published in 1906–1907.

Böhm-Bawerk E. von (1896). *Karl Marx and the close of his system*. London: T.F. Unwin.

Chen X., Wang B. (2020). Space of Ricci flows (II). Part B: Weak compactness of the flows. *J. Differential Geom.*, 116 (1), 1–123 (September). DOI: 10.4310/jdg/1599271253

Debreu G. (1959). *Theory of value: An axiomatic study of economic equilibrium*. N.Y.: John Wiley & Sons.

Ding B. (2012). On Samuelson's criticism of the labour theory of value. *Social Sciences in China*, 2, 79–93.

Engels F. (1947). *Anti-Duhring: Herr Eugen Duhring's revolution in science*. Moscow: Progress Publishers. Originally published in 1878.

Marx K. (1867). *Das Kapital*. Vol. I. Hamburg: Verlag von Otto Meissner. (Transl. from the German in: "*Marx and Engels. Collected works (Vol. I)"*. Vol. 35. London: Lawrence & Wishart in 1996.)

Marx K. (1894). *Das Kapital. Kritik der Politischen Ökonomie*. Vol. III. Hamburg: Otto Meissners. (Transl. from the German in: "*Marx and Engels. Collected works (Vol. III)"*. Vol. 37. London: Lawrence & Wishart in 1996.)

Meek R. (1956a). *Studies in the labour theory of value*. London: Lawrence and Wishart.

Meek R. (1956b). Some notes on the transformation problem. *Economic Journal*, 66, 261, March.

Meek R. (1961). Mr. Sraffa's rehabilitation of classical economics. *Scottish Journal of Political Economy, Scottish Economic Society*, 8 (2), June, 119–136.

Morishima M. (1973). *Marx's economics*. Cambridge: Cambridge University Press.

Morishima M. (1974a). Marx in the light of modern economic theory. *Econometrica*, 42, 611–633.

Morishima M. (1974b). The fundamental Marxian theorem: a Reply to Samuelson. *Journal of Economic Literature*, 12 (1), 71–74.

Qian X., Yu J., Dai R. (1990). A new discipline of science — the Study of open complex giant system and its methodology. *Chinese Journal of Nature*, 13 (1), 3–10.

Ricardo D. (1817). *On the principles of political economy and taxation*. London: John Murray. (Reprinted by Kitchener: Batoche Books in 2001.)

Say J.-B. (1803). *Traité d'économie politique*: *ou Simple exposition de la manière dont se forment, se distribuent, et se consomment.* Paris. (Transl. and reprinted from French by C.R. Prinsep "*A treatise on political economy; or the production, distribution and consumption of wealth"*. N.Y.: Augusts M. Kelley Publishers in 1971.)

Seton F. (1957). The transformation problem. *Review of Economic Studies*, 24, 3, 149–160.

Smith A. (1776). *An inquiry into the nature and causes of the wealth of nations*. London: Printed for W. Strahan; and T. Cadell. (Reprinted by New York: Random House in 1994.)

Sraffa P. (1960). *Production of commodities by means of commodities — a prelude to a critique of economic theory*. Cambridge: Cambridge University Press.

Sweezy P. (1942). *The theory of capitalist development*. New York: Monthly Review Press.

Sweezy P. (1949). *Karl Marx and the close of his system.* New York: Augustus Kelly.

Wang J., Wang T., Shi Y., Xu D., Chen Y., Wu J. (2022). Metaverse, SED model and new theory of value. *Complexity*. Article ID4771516. 26 p. DOI: 10.1155/2022/4771516

Wieser F. (1889). *Natural value*. Transl. and reprinted by Ch.A. Malloch. London, New York: Augustus M. Kelley Publishers, Macmillan and Co.

Winternitzv J. (1948). Value and prices: A solution of the so-called transformation problem. *Economic Journal*, 58, 230, June, 276–280.

Wu J. (1999a). On the causes of commodity price and market equilibrium at the critical point of price (I). *The Journal of Quantitative & Technical Economics*, 7, 21–28.

Wu J. (1999b). On the causes of commodity price and market equilibrium at the critical point of price (II). *The Journal of Quantitative & Technical Economics*, 8, 40–47.

Wu J., Qin Y. (2008). Commodity exchange model based on Marxist economics. *The Journal of Quantitative & Technical Economics*, 2, 149–160.

Wu J. (2012). *On wealth*. Vol. I–II. Peking: Peking University Press.

Wu J., Wu Z. (2021). Analysis of market equilibrium based on the new theory of value. *SCIREA Journal of Economics*, 6 (4), 71–113. DOI: 10.54647/economics79260

Wu J., Makarov V.L., Bakhtizin A.R., Wu Z. et al. (2020). The new theory of Value. *Economics and Mathematical Methods*, 56 (4), 5–19. [**Wu J., Makarov V.L., Bakhtizin A.R., Wu Z.** et al. (2020). The new theory of value // *Экономика и математические методы*. Т. 56. № 4. С. 5–19.]

Zhang Z. (2001). The final solution to the transformation problem. *The Journal of Quantitative & Technical Economics*, 18 (2), 4.

Zhang Z. (2004). *Solving the centennial problem*. Peking: People's Publishing House.

Анализ маржинализма. Часть 2

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Аннотация. В последние годы, китайские и российские ученые, сохраняя в качестве основы традиционную теорию стоимости,— трудовую теории стоимости и теорию прибавочной стоимости, а также гипотезу Джевонса, Теслы и Фоули — использовали математическую парадигму теоретической механики для создания системы математических моделей экономики, которую назвали новой теорией стоимости. Совместимая с традиционной теорией, новая теория стоимости выдвигает идею о том, что потребляемая в процессе производства рабочая сила определяет стоимость товара, а сила притяжения рабочей силы определяет оценку ее самой. В процессе производства постоянный и переменный капитал — как кинетическая и потенциальная виды энергии — переходят друг в друга, согласно теореме сохранения стоимости, что играет важнейшую роль в создании стоимости и добавленной стоимости продуктов. Эти теоретические положения имеют большое значение, поскольку превращают традиционную теорию стоимости в самодостаточную логическую систему в виде новой теории стоимости, которая вобрала рациональные элементы как из классической экономики, основанной на трудовой теории стоимости, и теории прибавочной стоимости, так и из неоклассической экономики с ее законом убывающей предельной полезности. В этой части статьи мы обращаемся к этой проблематике, исследуя происхождение закона убывающей предельной полезности.

Ключевые слова: новая теория стоимости, рабочая сила, гравитационный параметр рабочей силы, закон равновесия стоимости, закон убывающей маржинальной полезности, непротиворечивость.

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