# The New Explanation of Market Equilibrium Based on Theory of Labor Value

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**Abstract** There is market equilibrium when the demand willingness is consistent with the supply willingness. From the individual preferences and budget constraints, Western Economics deduced demand curve, causing the traditional demand willingness to be built on the basis of subjective utility. From the relative labor time of economic entity, this paper discusses the relationship between labor time and price readiness, demand curve or supply curve, and establishes the market equilibrium model based on labor value. In a perfectly competitive environment, the equilibrium exchange price of the model is the ratio of labor value between two commodities, and combines demand and supply sides' recognition of commodity quantity of labor, reflecting the socially necessary labor time contained in commodities.

**Key words** Relative labor time, Socially necessary labor time, Labor value, Exchange value, Market equilibrium

## 1 Introduction

In the history of economics, there are four value theories: cost-of-production theory of value developed by Adam Smith; labor value theory advanced by Marx; marginal utility theory put forward by the Austrian School; equilibrium price theory made by Marshall. From the individual's preferences and technology, equilibrium price theory, the combination of cost-of-production theory of value and marginal utility theory, analyzes the decentralized action of people seeking self-interest and guides the optimal allocation of resources (by perfect competition). It becomes the mainstream thought of current economics. However, doubt is casted on the analysis of demand built based on subjective and unfathomable utility function. In this regard, from the labor value theory, this paper intends to use relative labor time to re-derive the demand and supply curve to explain the relationship between labor value and market equilibrium.

## 2 Relative labor time and reservation price

First, we consider a simple economy. The economy is constituted by two persons ($A$ and $B$), each with eight hours of labor time. Both of them can produce two commodities ($x$ and $y$). The labor productivity of economic entity can be signified by the individual labor time consumed for the production of a unit of commodity. The larger the value is, the lower the labor productivity is. The labor productivity of the two persons is shown in Table 1.

**2.1 Self-sufficient production** Under the self-sufficient production, it is assumed that the economic entity evenly allocates the labor time on two commodities. The output of economic entity and output of collective are shown in Table 2.

**Table 1 Labor productivity (labor time consumed for the production of a unit of commodity)**

| Labor productivity of commodity $x$ | Labor productivity of commodity $y$ | Resources | |
|---|---|---|---|
| economic entity $A$ | 4 h | 2 h | 8 h |
| economic entity $B$ | 8 h | 1 h | 8 h |

**Table 2 The output of individual and collective when the self-sufficiency is achieved**

| | Commodity $x$ | Commodity $y$ | Resources |
|---|---|---|---|
| $A$ | 1.0 | 2 | 8 $h$ |
| $B$ | 0.5 | 4 | 8 h |
| Collective | 1.5 | 6 | 16 h |

**2.2 Specialized division of labor** The division of labor is conducted between economic entities: $A$ produces commodity $x$ while B produces commodity $y$ (Table 3). After the division of labor, the labor productivity and total resources remain unchanged, while the total output increases, bringing additional income. However, if the fruits of labor are not exchanged and economic entity has only a single product, the situation is worse compared with diversification of product when there is self-sufficiency.

**Table 3 Comparison of output of economic entity and collective before and after the division of labor**

| | Before the division of labor (self-sufficiency) | | After the division of labor | |
|---|---|---|---|---|
| | Commodity $x$ | Commodity $y$ | Commodity $x$ | Commodity $y$ |
| $A$ | 1.0 | 2 | 2 | 0 |
| $B$ | 0.5 | 4 | 0 | 8 |
| Collective | 1.5 | 6 | 2 | 8 |

**2.3 Division of labor and exchange** It is assumed that the economic entity exchange products in accordance with the propor-

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tion of one unit of commodity $x$ = four units of commodity $y$. What the economic entities get after exchange is better than what the economic entities get when there is self-sufficiency (Table 4). Obviously, the commodity economic mechanism built on the basis of specialized division of labor and free exchange is better than the self-sufficiency economic mechanism. Those products for the exchange become commodities.

**Table 4 Comparison of output of economic entity and collective before and after the division of labor and exchange**

| | Before the division of labor (self-sufficiency) | | After the division of labor | | Division of labor and exchange (1:4) | | Resources |
|---|---|---|---|---|---|---|---|
| | Commodity $x$ | Commodity $y$ | Commodity $x$ | Commodity $y$ | Commodity $x$ | Commodity $y$ | |
| $A$ | 1.0 | 2 | 2 | 0 | 1 | 4 | 8 h |
| $B$ | 0.5 | 4 | 0 | 8 | 1 | 4 | 8 h |
| Collective | 1.5 | 6 | 2 | 8 | 2 | 8 | 16 h |

**2.4 Available exchange price range** The exchange price of the above commodity: the price of one unit of commodity $x$ = the price of four units of commodity $y$. In fact, there is a price range between buyers' highest bid price and sellers' lowest asking price built based on relative labor time and derived opportunity cost, and the commodities are exchanged in this price range. If taking commodity $x$ as object of exchange and commodity $y$ as universal equivalent, then $A$ is the supply side and $B$ is the demand side. Assuming the opportunity cost ($C^x$) of producing one unit of commodity $x$ is as follows:

$C^x$ = one unit of commodity $x$ × labor time for one unit of commodity $x$/labor time for one unit of commodity $y$ = labor time for commodity $x$/labor time for commodity $y$ = relative labor time for commodity $x$.

The relative labor time and opportunity costs of both sides are as shown in Table 5.

**Table 5 Opportunity cost**

| | Labor productivity | | Opportunity cost (relative labor time) | |
|---|---|---|---|---|
| | Commodity $x$ | Commodity $y$ | Commodity $x$ | Commodity $y$ |
| $A$ | 4 h | 2 h | 2 units of $y$ | 1/2 units of $x$ |
| $B$ | 8 h | 1 h | 8 units of $y$ | 1/8 units of $x$ |

$A$ is the supply side of commodity $x$, and the purpose of its economic behavior is to obtain commodity $y$, and exchange commodity $x$ for $y$ (Fig. 1). Only when the exchange proportion is one unit of commodity $x \geqslant$ two units of commodity $y$ is $A$ willing to become a professional producer and supplier of commodity $x$.

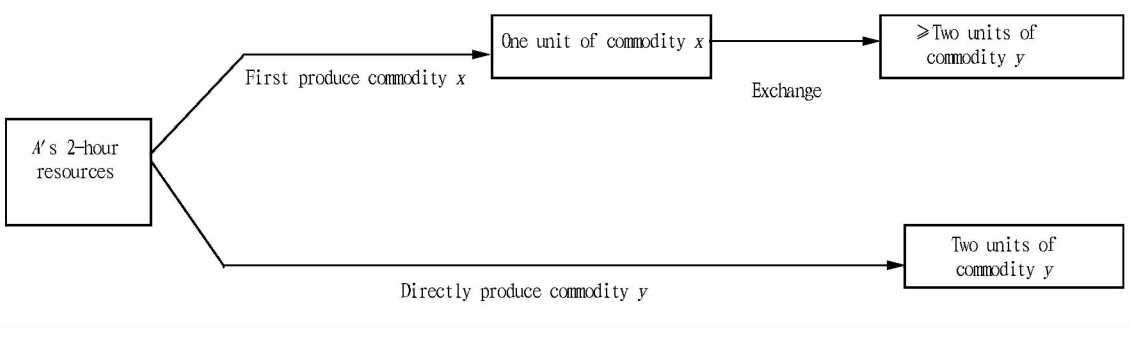


**Fig. 1 The decisions of supply side**

The reservation price of commodity $x$ suppler is the lowest asking price for two units of commodity $y$, namely the relative labor time (opportunity cost) for producing one unit of commodity $x$. Similarly, the reservation price of buyer is the highest bid price for eight units of commodity $y$. The reservation price of commodity $x$ supply and demand sides is summarized in Table 6.

**Table 6 The reservation price of supply and demand sides**

| | Opportunity cost (relative labor time) | Reservation price |
|---|---|---|
| Supply side $A$ | 2 units of $y$ | 2 units of $y$ |
| Demand side $B$ | 8 units of $y$ | 8 units of $y$ |

The exchange price range for one unit of commodity $x$ is [2 units of $y$, 8 units of $y$]. In the range, the transaction at any price is feasible, and it thus establishes the relations between payment willingness and objective relative labor time. There are numerous buyers and sellers, the expected exchange price is sole, and the market equilibrium will appear.

## 3 Market equilibrium model of relative labor time

In a large economic society, we make the following hypotheses:

**Hypothesis 1** The economic society can produce two products ($x$, $y$); the social basic economic system is private ownership of property; each market is in a state of perfect competition; the economic entity has economic rationality.

**Hypothesis 2** The labor resources are the same for individuals within the sector; the labor productivity in the production of commodity $x$ varies, expressed as $h_i^x$ by the labor time for per unit of commodity; the labor productivity in the production of commodity $y$ is the same, expressed as $h^y = 1$; thus, the relative labor

time ($C_i^x = \frac{h_i^x}{h^y} = h_i^x$) for the production of commodity $x$ is different.

**Hypothesis 3** Each economic entity purchases or supplies one unit of commodity (if a natural entity purchases or supplies n units of commodity, it can be split into n economic entities in theory).

**3.1 Relative labor productivity and demand curve** The relative labor time (opportunity cost) of commodity $x$ is $C_i^x = \frac{h_i^x}{h^y} = h_i^x$. The larger the value, the more the time consumed for the production of commodity $x$, the higher the opportunity cost. However, if the economic entity produces commodity $y$, then the reservation purchase price for the commodity $x$ is also higher. By sequencing the reservation purchase price for commodity $x$ in descending order, the demand curve is obtained, as shown in Fig. 2. When the market exchange price is high, only those economic entities, with higher reservation purchase price for commodity x than market price, will choose not to produce commodity $x$, but choose to first produce commodity $y$ and then buy commodity $x$. With the decline in the market exchange price, the cumulative purchase amount increases and the demand curve slopes downward on the right.

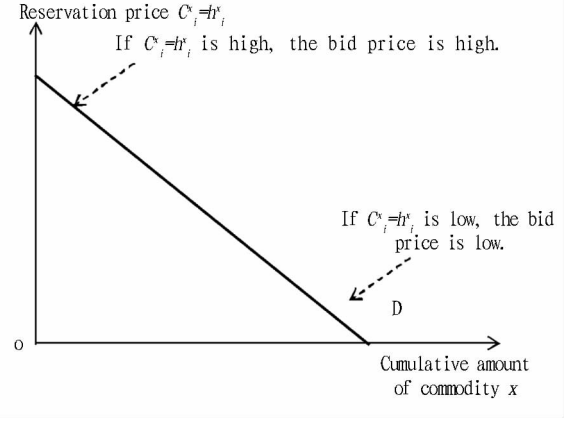


**Fig. 2 Relative labor productivity and demand curve**

**3.2 Relative labor productivity and supply curve** By sequencing the reservation supply price for commodity $x$ from low to high, the supply curve is obtained, as shown in Fig. 3. Only those economic entities, with lower reservation purchase price for commodity $x$ than market price, will choose to produce and supply commodity $x$. With the increase in the market exchange price, the cumulative supply amount of commodity $x$ increases and the supply curve slopes upward on the right.

**3.3 Relative labor productivity and market equilibrium** In a perfectly competitive market, the buying and selling of supply and demand sides will cause the adjustment of market exchange price to form a stable equilibrium exchange price, as shown in Fig. 4.

When the price makes the supply and demand sides reach an agreement on desiring amount, the market equilibrium will appear, that is, when one unit of commodity $x = \frac{h^{x*}}{h^{y*}}$ units of commodity $y$, both sides are willing to supply (purchase) $x^*$ units of commodity $x$. The equilibrium price at this point is based on the objective relative labor time.

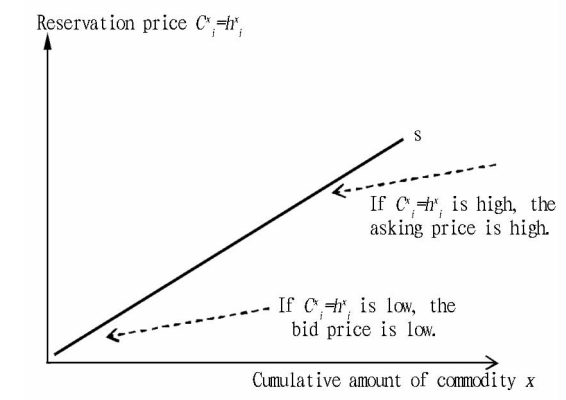


**Fig. 3 Relative labor productivity and supply curve**

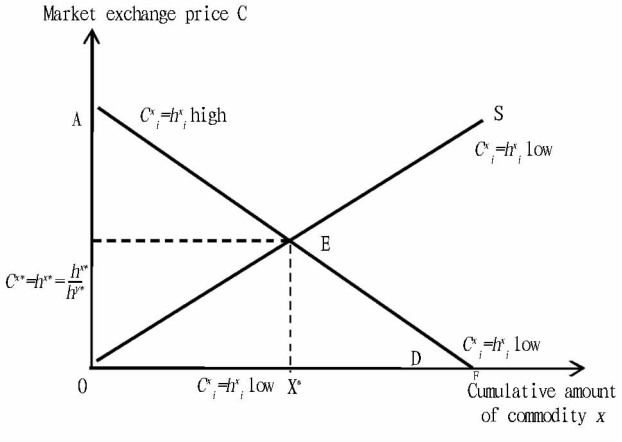


**Fig. 4 Relative labor time and market equilibrium**

## 4 Connotation of relative labor time and market equilibrium

**4.1 Equilibrium exchange price reflects the exchange value** Equilibrium exchange price means how many units of commodity $y$ to be exchanged for one unit of commodity $x$ when the market achieves a competitive equilibrium. The exchange price is the exchange value of commodity $x$ measured by commodity $y$. In Fig. 4, the whole society agrees that one unit of commodity $x$ is exchanged for $C^*$ units of commodity $y$, so the exchange value of one unit of commodity $x$ measured by commodity $y$ as general equivalent is $C^*$.

**4.2 Equilibrium exchange price reflects the labor value** The commodity value means the abstract quantity of labor contained in commodity determined by the socially necessary labor time. The market equilibrium price in this model reflects the labor value of commodity. (i) The market equilibrium price reflects the abstract quantity of labor. In Fig. 4, the market equilibrium ex-

change price $C^{x*} = h^{x*} = \frac{h^{x*}}{h^{y*}}$, and it is the exchange ratio recognized by all members of society. $h^{x*}$ hours of labor time is used for the production of one unit of commodity $x$, or $\frac{h^{x*}}{h^{y*}}$ units of commodity $y$, and there is difference for the whole society. $h^{x*}$ hours of labor is the general mental or physical consumption in the specific commodity production, which can be regarded as abstract quantity of labor. (ii) The market equilibrium price reflects the socially necessary labor time. According to Marx's explanation, the socially necessary labor time can be understood as the "average" abstract labor time recognized by demand and supply sides in the whole society, or the "average" abstract labor time causing the commodity market to achieve competitive equilibrium. In the whole society, the relative labor time for economic entity to produce commodity $x$ is different, higher or lower than $C^{x*} = h^{x*} = \frac{h^{x*}}{h^{y*}}$. It makes the individual value contained in one unit of commodity $x$ higher or lower than $C^{x*}$. Only for the production of one unit of commodity $x$ or $\frac{h^{x*}}{h^{y*}}$ units of commodity $y$, the labor time ($h^{x*}$) consumed is jointly recognized by demand and supply sides in a certain period. Then, $h^{x*}$ is the socially necessary labor time for the production of one unit of commodity $x$, and the labor value of one unit of commodity $x$. Similarly, the necessary social abstract labor time for the production of one unit of commodity $y$ is the labor value of one unit of commodity $y$. The market exchange price of commodity $x$ is the ratio of labor value of commodity $x$ to labor value of commodity $y$. When there is market equilibrium, the two commodities are exchanged based on the labor value ratio. It taking commodity $y$ as the general equivalent, commodity $x$ is sold according to its own labor value. In short, the perfectly competitive equilibrium can fully integrate each economic entity's recognition of quantity of labor contained in the commodity.

**4.3 Equilibrium exchange ratio guides the allocation of resources** In economic society, there are numerous economic entities which can produce commodity $x$. After the formation of market equilibrium price, only those economic entities with the relative labor time for the production of commodity $x$ lower than market equilibrium price (OE segment in Fig. 4), are voluntarily engaged in commodity production. In the economic society, there are numerous economic entities needing commodity x, and it relates to the distribution of a given commodity. After the formation of market equilibrium price, only those economic entities with the relative labor time for the production of $x$ higher than market equilibrium price and the relative labor time for the production of other commodities lower than the market equilibrium price of this commodity (AE segment in Fig. 4), voluntarily first produce other commodities and then exchange them for commodity $x$. Equilibrium exchange price becomes the dividing line of comparative advantage. It guides the economic entities with comparative advantage higher than the dividing line to directly produce goods and guides the economic entities with comparative advantage lower than the dividing line to indirectly produce goods. The whole society produces the given amount of commodities needed with the minimum input, so the allocation of resources is optimized.

## 5 Conclusions

In this paper, based on the relative labor time, we reconstruct the demand and supply curves. Under ideal environment of perfect competition, the only market equilibrium price is the ratio of labor value between two commodities, and commodity is sold according to its labor value. Compared with the traditional equilibrium price build based on subjective utility, the equilibrium price in this model can also play a role in guiding the allocation of resources, and it is based on objective quantifiable relative labor time. For a long time, it is difficult to calculate the labor value in the commodity, and this paper hopes to provide some ideas for the calculation of socially necessary labor time-the perfect competition equilibrium price in the model is the ratio of socially necessary labor time between two commodities, and also the ratio of labor value between two commodities.

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