REFORMULATING THE QUANTITATIVE CONNECTION BETWEEN LABOR-VALUE AND PRICE

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1. INTRODUCTION

In this paper, I will examine the quantitative connection between labor-value and price.

First, I will emphasize that labor-value and price are dimensionally different categories and this dimensionality problem includes the problem of reducing heterogeneous to homogeneous labor as its important part.

Next, I will try to explain how the quantitative connection between labor-value and price can be secured through the value determination of labor-power adopted by the so-called 'New solution' to the transformation problem(Dumenil, 1980 : Foley, 1982 : Lipietz, 1982 etc.).

Finally, by decomposing the widely-used concept called 'monetary expression of labor hour' into 'value expression of labor hour' and 'monetary expression of value', the implications of the labor theory of value will be reexamined from a new perspective. In particular, the weeknesses of the 'New solution' will be clarified.

2. THE RELATION BETWEEN LABOR-VALUE AND PRICE

In capitalist societies, commodities have market prices measured by monetary unit. On the other hand, the same commodities are measured by

the quantity of homogenized labor in the labor-value system.1) Namely, the same commodity is measured by entirely different counting principles in these two systems, the price system and the labor-value system.

The logical order from labor-value to market price is summarized as Fig.1.

labor-value ---> simple price ----> price of production ----> market price (homogenized
(monetary unit)   (monetary unit)   (monetary unit) labor time unit)

Fig 1

In general, 'simple price' or 'direct price'(Shaikh, 1984) is defined as the price which is proportional to the magnitude of value. Therefore, in the transformation process from labor-value into simple price, it is conceived that there is no change except measuring unit. The process from labor-value to simple price has been generally regarded as pertaining to the so-called value form analysis. However, simple price is nothing more than qualitatively modified value. The value form analysis focuses on this qualitative aspect. Therefore, the quantitative connection between labor-value and price is not provided by value-form analysis. Namely, it is impossible to compare labor-value with simple price directly, because the latter is a category pertaining to the price system and its dimension is different from that of the former. Without additional assumption, we can only know the ratio of two dimensionally different quantities.

On the other hand, in the process of transforming simple price into price of production, then into market price, the quantitative magnitude changes twice.

However, these are directly comparable, because they are all measured by monetary unit.

Therefore, in order to explore the quantitative connection between labor-value and simple price, what the dimension of labor-value and its relation with natural hour are must be explained.2) Most textbooks on 'political economy' presuppose the existence of money commodity(e.g. gold) to elucidate this quantitative connection. If x hours of socially necessary labor time are required to produce y ounces of gold, then 1 ounce of gold is regarded to be equal to (x/y) hours of socially necessary labor time. If a certain commodity is produced by z hours of socially necessary labor and is exchanged with 1 ounce of gold in market equilibrium situation, the value of this commodity is regarded to be equal to (x/y)z. However, this explanation is valid with proviso that all labors are homogeneous and the organic composition of capital in gold producing sector is equal to social average. Without doubt, this is not so especially under the modern inconvertible currency system.

As only market price is empirically observable, the logical order in Fig.1 must be reversed in reality.3) However, using conventional method, we cannot find the magnitude of value. In order to correctly capture the quantitative relation between labor-value and price, more information or some additional assumption is needed.

3. THE REFORMULATION OF THE VALUE-PRICE RELATION

I argue that the quantitative connection between labor-value and price can be secured through the value determination of labor-power. As labor-power is not the product of capital, 'price of production' of labor-power cannot be defined. So, in the case of labor-power the logical order in Fig.1 is somewhat different from that of other commodity. In other words, in the space of price, labor-power is measured by either simple price or market price.4) Then, by inversely transforming market price into simple price or value, we can find the magnitude of value of labor-power. The fact that Marx treats 'the transformation of the value of labor-power into wages' in the first volume of Capital before treating the so-called 'transformation problem' in the third volume of Capital is textual evidence for our claim.

It seems self-evident that labor-power is traded as a commodity in capitalist society. Despite the non-commodity character, labor-power can be regarded as a 'special commodity' because it is exchanged on the labor market with a price. However, the strong point of the labor theory of value lies in pursuing this point thoroughly.5) As a matter of fact, the distinctive feature of the labor theory of value lies in emphasizing the non-commodity character of labor-power. The theoretical foundation of capitalist exploitation consists in the specific ability of labor-power being productively used beyond a certain point, i.e. the value magnitude of labor-power.

Therefore, when we say that labor-power is a special commodity, the stressing point is not on 'commodity', but on 'special'. The specific field of the labor theory of value consists of analyzing the capitalist labor process characterized by class conflict and the production and appropriation of value. This field can only be secured by admitting the non-commodity character of labor-power.

Value and price are two systems that measure the same physical system by

two different principles. In the case of general commodity, the quantitative weight in the two systems are different, unless the organic composition of capital in the sector concerned is equal to social average. In the case of labor-power, however, this distortion does not take place.

Furthermore, accepting the basic idea of the so-called 'New solution', the sum of value added in labor-value terms is definitionally equal to the sum of prices of net product. Therefore, we can secure the quantitative connection between labor-value and price through the value determination of labor-power.

Imagine a hypothetical sector that 'produces' labor-power. This sector cannot be conceptualized as a production combining constant and variable capital. No doubt the rate of profit cannot be applicable to this sector.6) In other words, labor-power itself must be regarded as a 'net product', and therefore its value magnitude is equal(strictly speaking, proportional) to its price, i.e. wage. So value of labor-power is determined as the quantity of abstract labor proportional to money wage.7) Although we cannot measure the exact ratio reducing individual concrete labor to abstract human labor, the average ratio of the sum of prices to the sum of all the concrete labor as a whole8) can be calculated using macro-economic data. The value of labor-power must be transformed into wage by this very ratio. In other words, the value of labor-power is proportional to money wage divided by 'monetary expression of labor hour'. Without doubt, insofar as it is impossible to observe the ratio of the sum of concrete labor hour to the quantity of abstract labor, this magnitude is a first approximation.

There may be an objection that our reasoning is circular in the sense that value of labor-power depends upon money wage. However, in our theory,

the value magnitude of labor-power is determined by referring to the quantity of value produced of the whole economy, not by money wage alone.

Even if the trend of wage rate is stable over time, that of the value of labor-power can be fluctuating. Value is a concept to catch the mutual articulation between production and circulation. It is because of the special status of labor-power that the quantitative aspect of this articulation can be captured by the relation between value of labor-power and wage.

Furthermore, according to Marx's theory of relative surplus population, excess supply is a normal state in a capitalist labor market. If it is normal for wage to be equal to value of labor power, contrary to the case of commodity in general, market-clearing does not guarantee the value equivalent exchange of labor-power. Therefore, unless the price of labor-power is proportional to simple price by definition, there arises the logical contradiction between the labor theory of value and Marx's conceptualization of labor market in capitalism.

According to the conventional definition reducing value of labor-power to those of wage goods, changes in production conditions of 'non-basic' sectors in the Sraffian sense cannot affect the value of labor-power. However, this result must be modified. As 'monetary expression of labor hour' is determined by the total labor hour and the sum of value added of society, the value of labor-power and the rate of exploitation depend upon the power relation between classes and production conditions of the whole society, not just those of the sector concerned.

Marx explicitly stated that "an increase in the productivity of labor in those branches of industry which supply neither the necessary means of subsistence nor the means by which they are produced leaves the value of labor-power undisturbed"(Marx, 1976 : 432). However, according to our definition, say, an increase of labor productivity in the sectors producing luxury goods will raise 'monetary expression of labor hour', and therefore, cause a relative fall in the value of labor-power. It is interesting here to refer to Marx's argument that the general rate of profit is also affected by changes in production conditions of the luxury goods sector. In the Sraffian framework, the luxury goods sector cannot take part in the formation of the general rate of profit. In the Marxian framework, however, the general rate of profit is thought to be increased by the increase in the quantity of the surplus value produced in the luxury goods sector. Our definition of value of labor-power is in line with this conception. An increase in the labor productivity of the luxury goods sector without wage increase, other things being equal, will result in the increase of the rate of surplus value over the whole economy. If the equalizing tendency works, the rates of surplus value in other sectors will increase. As the labor

productivity in other sectors remains the same, there is no choice but for the value of labor-power to decline. The value magnitude of the product and the labor-power are simultaneously determined through the class-conflict within the site of production. This argument, however, does not confine the value-theoretic analysis to the individual process of production concerned, because we can confirm the logical priority of the class-conflict in the sense that the individual rates of surplus value ultimately depend upon the process of value(and therefore, surplus value) production over the whole economy.

As the value of labor-power is defined in this way, a prior knowledge of the sectoral rates of surplus value is indispensable for the calculation of the value quantity produced. If the rates of surplus value are equalized across sectors,9) we can calculate the value quantity produced in the sector concerned by means of multiplying the value magnitude of labor-power by (1+e), where e represents the rate of exploitation. Unless the sectoral rates of surplus value are equalized, though, this method is not available.

Therefore, we must choose one from the two alternatives, whether presupposing the equal rate of exploitation or examining the trend of the sectoral value of labor-power. If we define the transformation problem in the narrower sense, namely, the problem of compatibility between labor-value system and production price system in the state of the equal rate of exploitation, we can choose the former. In a more general situation, however, especially when considering evolution of value relation over time, the latter is desirable.10) Marx seemed to have thought that the value magnitude could be measured by calendar time, but this is not so. Since 'abstract labor' is a concept abstracting from various physical characteristics of all concrete labor, its dimension cannot be calendar time.11) Therefore, a lot of numerical examples using calendar time in Capital is a sort of metaphor only with a pedagogical meaning. There may be an objection that we can use the sector(or labor type) of which reduction coefficient is equal to social average, but there is no way to identify such a sector(or labor type) without some additional conditions derived from price system.

In the same vein of Dumenil-Foley-Lipietz solution, total labor hour worked(Sum mi)/total value of net product(Sum vi)/the sum of prices of net product(Sum pi) are definitionally equal on the condition that the dimensions are appropriately adjusted.12) They belong respectively to physical/value/price system. In particular, mi represents the sum of actual labor hour except time loss by man-hour unit.13) This relation can be summarized as Fig.2. The notation [ ] represents the dimension of the variable concerned. For example, [v] represents the dimension of value.14)

$$mi([hour]) \text{ ---(1)----> } vi([v]) \text{ ---(2)----> } pi([dollar])$$

Fig 2

In the process (1), the parameter of which dimension is [v/hour] is needed.

If we denote it as a, a manifests what amount of abstract labor is equalized to an hour of concrete labor. That is, (Sum mi) a = Sum vi. We can call a 'value expression of labor hour'.

In the process (2), the parameter of which dimension is [dollar/v] is needed.

If we denote it as E', E' manifests what amount of money is equalized to an unit of abstract labor. Namely, (Sum vi)E' = (Sum pi). E' can be called 'monetary expression of value'.

'Monetary expression of labor hour'(m0) developed by Dumenil-Foley-Lipietz directly connects the sum of prices to the total labor hour. So its dimension is [dollar/hour]. As pi/mi = aE', m0 is equal to aE'. We cannot identify a and E' separately. Only m0 can be empirically observable. Therefore, 'the sum of value = the sum of production prices(in net product)' can be manifested as (Sum pi) = (Sum vi)E'. Dumenil-Foley-Lipietz regard it as (Sum pi) = (Sum

mi)m0. This is because (Sum vi) and E' are not identifiable in practice. Their condition, m0=1 means 'one labor hour = one dollar', which implicitly presupposes that one labor hour corresponds to one unit of value(i.e. a =1). It has a strong point in determining the absolute level of value, but excludes 'value dimension'.

A certain assumption about the absolute standard of value is indispensable for the determination of value magnitude at one point of time, but the value of labor-power calculated upon such an assumption as m0=1 is, strictly speaking, a relative value magnitude of labor-power with respect to the sum of value of all commodities. When we analyze the trend of value relation over time, it is impossible to compare the value magnitude intertemporally because of the change in a itself. However, the trend of value of labor-power as a relative ratio can be found, and then, that of the rate of exploitation can also be found.

In conclusion, the amount of value(or abstract labor) corresponding to an hour of labor is an increasing function of labor productivity. No doubt uneven development of labor productivity incessantly changes the coefficient reducing the heterogeneous to homogeneous labor. While various elements(e.g. skill or labor intensity etc.) are included in the determinants of the parameter a, change in labor productivity can be regarded as the most important one. In particular, this is true in the case of making intertemporal comparisons on a macro-economic level, because the study object of value theory lies in investigating the interaction between labor productivity and income distribution in the process of capital accumulation.15)

4. MATHEMATICAL REPRESENTATION

Now the above argument can be restated mathematically.

If we denote the sum of money-wage payment as miwi where mi is total labor hour in the i-th sector, the value of labor-power(wL) is miwi /E'. As m0 = aE', miwi /E' = miwi /(m0/a) = (miwi /m0) a. The exact magnitude of a is not identifiable, but it is given as a constant at a point of time. So the value of labor-power is equal to (miwi /m0)*(constant), and its dimension is [v].

$$wL = miwi /E' = miwi /(m0/a) = (miwi /m0) a \qquad (1)$$

According to Dumenil-Foley-Lipietz solution, the value of labor-power remains constant insofar as the increase rate of money-wage is equal to that of monetary expression of labor hour. Strictly speaking, however, it is the value ratio between labor-power and all the other commodities that remains constant. That is, wage-profit ratio remains constant, and this means the constant rate of exploitation over whole economy. Although this is true, its effect is uneven across sectors. Unless all the labor employed in each sector is homogeneous, wage rate and the value of labor-power will differ across sectors. The significance of the labor theory of value consists of capturing the trend of the sectoral rates of the value of labor-power, therefore that of the sectoral rates of exploitation. We cannot agree to the argument that the rate of exploitation is a magnitude which has a meaning only at the level of the whole economy(Dostaler, 1982 : 88). If so, at the macro-economic level the rate of exploitation is equal to wage-profit ratio by definition and therefore, one of them will be theoretically redundant.

Now the sectoral rate of surplus value(ei) can be formulated as below.

Vi, Si, and ai denote, respectively, the quantity of variable capital advanced, the quantity of surplus value, and the reduction coefficient in the i-th sector.

The reduction coefficient here represents what amount of concrete labor corresponds to the quantity of abstract labor. Actually, the magnitude of a cannot be derived from the

aggregation of ai's. In other words, ai's are neither measurable nor empirically observable. However, at least, in theoretical sense it can be introduced to clarify the nature of the problem discussed in this paper.

$$ei = Si/Vi$$

$$= (aimi - miwi/E')/(miwi/E')$$

$$= (aimi)/(miwi/E') - 1$$

$$= (aimi)/(miwi/m0)\, a - 1$$

$$= (aim0/wi\, a) - 1$$

(2)

From (2), the change rate over time of $1+ei$ is

$$(ai*/ai) - (a*/a) - (wi*/wi) + (m0*/m0)$$

$$= [(ai*/ai) - (a*/a)] - [(wi*/wi) - (m0*/m0)] \tag{3}$$

Superscript * here means the change rate over time.

Abstracting from the problem of labor intensity, the first bracket in (3) rests upon the difference between the increase rate of labor productivity of the whole economy and that of the i-th sector. In other words, the direction of the rate of surplus value depends upon the difference between the change rate of wi and that of m0 in those sectors which develops at average rate.

If the i-th sector is developing over social average, $(ai*/ai) - (a*/a)>0$. So even in the case of $(wi*/wi) - (m0*/m0)>0$, the rate of surplus value in this sector can rise up. In other words, both the value of labor-power and the rate of surplus value can rise up simultaneously. If the i-th sector is developing below social average, $(ai*/ai) - (a*/a)<0$. So, the rate of surplus value can decrease even with the value of labor-power decreasing.

In a nutshell, my argument is that the first bracket in equation (3) is as important as the second when considering heterogeneous labor.

I note in passing that the increase of a is not incompatible with the decreasing tendency of the socially-necessary labor time in capitalist societies, because the increase of a means an increase of the value quantity produced as a 'flow' concept. The increase of E', however, results in the decrease of the value quantity embodied in one unit of commodity ; that is the decrease of the value as a 'stock' concept. Therefore, the key point of value analysis consists in studying the uneven evolution of the sectoral value-creating power with the change of ai, not in the intertemporal comparisons of absolute value quantities.

The above analysis can be illustrated geometrically. In the first quadrangle of Fig.3, total labor hour OA corresponds to, respectively, the value quantity newly produced OB and the sum of value added OC. As OA is equal to OD, the angle formed by OI and the horizontal axis in the fourth quadrangle is 450.

In the first quadrangle, the slope of OE(=OB/OA) represents the amount of value produced by one labor hour. The bigger the 'value expression of labor hour'(a) is, the steeper OE becomes. The slope of OF(=OB/OC) in the second quadrangle depends upon the inverse of 'monetary expression of value'. The smaller the 'monetary expression of value' is, the steeper OF becomes. Therefore, the quantitative connection among labor hour, value and price is completely analyzed in the first and second quadrangle.

The problem, however, is that a and E' are not observable.

So, Dumenil-Foley-Lipietz tried to connect the sum of prices to the total labor hour by directly analyzing only the third quadrangle. That is, the magnitude of 'monetary expression of labor hour'(m0) determines the slope of OG.

By focusing on the third quadrangle, though, they overlooked the importance of the first and second quadrangles. Alternatively put, as the reduction from heterogeneous to homogeneous labor is passed over by simply presupposing 'it is well done', the uneven evolution of value production process across sectors is not pursued thoroughly.

In general, a and E' increase with the development of capitalism.

This is represented by the rotation from OG to OG' in the third quadrangle. So the total labor hour OA(=OD) corresponds to the sum of prices more than OC, that is OC'. However, there are two hidden processes that connect OA with OB' and OC'.

Suppose that in the process of transformation from the economy OA-OB-OC to OA-OB'-OC', there is no change in the product composition of the whole economy. Assume that the inflation rate is equal to CH/OC and it works even for all commodities. The quantity of use value corresponding to OC in the economy OA-OB-OC will then be equal to that corresponding to OH in the economy OA-OB'-OC'. Nevertheless, it means a smaller quantity of
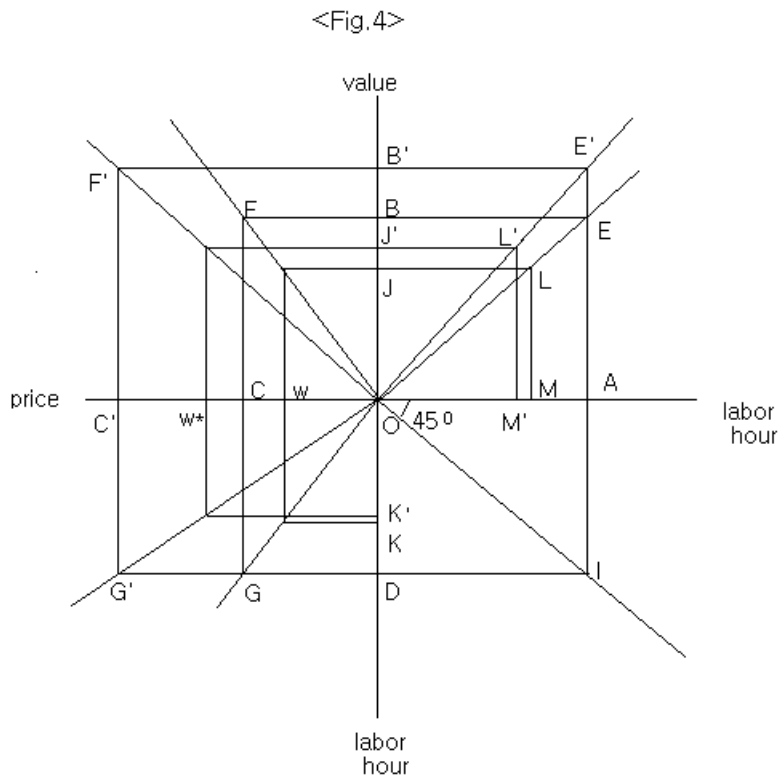
value produced, OB*. Therefore, the unit value of commodities decreases, which is consistent with the general tendency of capitalist accumulation.

<Fig.3>
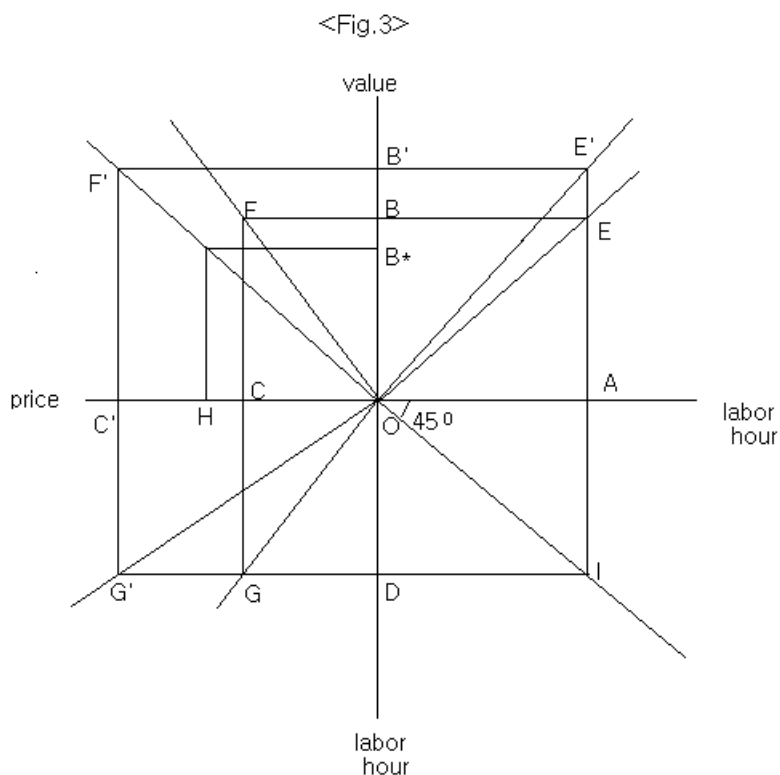
The problem of the value of labor-power is illustrated in Fig.4. If the wage rate is Ow in the economy OA-OB-OC, the value of labor-power is equal to OJ. According to Dumenil-Foley-Lipietz solution, though, it is equal to OK. Assume that the state of the

economy changes to OA-OB'-OC' and wage rate rises up to Ow*. Then the value of labor-power will rise up to OJ', but Dumenil-Foley-Lipietz might argue that it decreases to OK'.

Geometrically, in the OA-OB-OC economy the ratio of the value of labor-power(OJ) to the value sum of net product(OB) is equal to OL/OE and OM/OA. On the other hand, in the OA-OB'-OC' economy the value sum of net product and the value of labor power, respectively, are equal to OB' and OJ'. So this ratio is manifested by OJ'/OB', which is equal to OL'/OE' and OM'/OA. Therefore, this ratio decreases from OM/OA to OM'/OA in the process of transformation. In conclusion, the value of labor-power of Dumenil-Foley-Lipietz is actually expressed by this ratio, which is the reason we regard it as a first approximation.

<Fig.4>

value

B'   E'
F'
F   B
J'   L'
J   L
price   C w   M A
C'   w*   O 45⁰ M'   labor hour
K'
K
G'   G   D   I

labor hour

Now we can formulate the labor-value and the price system.

Firstly, in the conventional formulation of value system $v = vA + l$, l means the quantity of abstract labor of which the dimension is [v/i] where [i] means the physical measuring unit. If we denote the value of labor-power as W*, $l = mW^*(I+E) = (mW/m0)a(I+E)$. So value system can be formulated as below.

$$v = vA + l = vA + mW^*(I+E) = vA + (mW/m0) a(I+E) \qquad (4)$$

In (4), l is a vector of abstract labor resulted from the reduction of heterogeneous to homogeneous labor, which is equal to the sum of variable capital and surplus value. As m denotes a vector of actually purchased amount of labor, the sum of wage payment is equal to mW*. W* is a diagonal matrix whose principal diagonal elements are the sectoral value of labor-power(wi*). E is a diagonal matrix whose principal diagonal elements are the sectoral rates of exploitation(ei).

Secondly, price system is as below.

$$p = (pA + mW)(I+R) \qquad (5)$$

In (5), as p is a vector of market prices without presupposing the equal rate of profit, R is a diagonal matrix whose principal diagonal elements are the sectoral rates of profit(r_i). In addition, as the equal wage rate is not presupposed, W is not a scalar but a diagonal matrix whose principal diagonal elements are the sectoral wage rates(w_i).16) On the other hand, we can refute the Neo-Ricardian argument(Steedman,

1977) that if the technical conditions of production and the wage rate are given, relative prices and the rate of profit can be determined without any prior knowledge about value system, because it is after the determination of the sectoral structure of the rate of exploitation(E) that the relation between the amount of abstract labor(l) and that of actually purchased concrete labor(m) are determined.

$$mW = (1/a)m_0v(I-A)(I+E)-1 \qquad (6)$$

From (5),

$$mW = p[I-A(I+R)](I+R)-1 \qquad (7)$$

Equate (6) with (7),

$$(1/a)m_0v(I-A)(I+E)-1 = p[I-A(I+R)](I+R)-1 \qquad (8)$$

Therefore,

$$v = (a/m_0)p[I-A(I+R)](I+R)-1(I+E)(I-A)-1 \qquad (9)$$

Now we can confirm the implication of the equal rate of exploitation. If it is presupposed,

$$(I+E) = (1+e)I.$$

Therefore, (9) is transformed into

$$v = [a(1+e)/m_0]p[I-A(I+R)](I+R)-1(I-A)-1 \qquad (10)$$

From the two aggregates, i.e. (Sum V_i) = (Sum V_i') and (Sum S_i) = (Sum S_i'), we can calculate the magnitude of e with ease. Superscript ' here means the magnitude in price terms. Therefore, when the sectoral rates of exploitation are equalized, the structure of v vector(i.e. relative magnitude of value) can be determined. If, like Dumenil-Foley-Lipietz, we assume that a is 1, it can be uniquely determined. In other words, the equal rate of exploitation condition plays the role of connecting labor-value and price at micro-level. However, unless the sectoral rates of exploitation are equalized, there is no unique solution to (9), because it is an underdetermined system in which the number of equations, n is less than that of unknowns, 2n.

5. CONCLUSION

The task of the so-called 'transformation problem' in the third volume of Capital is to study the system of equilibrium prices in terms of labor-value on the conditions of equal rate of exploitation and profit. In a more general system (4)-(5) which connects the labor-value and market price, the exact quantitative connection at an individual commodity level cannot be found.

This does not mean that the labor theory of value is theoretically redundant, because the focal point of value theory consists in interpreting the interaction between labor productivity and income distribution in terms of uneven sectoral development of class conflict within the site of production.

The explanation of equilibrium prices is only a secondary task.

'Monetary expression of labor hour' can be reduced to the product of the ratio of value added to an index of use values produced and a ratio of the index of use values produced to labor hour expended. Labor-value is the very index measuring the quantity of use values produced. The argument of this paper is that this composition must be remembered especially when analyzing the uneven development. Without doubt, the difficulty is that we cannot calculate 'true labor productivity'. So, we need somewhat heroic assumption that the change rate of value added productivity mirrors that of 'value expression of labor hour'. Such an assumption is unavoidable, though, when we consider the problem of measuring relative rates of exploitation in different sectors of a national economy or different countries in the world economy.

FOOTNOTES

1. Much ink has been spilled over the problem of distinction between homogenized labor and abstract labor. For example, see Rubin(1972). In this paper, for analytical convenience, the two are regarded as the same concept.

2. Although the problem of dimensional consistency has been emphasized by Brody(1970) and Okishio(1982), they uniformly assume that all labors are homogeneous without explaining the concrete process of homogenization.

3. It is consistent with Marx's methodology to invert the process. He found the value concept in the process of 'inquiry' from the concrete to the abstract, and started from the latter in the process of 'presentation'.

In order to elucidate the quantitative connection between labor-value and price, we must take the process of 'inquiry' once again.

4. We can safely assume that the average of market wage is equal to the simple price of labor.

5. With regard to Marx's distinction between labor and labor-power, the following two points must be emphasized.

First, insofar as labor-power is a commodity, it must have use value.

Second, contrary to the case of commodity in general, value and use-value of labor-power are homogeneous.

6. Without doubt, there are many for-profit institutions for training and education. But, in Marx's terms, at least, the 'simple labor' itself is (re)produced in capitalist way.

7. Actually, the concept of value of labor-power as center of gravity for wage is negated here.

8. This is so-called 'monetary expression of labor hour' or the inverse of 'labor equivalent of money' by Dumenil(1980), Foley(1982) and Lipietz(1982) etc.

9. In this case the magnitude of the rate of exploitation can be calculated by the wage-profit ratio of the whole economy. This is because the sum of profit is definitionally equal to the sum of surplus value and total wage bill is equal to the value sum of labor-power.

10. Although not stressing the indeterminacy of the value quantities, at least in technical aspect, Roberts makes a similar argument with this paper.

For example, with regard to the problem of dimensionality in our terms, he argues that "one thing I would insist that we can't do is simply dismiss the issue[the so-called reduction problem - Rieu] by...assuming that...a clock hour of one sort of concrete labor has the same value-creating effect as a clock hour of another"(Roberts, 1996 : 13). Then he draws the conclusion that uniform rate

of exploitation for all types of concrete labors provides the additional information needed for the quantitative determination of value(Ibid., : 33-4). This paper places more emphasis on the indeterminacy aspect.

11. Krause(1982 : 83) correctly recognizes this point, but his concept of 'abstract labor' is somewhat misleading. Because it is nothing but a specific concrete labor chosen as numeraire and measured by calendar hour.

12. Here 'Sum' denotes summation(Sigma). This unusual notation is

entirely due to a technical problem with the typewriter.

13. If workers are not paid by hourly rate, m_i can be different from the purchased quantity of labor. As a matter of fact, the capitalist always tries to confine the time loss to the minimum limit. At one point of time, though, the quantitative relation between both of them is given. So we can assume away this problem.

14. The reason of using [v] is to emphasize that the quantity of abstract labor cannot be measured by calendar hour.

15. Roemer(1978) tried to prove that the differences in the rate of exploitation due to the elements except labor productivity might be deepened over time. His analysis implicitly rests upon the misleading assumption that the rate of exploitation can be calculated with respect to an individual worker. We assume that the differences due to socio-cultural elements(e.g. sex or color of skin etc.) remain constant. As the calculation of the rate of exploitation with respect to an individual worker is impossible, it is sufficient to assume that the relative ratio of the super-exploited workers in each sector is stable over a certain period of time.

16. We can confirm the dimensional consistency in (5). As each element of m means the concrete labor time expended per unit of commodity, its dimension is [hour/i]. And the dimensions of W and a are, respectively, [dollar/hour] and [v/hour]. Therefore, the dimension of $(mW/m0)$ (I+E) is $\{([hour/i]*[dollar/hour]/[dollar/hour]\}*[v/hour] = [v/i]$.

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