A Note on Disequilibrium Theory

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Introduction

Within the past several years, there have appeared a lot of criticism against the orthodox economic theory, by the American neoclassical school. The neoclassical standard textbook provides us three major paradigms of the pure theory to analyse the economy ;

(i) the general equilibrium apparatus with tâtonnement process for the determination of relative prices in the short run (micro-economic thery) ;

(ii) the income-expenditure model (IS-LM apparatus for determination of short run equilibrium levels of the national income., the rate of interest and the level of employment (Keynesian macro-economic theory) ;

(iii) the neoclassical growth theory with Harrod-neutral technological change for explaining the long run stylized facts.

These paradigms has submitted to criticism partly because the tndividual item has some weakness and partly because the lack oı iheoretical interrelations between these three models.

The general equilibrium theory, though it has the beautiful and rigorous mathematical structure, is obviously far from the realism. Kornai sentenced the general equilibrium theory to death, stating "it should be discarded because——owing to weaknesses of its basic ass-

umptions, concepts and question formation——it is useless as a real science theory."[1] Furthermore, the general equilibrium theory fails to incorporate imperfect competition and transaction costs.[2] Leijonhufvud claims that the income-expenditure model does not express the substance of the Keynes' General Theory. According to Clower and Leijonhufvud, the Keynes (not Keynesian) was concerned with "the problems of the 'short run,' i. e., of disequilibrium."[3]

The neoclassical growth theory is regarded as an example of the "neo-classical resurgence", because of its presumption of the full employment.[4] Some economists may be reluctant to assume the full employment even in case of long run.

In addition to the questions to the individual paradigm, the following question will arise; are there any theoretical interrelations between (i), (ii) and (iii)? First, one of the notorious scandals is the lack of the microeconomic foundations of the macroeconomic theory (the relation between (i) and (ii)).[5] In other words, there is great ambiguity about the relation between the general equilibrium theory and the Keynesian theory. Second, the relation of the short run macroeconomic theory with the long run macroeconomic theory is still ambiguous.

The aim of this note is neither to make a survey of all above disputes giving answers to them, nor to quest for the distinctions between Keynes' and Keynesian theories.[6] We concentrate our attention to the problem of the microeconomic foundations of macroeconmics. We relinquish the Walrasian presumption of the perfect velocity of price changes. We also admit the possibility of transaction out of the general equilibrium state, i. e., we will investigate dynamic behavior of the variables in succession of disequilibrium transations.

We take up the Clower model as an attempt to assert that transaction with involuntary unemployment is actually carried out in some occasions. Although Clower tried to examine the relationship between the general equilibrium theory and the Keynesian theory and to explain the Keynesian consumption function and the existence of unemployment from the choice-theoretic basis, his model leaves some defects, in particular, his model possibly fails to assert the execution of transaction according to his "short-side" principle some cases which Clower makes no reference to. Followings are some notations which will be used in the following sections.

x_t a column vector of quantities of consumers' goods, i. e., $(x_1 \ldots, x_i) \geqq 0$ where i is a finite positive integer. Supplied by firms, demanded by households, and produced from factors in the time interval t.

n_t a column vector of factors, i. e., $(n_1, \ldots, n_j)$, where j is an intger. Supplied by households, demanded by firms, In particular, we sometimes refer to the simple case of $i=1$, and $j=1$.

p_t a row vector of prevailing prices of consumers' goods at t, i.e., $(p_1, \ldots, p_i)$.

w_t a row vector of prevailing prices of factors, i. e., $(w_1, \ldots, w_j)$

r_t an amount of profit gained by firms at t. Hereafter we omit subscript t when it is so obvious.

f a production function. $f' > 0$ and $f'' < 0$.

u an utility function.

Superscipts;

d demanded,

s supplied,

* notional or microscopic optimal,

′ dual decided or constrained optimal,

^ actually transacted,

- given for t,

e equilibrium.

§1 A Consistent Interpretation of the Clower Model

The general equilibrium theory assumes that all trasactions are carried out only when a quantity of demand for a good just meets that of supply in every market under a certain set of prises, so called the equilibrium price. In case of disequilibrium (notional demand differs from notional supply in at least one market under a set of prices), the general equilibrium theorists expect that prices vary in accordance with the existence of excess demand or excess supply both in commodity markets and factor markets. The price continues to vary until it becomes the equilibrium price. This process is called as the tâtonnement process which is the same with so called the recontract system. Existence and stability of the general equilibrium has been studied mathematically by many economists for the last decade.

However, the economy depicted by the general equilibrium theory seems to be far from the observed economy, particularly the final consumption goods market. Moreover the general equilibrium theory is inconsistent with the transaction with the involuntary unemployment unless it is modified.

According to Clower, we construct a two-sector economy where households sell their labor service to consume goods and firms make goods out of labor.

Model

The values of notional demand and supply are calculated by

solving the maximization plan of households and firms under a given set of prices. A firm maximizes its profit r, following to the well-behaved production function, i. e.,

maximize $r=\bar{p}x^s-\bar{w}n^d$, with respect to n^d,

subject to $x^s-f(n^d)=0$.

The notional supply of goods are denoted by x^{s*} and the notional demand for labor by n^{d*}, such that $\bar{w}/\bar{p}=f'(n^d)$ $x^{s*}=f(n^{d*})$, and $r^*=\bar{p}x^{s*}-\bar{w}n^{d*}$.

On the other hand, a household maximises its utility, i. e.,

maximize $u(x^d, -n^s)$

subject to $\bar{p}x^d-\bar{w}n^s-\bar{r}=0$, where $\bar{r}$ is a parameter for a household. The solutions of the plan are denoted by notional demand for goods x^{d*} and notional supply of labor n^{s*} such that

$$\frac{\partial u/\partial x^{d*}}{\bar{P}}=\frac{\partial u/\partial n^{s*}}{\bar{w}}$$

Notional values are satisfying the budget constraint, then we get

$$\bar{p}(x^{d*}-x^{s*})+\bar{w}(n^{d*}-n^{s*})+(r^*-\bar{r})=0. \qquad (1)$$

This equation should be regarded as the Walras' Law in the sense of Lange. However, according to Clower the equation (1) will be regarded as the Say's Principle. This is a matter of definition.[7]

Definition of equilibrium

The general equilibrium can be defined as the state $x^{d*}=x^{s*}$ and $n^{d*}=n^{s*}$ provided that $r^*=\bar{r}$. Only in the general equilibrium "all transactions planned at prevailing prices can, in principle, actually be carried out."[8] The price that yields the state of the general equilibrium is called the equilibrium price, (p^e, w^e).

Justification of $r^*=\bar{r}$

About the equality of r^* and $\bar{r}$, Clower justified as follows; "Since

in general the variables r^* and $\bar{r}$ refer to completely independent individual experiments, we cannot assume that $r^* \equiv \bar{r}$. In the case of market experiments, however, it does seem plausible to suppose that $r^* = \bar{r}$ provided that the variables x^{i*} and n^{i*} have assumed their equilibrium values."[9] However the relation of $r^* = \bar{r}$ is required to define the equilibrium point, so that the justification of the relation can not use the equilibrium condition like the above provided clause.

The possible justifications of $r^* = \bar{r}$ might be as follws; (a) The transaction of the consumers' goods market is executed first, which means r becomes the actual value, and the labor market next. (b) The household has perfect foresight about the value of distributed profit. (c) $\bar{r}$ is anticipated value.

At least in Clower's context, (a) is meaningless for Clower concentrate his attention on the effect from the disequilibium labor market to the goods market, the direction of the spillover effect is adverse. So Clower seems to take (b), moreover Clower seems to assume implicitly that firms does not have constraints from any market, because he does not refer to dual decision of the firm.[10] However, this implicit assumption is inconsistent with the rule of transaction below. If $\bar{r}$ is an anticipated value as (c), the possiblity of violation againtst budget constraint may arise when the anticipated value is not realized.

Adjustment process

Clower admitted the possibility of varying prices; "it is plausible to suppose that prevailing prices tend to vary over time, rising in markets where demand exceeds supply, falling in markets where

supply exceeds demand."(11) However, we may interpret that the adjustment speed of quantity is more than that of prices in Clower's context. We may write as follows;

$$p_{t+1} - p_t \gtreqless 0 \quad \text{if } x_t^d - x_t^S \gtreqless 0, \quad \text{respectively}$$

$$w_{t+1} - w_t \gtreqless 0 \quad \text{if } n_t^d - n_t^S \gtreqless 0, \quad \text{respectively}$$

The rule of transaction

Clower specified the rule of transaction as the short side principle, i. e., the amount of actual transaction is equal to the amount of notionl (effective) demand if demand is less than supply, and to the amount of supply if supply is less than demand.

Plar vs.Realization

Case 1 Realized $\geqq$ Notional revenue for household ;

$\overline{w}\hat{n} \geqq \overline{w}n^{s*}$, then no modification on initial plan. "The functions x^{d*} and n^{s*} constitute relevant market signalling devices."

We point out that if the inequality holds strictly in above equation, it violates the short side principle. We believe Clower should have written the equation with equality only. We will discuss this point below. Case 2 Dual decision case ; Realized<Notional revenue ;

$\overline{w}\hat{n} < \overline{w}n^{s*}$, in this case consumers fail to sell his labor as much as they desired, so they have to maximize their utilities being constrained by their actual revenue. Households' modified plan or dual decision.

$$\begin{cases} \max \quad u(x^d, \hat{n}) \\ \text{st.} \quad \overline{p}x^d - \overline{w}\hat{n} - \hat{r} = 0 \end{cases}$$

Solution ; $x^{d\prime} = x^{d\prime}(\overline{p}, \hat{y})$, where $\overline{y} = \overline{w}\hat{n} + \overline{r}$.

"The functions $x^{d\prime}, n^{s*}$ are the relevant providers of market signals".

Validation of transaction

Clower assumes;

(a) A central "market authority" is responsible for setting all prices.

(d) No purchase order is "validated" unless it is offset by a sale order that has already been excuted.

(c) Sales orders are "validated" automatically, but the rate at which such orders are executed is governed by prevailing demend conditions.

(d) At some "initial" stage in the evolution of market trading arrangements, the market authority advances a nominal quantity of book credit to one or more transactors to set the trading process in motion.

Our comment;

We confirm that, although (a) seems to mean that a central market authority is the same as an auctioneer in the general equilibrium theory, they are completely different. This authority tends to maintain price levels in an interval once he has set them at the beginning of the interval. During the interval transactors can execute transaction through the rule of transaction. Otherwise, the Clower model becomes the same as the general equilibrium one.

We believe that (d) is an intrinsic assumption for the Clower model. In the general equilibrium theory, there is no need to assume such advances. Because there is no transaction into execution until notional demands meet notional supplies after tâtonnement process. (d) implies that there is the widespread of transaction from the first transactor to others. It seems to be important to specify which market is first under transaction. (d) also implies that "advances" should be explicitly introduced as parameters, and the formulation

of economic system should be written in discrete system.

Unemployment

From Walras' law, $\bar{p}(x^{d*}-x^{s*})+\bar{w}(n^{d*}-n^{s*})=0$, (4)

the involuntary unemployment ($\bar{w}n^{d*}<\bar{w}n^{s*}$) implies excess demand in goods market ($\bar{p}x^{d*}>\bar{p}x^{s*}$).

Assume that $\bar{w}(n^{d*}-n^{s*})<0$, Short-side principle implies $\bar{w}\hat{n}\leqq\bar{w}n^{d*}<\bar{w}n^{s*}$. If, in particular, j=1, then $n^{d*}=\hat{n}$.

Now that the aggregate demand for ccnsumers' goods diminishes to the extent of $\bar{p}(x^{d*}-x^{d\prime})=\bar{w}(n^{s*}-\hat{n})$,

where $\bar{p}x^{d*}>\bar{p}x^{d\prime}$ (5)

Clower states; "In a state of involuntary unemloyment, Walras' Law must be replaced by the more general condition,

$\bar{p}(x^{d\prime}-x^{s*})+\bar{w}(n^{d*}-n^{s*})\leqq 0$, (6)

i. e., the sum of all market excess demands, valued at prevailing market prices, is at most equal to zero. . . . . Contrary to the findings of traditional theory, excess demand may fail to appear any where in the economy under conditions of less than full employment." Our comment; suppose $n^{s*}<n^{d*}$, which Clower does not refer to, the state of labor market should be called (super) full employment. We can apply short side principle here.

$n^{d*}>n^{s*}=\hat{n}$

Then the firm must carry out dual decision, $x^{s\prime}$ ($<x^{s*}$) takes place of x^{s*}, while x^{d*} is still valid. valid. Then,

$\bar{p}(x^{d*}-x^{s\prime})+\bar{w}(n^{d*}-n^{s*})\geqq 0$, (6′)

for the first item more than makes up for the negative value of the second item.

We consider that Walras' Law should be formulated with

"notional" elements only, then it would identically vanish. Eqs (6) and (6′) are not like Walras' Law we usually consider.

We may think of the alternative adjustment process that the wage is inflexible only downward. When we assume the wage goes up when $n^{s*}>n^{d*}$, that is we take the price adjustment principle in a period instead of the short side principle, the firm's notional demand of labor, n^{d*}, which is now varying according to the wage upward adjustment, is always realized.

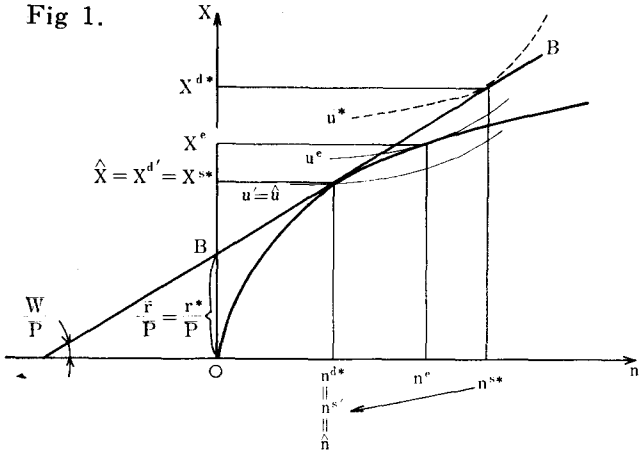
Anyway, since Clower does not mention the case of $n^{s}<n^{d*}$, probably because his intention is to analyse the Keynesian theory of the depressed economy from the viewpoint of the equilibrium theory,we could not specify Clower's answer to the question whether or not the wage is inflexible not only downward but also upward. We will prepare criticisms according to the possible answers; that is, whichever interpretation they may choose, the Clower's theory is inconsistent or incomplete in its logic. In order to show that, we should refer to Clower's Figure 1. and complete the the review of the Clower Model.

Interpretation of Clower's Figure 1.

Clower shows what will happen in the case of i=1, and j=1, that is there are only two markets of the aggregate good and labor. Clower's explanation; [13] $r^*=\bar{r}$, although we so far do not specify why so, means the coincidence of the value on x-axis of the budget line and that of the tangent line with the gradient of $\bar{w}/\bar{p}$ to the production function. (The value is denoted by B.) The former means the transfer income household can earn without offering their labor, the latter the earned profit by the firm provided that $n^{d*}=\hat{n}$.

Given $\frac{\bar{w}}{\bar{p}}$, the firm chooses the n^{d*} and x^{s*} by profit maximization

Fig 1.



plan. Consequently, r* is determined as a value on x-axis of BB′ line which is regarded as the budget equation by the household, and U* is the highest utility level under that budget constraint. Then n^{s*} and x^{d*} are determined.

Suppose, as Clower does so, $n^{s*} > n^{d*}$, then we can apply the short side principle, i. e., $\hat{n} = n^{d*} < n^{s*}$, now that the budget constraint is the segment AB. After dual decision of household, $x^{s*} = x^{d'}$ always holds, for in this case, the point A is necessarily the ut ility-maximizing point constrained by $\hat{y}$, provided that the utility function is strictly quasi-concave with respect to the consum ption aggregate good and leisure. Then $n^{d*} = \hat{n}$, $x^{s*} = x^{d'} = \hat{x}$, hold. Then the equation (6) holds with equality. $\hat{n}$ and $\hat{x}$ represent the temporal equilibrium, in the sence that the disequilibrium (in labor market) is completely absorbed in dual decision and was not carried over. In t+1 period, the same amounts of commodities will be transacted, if $\bar{w}_{t+1}/\bar{p}_{t+1} = \bar{w}_t/\bar{p}_t$. However, $\hat{n}_t$ and $\hat{x}_t$ may not be be the short-run equilibrium because the price tends to vary over

time unless it is the general equilibrium price. (See Adjustment process of prices, above.)

Our criticism; The case of Figure 1 is a very particular one where $i=1$ and $n^{s*}>n^{d*}$. We show how difficult it is to apply Clower's explanation to the case of $i\geqq 2$, and the case of $n^{s*}<n^{d*}$.

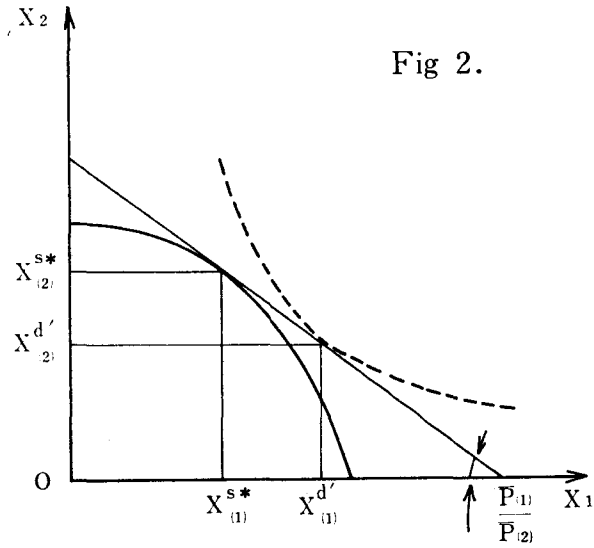
First suppose $n^{s*}>n^{d*}$, but $i=2$, which means there are two distinct consumption goods. After the dual decision, the household chooses the "effective" (which means really financed) demands for good 1 and good 2.

$x^{d'}{}_{(1)}(\overline{p}, \hat{y})$ and $x^{d'}{}_{(2)}(\overline{p}, \hat{y})$ where $\hat{y}=\overline{w}\hat{n}+\overline{r}$, $\hat{n}=n^{d*}<n^{s*}$ and $\overline{p}=(\overline{p}_{(1)}, \overline{p}_{(2)})$.

Since $\overline{p}$ is taken arbitrarily at the beginning of the period, there is no guarantee that $x^{d'}{}_{(1)}=x^{s*}{}_{(1)}$ and $x^{d'}{}_{(2)}=x^{s*}{}_{(2)}$. (see Figure 2) When $x^{d'}{}_{(1)}\gtrless x^{s*}{}_{(1)}$ and $x^{d'}{}_{(2)}\lessgtr x^{s*}{}_{(2)}$, respectively, what is the amount of transaction executed?

Possible answers are as follows; (a) $\overline{p}$ is happened to be the one which guarantees $x^{d'}=x^{s*}$, $i=1, 2$. To assume it *a priori* is to lose generality. (b) $\overline{p}^{e}$ (the price which guarantees the equilibrium both in $x_{(1)}$ and $x_{(2)}$ markets.) will be groped by tâtonnement process after the transaction in the labor market is carried out. This is in the framework of the general equilibrium theory without labor market, in other words, the equilibrium should be referred as a "second-best" solution. The thery could no longer be regarded as a disequilibrium theory. (c) The short side principle is valid in each commdity market. If $x^{d'}{}_{(1)}>x^{s*}{}_{(1)}$ and $x^{d'}{}_{(2)}<x^{s*}{}_{(2)}$, then $\hat{x}_{(1)}=x^{s*}$ and $\hat{x}_{(2)}=x^{d'}{}_{(2)}$. Then we can explain where the transaction takes place. This standpoint allows the firm to be possibly constrained on their notional values. According to this principle, just like in labor market, we can define

the transaction under disequilibrium. However, we must proceed the analysis where unsatisfied demand $(x^{d'}_{(1)} - \hat{x}_{(1)})$ and unsatisfied supply $(x^{s*}_{(2)} - \hat{x}_{(2)})$ go. If there left no carried-over diseqeuilibium (like Clower's particular case of Figure 1), the economy will be called at intertemporal equilibrium, and we can see the periods separately. However if there is the unsatisfied (ex post) supply or demand, we must specify the carried-over disequilibrium in the form of money balance or something like that. (d) We can introduce the concept of stock of goods, which will increase when $x^{s*} > x^{1'}$ and decrease when $x^{s*} < x^{d'}$. However we have to face with some difficulties which is caused by the introduciton of stock (see Hicks, "Capital and Growth", chapters 8 and 9).

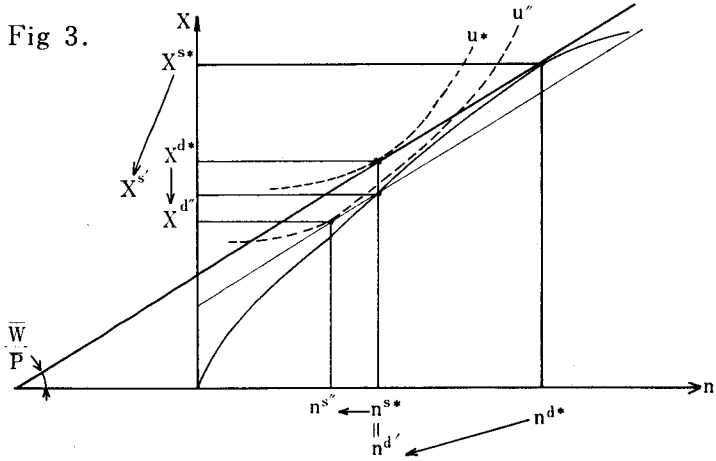


Secondly, suppose $n^s < n^{d*}$, i=1. The short side principle (verbally stated in page 21) in labor maket imposes the firm to reduce his labor demand. However, they cannot sell the amount of dual decided good

supply, because the point $x^{s'}$ may not be the utility maximizing point. (see figure 3).

What has happened? This is caused by the assumption of $r^*=\bar{r}$. At the time of the firm's dual decision, the notional profit has changed then household suffers the reduction of $\bar{r}$. It is easy to see

Fig 3.



that this process continues infinitely and no transaction will take place forever, or some disequilibrium will be carried over. This is not what we have intended to explain as disequilibrium theory. If we admit the upward adjustment of real wage when $n^{s*}<n^{d*}$, the analysis goes to the general equilibrium theory. That is not what we intend to analyse.

Finally, we could say that Clower's illustration holds only when $i=1$, $j=1$, and $n^{s*}\geqq n^{d*}$, and when labor market transaction is carried out first under the short side principle.(13) To analyse "disequilibrium" theory, the Clower Model is inconsistent or insufficient, which has happened partly because the assumption of $r^*=\bar{r}$ (which will lead to no-transaction in some cases). But the assumption is indispensable to

avoid the carrid-over disequilibrium., The difficulty also comes from no specification on the rule of transaction in good market.

Anyway, we have to have the model which either can be used to analyse the carried over disequilibrium, or does not cause the carried over disequilibrium provided that it is consistent and compete.

§ 2. Disequilibrium Model

(consistent formulation of the Clower Model)

1. A unit of time (a length of a period) is defined as the length required to execute transaction in the economy.

   A temporarily equilibrium is defined as that notional demand which economic agents planed at the begining of the period is realized.

   Goods are perishable (for sake of simplicity), a part of produced good that could not meet demand at t is assumed to be disappeared at t+1.

   One side of all trade is money, which means commodities do not buy other commodities.

   Prices do not change in a period, but do vary over time.

   Actual transaction is executed by the short side principle.

2. At the beginning of t, firm has M^F_t(fiat money), and production facilities.

   Household has M^H_t and T (disposable time duration). Prevailing price and wage are p_t and w_t, respectively.

   Firm plan ; naive myopic maximization of profit.

   1. profit-max. over one period,
   2. without anticipation of price change nor that of effective demand.

$$\begin{cases} \max r = p_t f(n^d_t) - w_t n^d_t, & f' > 0 \quad (1) \\ \text{ST } w_t n^d_t \leqq M^F_t \quad \text{Note; no need to assume } f'' < o & (2) \end{cases}$$

solution; n^{d*}, $x^{s*} = f(n^{d*})$, and r^*

3. Househld Plan; myopic maximizaton of current utility

$$\begin{cases} \max u = u(x^d_t, -n^s_t) & (3) \\ \text{ST } M^H_t + w_t n^s_t \geqq p_t x^d_t, \ n^s_t \leqq T & (4) \end{cases}$$

solution; n^{s*}_t, x^{d*}_t

Note; Consumer is not attracted by hoarding of money balance, Consumer can not spend profit devident which is distributed at the end of t, for the good market is already closed.

4. Transaction order of markets; labor→good→profit distribution.

labor market; short side principle means $\hat{n}_t = \min(n^{d*}_t, n^{s*}_t)$

5. Dual decision is made after transaction in labor market and production that requires no time duration, i. e., goods are produced just after the transaction of labor.

Now that Firm has; $x^{s\prime}_t = f(\hat{n}_t)$ effective supply (5)

in $n^{d*} \leqq n^{s*}$, then $x^{s\prime} = x^{s*}$

and $M^F_t - w_t \hat{n}_t$.

Household has; $M^H_t + w_t \hat{n}_t$, (6)

dual decision, if necessary

max u, st. $M_t + w_t \hat{n}_t \geqq p_t x^d$

solution; $x^{d\prime}$ (effective demand) if $n^{s*}_t \leqq n^{d*}_t$, $x^{d\prime} = x^{d*}$

in case of only one good, $x^{d\prime} = (M^H_t + w_t \hat{n}_t)/p_t$,

provided that there is no saturation.

6. Goods market in short side principle.

$$\hat{x}_t = \min(x^{s\prime}, x^{d\prime}) \quad (7)$$

then $\hat{r}_t = p_t \hat{x}_t - w_t \hat{n}_t$ (8)

$$\hat{u}_t = u(\hat{x}_t, -\hat{n}_t) \quad (9)$$

7. At the end of t, the profit $(\widehat{r})$ is assumed to be distributed from Firm to Household, in aggregate or in repesentative form,

$$M^F_{t+1}=M^F_t,$$

$$M^H_{t+1}=M^H_t.$$

8. At the instance of change from the end of t to the beginning of t+1, some adjustments will be carried out;

$$p_{t+1}=\alpha(x^{d\prime}-x^{s\prime})+p_t, \quad \alpha>0 \tag{10}$$

$$w_{t+1}=\beta(n^{d*}-n^{s*})+w_t, \quad \beta>0 \tag{11}$$

Note to 7; Equality of the nominal initial endowment of money is resulted from full distribution of profit. But this does not mean that the "real" initial endowment does not vary over time. The "real" endowment should be measured by M_t/p_t, which varies according to changes of p_t over time.

Moreover, if there are many firms and many households and distinct distributional coefficients, then initial endowment of a household or a firm is different time to time in nominal too.

Concluding Remarks

9. We could formulate the rule of transaction under disequilibrium state as a "short-side" principle. We assert that dual-decision hypothesis requires transactions in factor markets and goods markets not to coincide in time, and that which leads us to introduce money However, we could not show the inter-interval behavior of prices and amounts of transaction yet. Are they converging to the "equilibrium" state? We hope we can answer in near future.

Notes;

(1) Kornai, [6] p. 359

(2) Arrow, [1] p. 734 fn

(3) Leijonhufvud [7] p. 36

(4) Hines [5] p. 10

(5) Arrow [1] p. 734

(6) See the brilliant survey of the problem of "Keynes vs. Keynesian"; Grossman [4]

(7) Leijonhufvud [7] p. 91; *In the s.nse of Lange*, Walras' Law is the relation relevant to a money, whereas Say's Law applies only to barter systems and gives rise to "false dichotomies" and like troubles if misapplied to a money using system. *In the sense of Clower*, Walras' Law is irrelevant to the stability properties of a money economy, whereas Say's Principle expresses the transactor budget-constraints not just in a barter system, but in a money system as well.

(8) Clower [3] p. 106. Clower really stated his definition of the general equilibrium verbally.

(9) Clower [3] p. 107, with replacement of notaions.

(10) Barro-Grossman [2] put the Clower model togather with the Patinkin model. Barro-Grossman made the model both a household and a firm may suffer the constraint in labor and/or goods market. However, the order of markets of clearing may arise to question since the concept of dual-decision assume that the transaction is actually executed by short-side principle at out of the equilibrium price set.

(11) Clower [3] p. 106

(12) Clower [3] p. 122

(13) We thank professor Ara for his profound comment that we should rather devide households into "workers" (who choose leisure-income balance and receive profit devidend) and "Rentiers"

(who receive all profit $\hat{r}$, do no work, and consume all their income). When we follow it, the Fig. 3 case does not occur. This may be another solution to Clower's insufficiency.

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