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EFFECTIVE DEMAND AND NATIONAL INCOME: A MICROECONOMICS OF THE *IS-LM* ANALYSIS AND ITS APPLICATION TO THE STAGNATION OF THE JAPANESE ECONOMY

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Abstract: This paper develops a simple microeconomics of the *IS-LM* analysis with the intention of understanding controversies about the long-term stagnation of the Japanese economy and suggesting some remedies. Using an extended two-period model of the representative consumer with the Robertsonian consumption lag, I derive the Keynesian consumption function and liquidity function and formulate the *IS-LM* equilibrium on that basis. It contains the Keynes–Hansen 45 degree-line model of effective demand as a special case where the consumer has no liquidity preference, and the economy is caught in the zero-interest rate liquidity trap. The model supports the Monetarist's view that it is impossible to achieve full employment without providing enough money for transactions. It also endorses the Keynesian policy of fiscal expansion in the short run and structural reforms conducive to improving the public's expectations of future income in the long run as effective remedies for underemployment due to deficient aggregate demand. (JEL E10 E21 E24)

Key words: Consumption; Liquidity Preference; Liquidity Trap; Multiplier, The Japanese Economy.
JEL Classification Number:

1. INTRODUCTION

As the Japanese economy suffered from extremely slow or even negative growth and increasing unemployment for more than a decade since the collapse of the Bubble around 1992, policy makers and commentators were apparently divided into three distinct camps, Structuralists, Inflationisits, and Keynesians with respect to their diagnoses and policy proposals for Japan's conomic trouble. The Structuralists, adopted by the Koizumi cabinet of Japan, pointed to government budget deficits, banking system, social security system and anachronistic regulations on economic activities as the major factors responsible for the long stagnation and argued for structural reforms as

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indispensable prerequisites for revitalization of the ailing economy. They regarded fiscal and monetary stabilization policies as shortsighted and ineffective in view of the discouraging experiences in the troubled decade. Keynesians and Inflationists believed that the chronic deficiency of aggregate demand was the most important immediate cause of the depression and called for the continued execution of appropriate fiscal and monetary policies as measures inescapable for economic recovery, but their emphases were different. Naturally, Keynesians tended to support appropriately designed fiscal expansion or tax-cut as effective policy instruments to combat unemployment due to deficient demand. In contrast, Inflationists, e.g., Krugman (1998), advocated the creation of long-run inflation by means of steady expansion of monetary base (the so-called inflation targeting policy).

What are their underlying economic models? Some extreme structuralists may be sympathetic to the neoclassical macroeconomic model in which the aggregate market economy behaves as if it were planned and foreseen by a rational individual possessing perfect information about its structure and, therefore, any governmental stabilization policy is not just unnecessary and but also harmful. This model is, however, too unreal to be accepted by policy-minded economists even in the structuralist camp. The old IS-LM model seems to be still influential among practical economists belonging to the Inflationist and Keynesian camps, but it is no longer fully supported by academics because of its lack of microeconomic foundations[1]. There are ceratainly some attempts by the New Keynesians, beginning with Kiyotaki and Blanchard (1987) and Kiyotaki (1988), to provide various policy-oriented macroeconomic models with microeconomic foundations.[2] They typically introduce monopolistic competition among firms (or households) and invoke the existence of menu costs, or coordination failures among firms to justify government intervention (such as monetary expansion) in the market economy. The phenomenon of underemployment envisaged in these models is attributable to the assumption of monopolistic competition rather than to the deficiency of aggregate demand. They are perhaps far away from the view of the world entertained by practical present-day Keynesians as well as old Keynesians. Apparently, they are not designed to match the world of structuralists and inflationists either.

The present paper attempts to construct a new microeconomics of the IS-LM analysis focusing on the deficiency of aggregate demand as the culprit of economic depression and capable of embracing at least partially the views of all three camps of economists mentioned above. In this connection, we should note that Krugman (1998) also proposed a useful model of an aggregate Keynesian economy with a microeconomic foudation. His model is, however, too simple as a reformulation of the IS-LM model in its treatment of money, long-run expectations, and government to compare and discuss various policy measures. In this paper, we present an alternative and much

[1] For instance, see McCallum and Nelson (1999) for a review of the main criticisms of the IS-LM approach. Nevertheless, the IS-LM model is adopted as the main workhorse for the analysis and exposition of macroeconomic phenomena in such relatively new and popular textbooks for undergraduate students as Mankiw (1992) and Blanchard (1997).

[2] For a survey of the literature, see Silvestre (1993).

more structured model consistent with the representative consumer's optimizing behavior. As a price of detailed analysis of the demand side of the economy, we simplify here the supply side of the economy abandaning the ful rationalization of the model. This setup not only follows the tradition of the IS-LM analysis but also reflects the widely accepted observation that the long-term slump of the Japanese economy was partly attributable to its high saving rate or low propensity to consume. The structure and major conclusions of the paper are as follows.

In Section 2, we shall formulate the representative consumer's optimizing behavior in the economy in which money serves not only as a means of payment circulating from producers to consumers and then from consumers back to producers with a one-period time lag as in the Robertsonian period analysis[3] but also as a store of value when bonds (or loan contracts) are exposed to default risks as emphasized by Keynes (1936). In Section 3, we shall derive the "Keynesian" consumption function and liquidity preference function which depend negatively on the nominal rate of interest, and positively on current disposable national income, financial wealth and the consumer's expectations of future income flows. The last factor reflects the consumer's perception of job opportunities, national productive capacity and social security system in the future. It is important especially because Structuralists, Inflationists and Keynesians all agreed that the public's low expectations concerning future income was substantially responsible for the stagnation of the Japanese economy. Section 3 will then define the market equilibrium of the economy and lay a microeconomic foundation of the IS-LM analysis. Section 4 will be devoted to the analysis of monetary and fiscal policies and Section 5 to the discussion of other disturbances exogenous to the model. The present model clearly supports the old Monetarist's view that it is impossible to achieve full-employment national income without providing enough money for transactions. Also, it will show that monetary expansion by means of open market operation is not effective when the aggregate effective demand is extremely weak and the nominal interest rate is close to zero as in the Japanese economy at the beginning of the 21st century. In order to boost the economy under such a circumstance, it is therefore necessary to adopt Keynesian policies such as tax cut and government spending in the short run, and to carry out structural reforms conducive to improving the public's expectations of future income in the long run. The creation of inflation expectations by continued monetary expansion *à la* Krugman (1998) may also be helpful if it succeeds in increasing the present value of expected flows of future income.

In section 6, we shall consider the special case of the present model where there is no demand for money as a store of value, or to put it differently, bonds are received to be riskless. This is the so-called Monetarist case in which the LM curve becomes vertical. Rather surprisingly, it will turn out to replicate the simplest Keynesian model of effective demand as developed in Keynes (1936, Chapter 3) and illustrated by Hansen (1953) when the economy is caught in the zero-interest liquidity trap. For instance, an increase in government spending will be shown to exert a positive multiplier effect on

[3] Robertson (1926).

national income without crowding out private expenditure. It differs, however, from the standard version of the Keynesian model in the sense that money is important here. The monetary authority must increase money supply either by open-market operation or by money printing in order to realize the increase in national income. The usual exposition of the Keynes–Hansen model ignores this monetary implication of fiscal policy. As long as money supply is increased by open market operation, all the results of comparative statics in the Keynes–Hansen model are valid in the present model including the balanced budget proposition that the fiscal multiplier is equal to unity in case of tax-financed increase in the government spending. In case of money printing, however, the multiplier effects of autonomous spending will be enhanced and the balanced budget multiplier will become greater than unity. In Section 7, we consider some dynamic implications of the present model allowing for statically rational income expectations and adjustment of the price level in response to the gap between full employment and actual incomes. Finally, Section 8 concludes the paper by pointing out some limitations of the present analysis.

2. CONSUMPTION AND LIQUIDITY PREFERENCE

We consider an extended two-period economy in which there are many identical consumers who behave as if they were one giant consumer. The representative consumer plans to consume in the current period and also store some real purchasing power for future consumption without distinguishing consumption expenditures in different future periods. Her income is paid in money every period in the form of wages, dividends and interest from her labor and capital (loan) services delivered in the preceding period. For simplicity and definiteness, let us assume that the representative consumer's utility function at the beginning of period t is of the following log-linear form:

$$u_t = \ln C_t + (\beta - \gamma) \ln R_{t+1} + \gamma \ln L_t\,, \quad \beta > \gamma, \gamma \geq 0, \tag{1}$$

where C_t is real consumption in period t, R_{t+1} is the real purchasing power the consumer plans to hold at her disposal in period $t + 1$ for future consumption through financial and non-financial arrangements (to be explained later), and L_t is the part of R_{t+1} she plans to store in the form of real cash balance.[4] Note also that money plays a role as a store of value. Our interpretation of the money-in-utility assumption is quite different from the usual explanation that money holding represents the utility derived from consumption in all future periods, or that it reduces implicit transactions costs.[5] We take it to mean that there is some uncertainty about the real value of loan contract in view of possible default and parameter γ reflects the consumer's evaluation of this uncertainty. The greater the value of γ is, the greater her perception of or aversion to

[4] When $\gamma = 0$, R_{t+1} can be interpreted as the composite commodity of future consumption goods, given the expected rates of interest and inflation in future periods. See Hicks (1939), Mathematical Appendix.

[5] For instance, see Neary and Stiglitz (1983), or McCallum and Nelson (1999).

this uncertainty is.[6] We believe that the present modelling of the consumer's behavior is one of the possible ways to formulate her intrinsic nearsightedness and bounded rationality.[7]

We assume that there is only one good called the "national product". Firms produce the national product using labor and capital stock and finance their investment (if any) by borrowing from consumers in each period. The government finances its expenditure by taxing consumers. For simplicity, the government is assumed here to keep balanced budget. The central bank is assumed to control money supply either by engaging in open market operation or by printing money at the beginning of each period. In case that the consumer is fully aware of her ownership of firms, the private loans cancel out each other. Here, the consumer is supposed to respect her interest income and distinguish it from her non-interest income consisting of wages and dividends. In the contemporary capitalism characterized by separation of ownership and management, the present assumption seems more natural.[8] At the beginning of each period, the consumer is supposed to prepare money for consumption, tax payment and saving out of interest and non-interest money incomes obtained from firms as rewards to the services she delivered in the preceding period and cash balances carried over from the preceding period. Thus, money serves as a means of payment as well. The consumer's consumption in period t is constrained by

$$p_t(C_t + T_t) \leq p_{t-1}X_{t-1} + (1 + i_{t-1})A_{t-1} + p_{t-1}L_{t-1} - A_t - p_t L_t + \Delta M_t - \Delta H_t, \tag{2}$$

where p_t and T_t denote the price level and tax payment (fixed in real value) in period t, p_{t-1} and X_{t-1} the price level and non-interest real income in period $t-1$, i_{t-1} the nominal rate of interest in period $t-1$, A_t and A_{t-1} the nominal value of bonds purchased in periods t and $t-1$ and L_{t-1} the real cash balances carried over from period $t-1$. There are also variables standing for the central bank's operation: ΔM_t is its monetary injection and ΔH_t is its purchase of private bonds (or lending certificates) at the beginning of period t. For simplicity, we assume that there are only-fixed price bonds, or certificates of lending, tradable with variable interest rates. If the central bank increases money supply by purchasing operation, $\Delta M_t = \Delta H_t > 0$. If it increases money supply by just printing money and giving it away, $\Delta M_t > 0$ and $\Delta H_t = 0$. The consumer's non-interest income, X_t, consists of wages and dividends paid out by firms.

The amount of purchasing power she expects to obtain in period $t+1$ and after through current saving and future earnings is

[6] (1) can also be written

$$u_t = \log C_t + \beta \log R_{t+1} + \gamma \log(L_t / R_{t+1}).$$

Thus the consumer is concerned about the proportion of purchasing power held in the form of real cash balance, apart from the size of the total purchasing power itself, which she plans to carry over to period $t+1$.

[7] See Neary and Stiglitz (1983) for an early attempt to formulate a similar extended two-period model. The present model differs, however, from theirs in the treatment of money and lending among other things.

[8] Keynes' critique of Say's law is also based on the recognition that the savers (consumers) and investors (producers) are different agents acting independently of each other. See Keynes (1936), pp. 18–21.

$$p^e_{t+1} R_{t+1} = p_t X_t + p^e_{t+1} Z_{t+1} + (1 + i_t) A_t + p_t L_t \,, \tag{3}$$

where p^e_{t+1} is the price level expected to prevail in period $t+1$, X_t is non-interest income in period t, i_t is the nominal rate of interest in period t and Z_{t+1} is the real current value (in period $(t+1)$) of her after-tax non-interest income flows expected to be earned in all future periods. It captures the consumer's long run expectations regarding her future earnings. We assume that Z_{t+1} is given as a finite value. Given the expected flows of real non-interest income, its current value increases with the expected rate of future inflation and decreases with her subjective discount rate of expected future incomes, as well as with the expected rate of interest.[9]

From (2) and (3), we obtain

$$C_t + \frac{1+\pi_t}{1+i_t} R_{t+1} + \frac{i_t}{1+i_t} L_t \leq \frac{1}{1+i_t} X_t - T_t + \frac{1+\pi_t}{1+i_t} Z_{t+1} + \frac{M_t + H_t}{p_t} \,, \tag{4}$$

where π_t $(= (p^e_{t+1} - p_t)/p_t)$ is the expected rate of inflation from period t to period $t+1$, M_t is money supply in period t consisting of non-interest income from the firms' sale in period $t-1$, interest income from lending to firms in period $t-1$, and monetary injection from the central bank in period t, i. e.,

$$M_t = p_{t-1} X_{t-1} + i_{t-1} A_{t-1} + L_{t-1} + \Delta M_t = M_{t-1} + \Delta M_t \,. \tag{5}$$

and H_t is the amount of bonds held by the consumer after transactions with the central bank at the beginning of period t, i.e.,

$$H_t = A_{t-1} - \Delta H_t \,. \tag{6}$$

Thus $M_t + H_t$ is the consumer's financial wealth disposable in period t. Henceforth, let us write

$$V_t = M_t + H_t \,. \tag{7}$$

for brevity. When $\Delta M_t = \Delta H_t = 0$, we have $V_t = M_{t-1} + A_{t-1}$. It is then a historical data exempt from the market operation of the monetary authority.

Given i_t, p_t, π_t, X_t, T_t, V_t and Z_{t+1}, the consumer is supposed to maximize her utility function, u_t, in (1) with respect to C_t, R_{t+1} and L_t subject to the consolidated budget constraints (4). From the first-order condition for maximization, the optimal solutions are derived as follows:

$$C_t = \frac{1}{(1+\beta)(1+i_t)} \left(X_t - (1+i_t)\left(T_t - \frac{V_t}{p_t} \right) + (1+\pi_t) Z_{t+1} \right) , \tag{8}$$

$$L_t = \frac{\gamma}{(1+\beta) i_t} \left(X_t - (1+i_t)\left(T_t - \frac{V_t}{p_t} \right) + (1+\pi_t) Z_{t+1} \right) , \tag{9}$$

$$R_{t+1} = \frac{\beta - \gamma}{(1+\beta)(1+\pi_t)} \left(X_t - (1+i_t)\left(T_t - \frac{V_t}{p_t} \right) + (1+\pi_t) Z_{t+1} \right) . \tag{10}$$

The consumer will not purchase bonds when the nominal rate of interest is negative. Were it be negative, she would certainly be able to store value merely by hoarding

[9] See Appendix for an illustration of this concept.

money with less costs than by buying bonds. Consumption function and liquidity preference function given by (8) and (9) will be of central importance in the ensuing analysis as building blocks of the temporary market equilibrium to be defined below.

3. MARKET EQUILIBRIUM

Let us turn to the temporary market equilibrium of the economy in period t where the current markets for the product and financial transactions are cleared. We assume away futures markets. In order to focus on the demand side of the economy, we simplify the supply side by assuming that the aggregate supply is constrained only by

$$b_t(Y_t + \delta K_t, K_t)(Y_t + \delta K_t) \leq N_t\,, \tag{11}$$

where Y_t is the net national product (or alternatively national income), $b_t(Y_t + \delta K_t, K_t)$, is labor input per unit output, K_t is aggregate capital stock available in period t. δ is the rate of capital depreciation, N_t is the aggregate supply of labor assumed to be given in period t. Given production technology and aggregate capital stock, labor input per unit output, $b(Y_t + \delta K_t, K_t)$, is assumed to be a non-decreasing function of aggregate output, $Y_t + \delta K_t$, over the relevant range. The classical system is characterized by the assumption that (11) is satisfied with strict equality by the adjustment of real wages. We denote by Y_{Ft} the full-employment income, or the value of Y_t that satisfies (11) with equality. In contrast, the Keynesian system that we consider in this paper deals with the case that (11) is satisfied with strict inequality on account of wage rigidity and deficient aggregate demand for national product. Firms are assumed to produce as much as there is demand for the product in the market.

The national income in period t is composed of non-interest and interest incomes paid out by firms, i. e.,

$$p_t Y_t = p_t X_t + i_t A_t\,. \tag{12}$$

Let us rewrite (8) and (12) using the concept of national income rather than non-interest income. The consumer's budget constraint (2) satisfied with equality and the definition of money supply (5) imply

$$A_t - H_t = M_t - p_t(T_t + C_t + L_t)\,. \tag{13}$$

Substituting (12) and (13) into (8) and (9), we obtain

$$[(1+\beta)(1+i_t) - i_t]C_t - i_t L_t = W_t\,, \tag{14}$$

$$-\gamma i_t C_t + (1 + \beta - \gamma) i_t L_t = \gamma W_t\,, \tag{15}$$

where

$$W_t = Y_t - T_t + (1+\pi_t)Z_{t+1} + \frac{V_t}{p_t} \tag{16}$$

stands for the value of the national wealth in period t. Solving (14) and (15) for C_t and L_t yields

$$C_t = \frac{1}{1 + (1 + i_t)(\beta - \gamma)} W_t , \tag{17}$$

$$L_t = \frac{(1 + i_t)\gamma}{[1 + (1 + i_t)(\beta - \gamma)]i_t} W_t . \tag{18}$$

Equations (17) and (18) may be regarded the "Keynesian" consumption function and liquidity preference function in period t. Both of them are increasing functions of disposable non-interest income and financial wealth in period t and of the real value of disposable non-interest income flows in period $t + 1$ and thereafter.[10] Both of them depend positively on the expected rate of inflation and negatively on the nominal rate of interest in period t. The present model also embraces the Monetarist (or classical) case in which parameter γ is zero and liquidity preference disappears.

The equilibrium condition for the product market in period t is given by

$$C_t + I_t + G_t = Y_t , \tag{19}$$

where I_t is net investment, G_t is real government expenditure in period t. To focus on the basic structure of the present model, we assume that the government budget is balanced every period (specifically, $G_t = T_t$), and there is no outstanding government debt. The equilibrium conditions for money market are then written,

$$L_t + (C_t + I_t + G_t) = \frac{M_t}{p_t} , \tag{20}$$

$$\frac{A_t - A_{t-1}}{p_t} = I_t . \tag{21}$$

The first term on the left-hand side of equation (20) stands for "speculative" demand for money, the second bracketed term for "transactions" demand for money.[11] Equation (21) describes equilibrium in the bond market where private investment in period t is financed by increased loan contract in the same period. In view of (13), however, equation (21) is not independent of (19) and (20) in the sense that it is satisfied when the latter equations are satisfied. Ignoring (21), therefore, let us concentrate on equations (19) and (20) in what follows.

Substitute (17) into (19) to obtain the IS equation in the present model:

$$(Y_t - G_t - I_t)(\beta - \gamma)(1 + i_t) = I_t + (1 + \pi_t)Z_{t+1} + \frac{V_t}{p_t} . \tag{22}$$

Similarly, (18), (19) and (20) lead to the LM equation:

$$Y_t + \frac{(1 + i_t)\gamma}{[1 + (1 + i_t)(\beta - \gamma)]i_t}\left[Y_t - G_t + (1 + \pi_t)Z_{t+1} + \frac{V_t}{p_t}\right] = \frac{M_t}{p_t} . \tag{23}$$

We basically assume that V_t, I_t, G_t, Z_{t+1} and π_t are exogenously given in this system.[12] There are potentially four endogenous variables, i_t, p_t, M_t and Y_t, in equations

[10] Some may argue that they are not Keynesian in view of their dependency on financial wealth including real cash balances.

[11] See Keynes (1936), p. 199.

[12] Except for the case in which the central bank is assumed to provide helicopter money.

(22) and (23). The classical equilibrium obtains when Y_t is determined to satisfy (11) at its full-employment level, Y_{Ft}, and the equilibrium values of i_t and p_t are endogenously determined so as to satisfy (22) and (23) with M_t given by the central bank and $\gamma = 0$. On the other hand, the usual Keynesian IS-LM equilibrium is defined as the state of economy where i_t and Y_t are endogenously determined with p_t and M_t exogenously given and the supply-side constraint (11) satisfied with strict inequality. The implicit assumption here is that money wage, and therefore, real wage are given at a level sufficiently low to induce profit-seeking firms to produce as much as there is demand for their product but sufficiently high to motivate the consumer-worker to supply labor. There are alternative practically important versions of the classical and Keynesian equilibria with the assumption that the central bank adjusts money supply to achieve a given target level of interest rate. In this alternative versions, M_t is endogenously determined for the given value of i_t.[13] Follwing convention, however, we confine ourselves to the usual Keynesian IS-LM equilibrium in this paper.

In most of what follows, we thus adopt the standard version of the IS-LM model where the central bank is assumed to follow a money supply rule in the words of Romer (2000) committing to a given target volume of money supply. The left-hand side of the above equation system contains two endogenous variables, i_t and Y_t, whereas the right-hand side contains exogenous variables only. Without explicitly solving the system, one can show that there is a unique economically meaningful pair of equilibrium interest rate and national income when money supply is sufficiently large. Consider Figure 1 that displays a version of the familiar IS-LM diagram on the assumption that $M_t/p_t > I_t + G_t$. The downward sloping IS curve depicts the combination of i_t and Y_t that satisfies equation (22). It is part of a rectangular hyperbola with horizontal asymptote passing through point $(-1, 0)$ and vertical asymptote passing through point $(0, I_t + G_t)$.The upward sloping LM curve shows the combination of i_t and Y_t that satisfies equation (23). It is part of a quadratic curve along which Y_t converges to M_t/p_t as i_t tends to infinity. Clearly, there is only one intersection of the IS and LM curves where i_t and Y_t are positive and Y_t is greater than $I_t + G_t$ and smaller than M_t/p_t.

PROPOSITION 1. *Given the private autonomous investment, the government expenditure and money supply such that $M_t/p_t > I_t + G_t$, there exists a unique meaningful equilibrium where the national income and interest rate are adjusted to clear both product and money markets.*

Having confirmed the unique existence of the IS-LM equilibrium, we now turn to some comparative statics of the system.

4. FISCAL AND MONETARY POLICIES

Figure 1 makes it clear that the equilibrium value of Y_t is trapped between $I_t + G_t$ and M_t/p_t. On the one hand, there would be no product left for consumption if $Y_t \leq I_t + G_t$. On the other hand, there would not be enough money for hoarding and transactions

[13] For example, Romer (2000) proposes with good reasons these alternative versions of the IS-LM model.

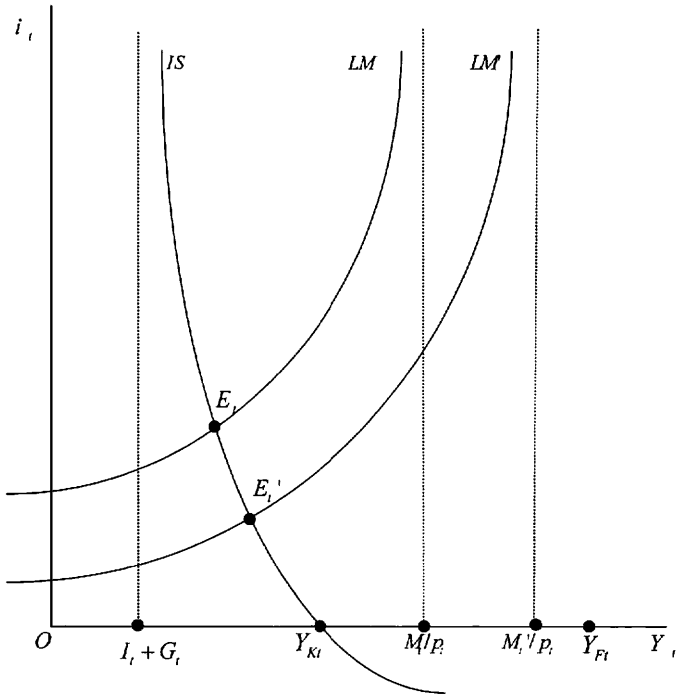

Figure 1. The *IS-LM* Equilibrium and Monetary Expansion.

if Y_t exceeds M_t/p_t. From the viewpoint of macroeconomic policy, it is especially important to recognize that the equilibrium value of Y_t cannot exceed M_t/p_t. Thus, the government may not be able to achieve full employment national income, Y_{Ft}, by fiscal policy alone. Figure 1 illustrates this point by showing the case in which M_t/p_t is smaller than Y_{Ft}. In such a case, it is simply impossible to achieve full employment in equilibrium without increasing real cash balances. In other words,

PROPOSITION 2. *If the full employment of labor is to be achieved in the IS-LM equilibrium, real money supply must be equal to, or greater than the full-employment national income.*[14]

The role of monetary policy for the purpose of securing full employment is twofold. First, as Proposition 2 suggests, it must provide a sufficient amount of money supply to keep real balances above the level of full-employment national income. This role is often overlooked in the standard textbook of Macroeconomics. Second, it can increase

[14] Note that the length of period is chosen in the present model so as to make the income velocity of money exactly equal to one. The length of period employed for practical purposes may be longer or shorter than in this benchmark case so that the minimum level of money supply compatible with full-employment may actually appear to be only a certain proportion of the full employment national income.

national income and employment by increasing money supply when national income is less than the full employment level. In fact, an increase in money supply by means of open-market purchasing of government bonds does not affect the IS curve but shifts the LM curve rightward bringing about a fall in interest rate and a rise in national income. This analysis of monetary policy is only familiar to any student of Macroeconomics. Regarding this second role, however, the present model also reveals the important but often ignored point that monetary policy of this type alone may not be capable of achieving full employment when the level of aggregate demand is extremely low. To see this point, note that no one would be willing to lend money if the nominal rate of interest were negative. Therefore, the equilibrium value of nominal interest rate cannot be negative. Denote by Y_{Kt} the effective demand for national product when the nominal rate of interest is zero. It is given by setting $i_t = 0$ in (22) as

$$(\beta - \gamma)Y_{Kt} = (1 + \beta - \gamma)I_t + (\beta - \gamma)G_t + (1 + \pi_t)Z_{t+1} + \frac{V_t}{p_t}. \tag{24}$$

Now, Y_{Kt} may be smaller than Y_{Ft} in deep depression where the determinants of aggregate demand in the right-hand side of (24) are very weak. Figure 1 depicts such a situation. Note that the central bank's open market operation does not affect the value of the consumer's financial asset, $M_t + H_t$. Thus it cannot increase the national income beyond Y_{Kt} and hence cannot achieve the full employment if $Y_{Kt} < Y_{Ft}$.

PROPOSITION 3. *Monetary expansion by means of open market operation lowers the rate of interest and thereby increases the national income. It is, however, incapable of achieving full-employment income in deep depression where* $Y_{Kt} < Y_{Ft}$.

It is certainly possible, however, to achieve full-employment income even under such a circumstance, by printing money and giving it to the public as income subsidy (the so-called helicopter-money injection). This method of monetary expansion is effective since it increases V_t, or $M_t + H_t$. It can be regarded as a combination of monetary policy (money printing) with fiscal policy (tax cut) to which we now turn.

Let us consider the effect of a fiscal expansion when money supply is insufficiently provided. By assumption, the present model only allows for balanced budget expansion to secure full employment. The usual textbook presumption is that the associated fiscal multiplier is less than unity since the balanced budget multiplier would be unity only when the rate of interest were unchanged but it actually rises as a result of the fiscal expansion. In the present model, the balanced budget multiplier should also be less than unity, but greater than the size of usual presumption. The inspection of (22) and (23) immediately reveals that the IS curve shifts rightward exactly by the size of the increase in the government expenditure and the LM also shifts rightward by less than the shift of the IS curve. Figure 2 shows this case where it shifts the LM curve concomitantly in the rightward direction to dampen the rise in the interest rate and alleviating its crowding-out effect.

PROPOSITION 4. *Suppose that the consumer has a positive liquidity preference, i.e.,* $\gamma > 0$. *A tax-financed increase in the government expenditure raises interest rate*

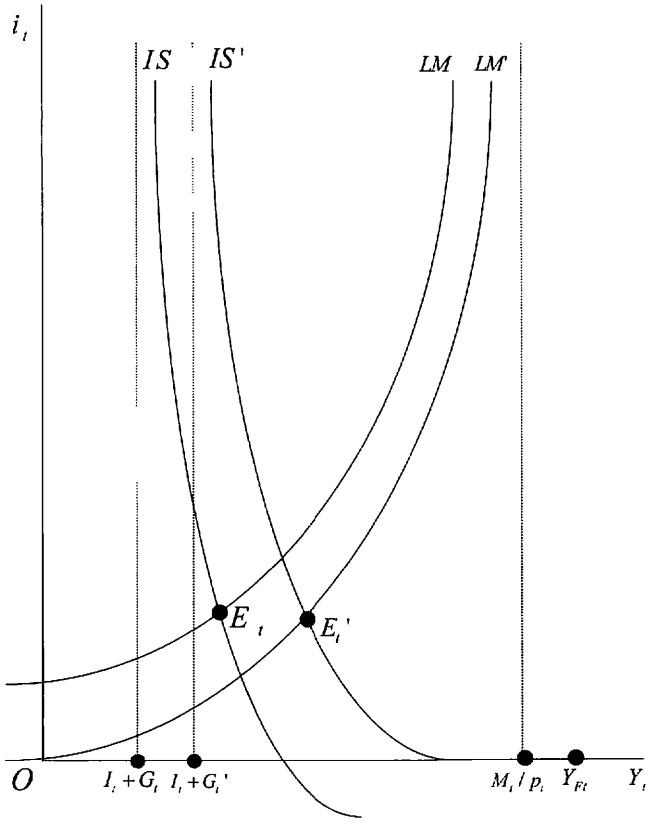

Figure 2. Fiscal Expansion.

and increases the national income. The associated fiscal multiplier is less than one but greater than the magnitude implied in the standard textbook where the LM curve remains unaffected in the face of balanced-budget fiscal expansion.

The rate of increase in national income will decrease, however, as the government expenditure increases. A concomitant sharp rise in the rate of interest will crowd out consumption expenditure to offset the increase in the government expenditure as national income approaches the available amount of real cash balances. The effect of autonomous investment on national income is presumably greater than that of fiscal expansion of the same size because the former shifts the IS curve much more than the latter although it leaves the LM curve unaffected.

5. KNIGHTIAN UNCERTAINTIES AND OTHER DISTURBANCES

At this point, we wish to draw the reader's attention to two distinct sources of Knightian uncertainty latent in the present model economy. One is uncertainty about future earnings. The consumer is supposed to estimate the exact value of her future non-interest incomes but may not feel certain about her estimation. For instance, she may have static expectations with respect to future earnings but feel uncertain about them. This kind of Knightian uncertainty is likely to affect her utility function. We assume that her discount rate of expected future incomes rises to decrease the discounted value of her expected future incomes, Z_{t+1}, when her sense of uncertainty gets stronger.[15] This decreases her disposable wealth W_t thereby shifting IS curve leftward and the LM curve rightward. The inspection of (22) and (23) immediately reveals, however, that the the shift of the IS curve is larger than that of the LM if β is not too amall and γ is not too large.[16]

PROPOSITION 5. *Suppose that the consumer has a positive liquidity preference, i.e., $\gamma > 0$. An increase in the uncertainty of future earnings will lower the interest rate and decrease the national income under normal circumstances.*

Clearly, a rise in the the present value of the future earnings, $(1+\pi_t)Z_{t+1}$, increases the disposable wealth and exerts positive effects on the national income.[17] These comparative statical results may be taken to endorse some policy proposals for combating structural depression due to deficient aggregate demand. For instance, some argue for creating expectations for inflation (e.g., Krugman (1998)) and others for carrying out reforms in government public enterprises (e.g., the Koizumi cabinet of Japan at the beginning of the 21st century) as possible remedies for the decade-long depression in the Japanese economy. In view of the present model, these proposals are meaningful as long as they are capable of increasing the consumer's expected future earnings, $(1+\pi)Z_{t+1}$, in one way or another.

Another source of uncertainty is the possible default of loan contract, which gives rise to liquidity preference. The consumer is supposed to possess no knowledge of objective probability distribution of default but perceive uncertainty of loan contract and translate it into her liquidity preference. The intensity of liquidity preference is here summarily indicated by parameter γ. An increase in perceived uncertainty of loan contract, or a rise in γ, increases speculative demand for money and at the same time decreases the propensity to save. Thus it shifts the LM curve leftward and the IS curve rightward concomitantly. The inspection of (22) and (23) reveals that the shift of the IS curve is

[15] See Appendix for an explanation.

[16] The exact condition for this result is given by

$$\beta > \frac{\gamma}{(1+i_t)\gamma + [1+(1+i_t)\beta]i_t}$$

We may assume that this condition is satisfied under normal circumstances.

[17] See Appendix for an explanation.

normally smaller than that of the LM curve.[18]

PROPOSITION 6. *Suppose that the consumer has a positive liquidity preference, i.e.,* $\gamma > 0$. *An increase in her liquidity preference will raise the interest rate and decrease the national income under normal circumstances.*

The confidence in the loan contract is thus an important factor in the determination of business conditions. The ill-performing banking system has aggravated the depression in Japan partly because it has weakened the public's confidence in the loan contract. The central bank must increase money supply to compensate for a decline in the confidence if it is to maintain the equilibrium national income.

The consumer's propensity save, as determined by $\beta - \gamma$, reflects her evaluation of the future consumtion relative to the present consumtion. A rise in β shifts the IS curve leftward and the LM curve rightward.

PROPOSITION 7. *Suppose that the consumer has a positive liquidity preference, i.e.,* $\gamma > 0$. *Given* γ, *an increase in her propensity to save will lower the interest rate and decrease the national income when liquidity preference measured by* γ *is weak. Its effect on the national income may be reversed when liquidity preference is extremely strong.*

The propensity to save is likely to increase if the prospect of publicly financed consumption (e.g., through the social security system) deteriorates as is the case with the present-day Japan. In fact, some of the Structuralist's reform proposals on the national medical and pension systems reduce the net income of the older generations and may generate adverse effects on the aggregate effective demand. They must, therefore, be supplemented with compensating measures to reform the retirement system and public enterprises, which improve the expectations of the representative consumer's future earnings.

6. THE MONETARIST AND KEYNESIAN SPECIAL CASES

In this section, we consider the Monetarist special case when there is no liquidity preference, or $\gamma = 0$.[19] We will argue that the Keynes–Hanses special case (as presented in Chapter 3 of Keynes (1936) and later popularized ny Hansen (1953)) may be conceived as a special case of this Monetarist model where aggregate effective demand is extremely low because of high propensity to save and weak expectations concerning future earnings. This interpretation is unorthodox at least in two respects. First, the Keynes–Hansen special case is usually considered to arise when the IS schedule becomes vertical because of inelasticity of demand with respect to interest rate. Second,

[18] A sufficient condition for this result is

$$(1 - i_t)\beta > 2\gamma + \frac{i}{1 + i^2},$$

which can be satisfied when γ is small compared with β.

[19] The Monetarist special case is said to arise when the LM curve becomes vertical. For instance, see Tobin (1974).

the Keynes-Hansen special case is usually contrasted with the Monetarist special case as if they are the two polar cases of the general IS-LM model. The present interpretation neither rests on the interest-inelasticity of aggregate demand. nor does it separate the Keynes–Hansen case from the Monetarist case in the orthodox fashion.

With $\gamma = 0$, (23) reduces to the simple quantity equation of money:

$$Y_t = \frac{M_t}{p_t}, \tag{25}$$

which gives the equilibrium value of Y_t corresponding to the given value of M_t/p_t. The vertical LM line in Figure 3 shows the graph of this equation. As Monetarists argued, money supply appears to be the sole factor in the determination of equilibrium national income in this special case. The demand for national product coming from private investment and government expenditure plays no role there. The downward-sloping IS curve depicts the combination of i_t and Y_t that satisfies (22). It determines the equilibrium interest rate, given the value of financial wealth V_t/p_t. Substituting (25) into (22) and rearranging terms, we get

$$1 + i_t = \frac{I_t + (1 + \pi_t)Z_{t+1} + V_t/p_t}{\beta(M_t/p_t - G_t - I_t)}, \tag{26}$$

where $M_t/p_t - G_t - I_t > 0$. An increase in money supply increases the equilibrium national income and lowers the equilibrium interest rate as long as $M_t/p_t < Y_{Ft}$. In contrast, an increase in government expenditure, or in any other exogenous expenditure, fails to affect the equilibrium income. It merely brings about a rise in the equilibrium interest rate. The crucial assumption here is the absence of liquidity preference. Clearly, It leads to the well-known Monetarist proposition that there can be no change in equilibrium income without a corresponding change in money supply.[20]

In view of (26), the nominal rate of interest is non-negative if

$$(\beta - 1)\frac{M_t}{p_t} \leqq (1 + \beta)I_t + \beta G_t + (1 + \pi_t)Z_{t+1} + \frac{H_t}{p_t}. \tag{27}$$

The right-hand side of inequality (27) is positive. Clearly, this inequality is satisfied if $\beta < 1$.

PROPOSITION 8. *If the consumer has no liquidity preference (i.e., $\gamma = 0$), the Monetarist special case obtains under condition* (27).

This proposition clarifies the role of liquidity preference in the IS-LM analysis. The existence of liquidity preference is indispensable for the efficacy of fiscal policy per se. In fact, in the absence of liquidity preference, an increase in any component of effective demand such as government expenditure and investment cannot increase the equilibrium national income by itself without the help of accommodating increase in money supply.

[20] The original Monetarist interpretation of the IS-LM model was given by Friedman (1970, 1971). See Tobin (1974) for some critical comments.

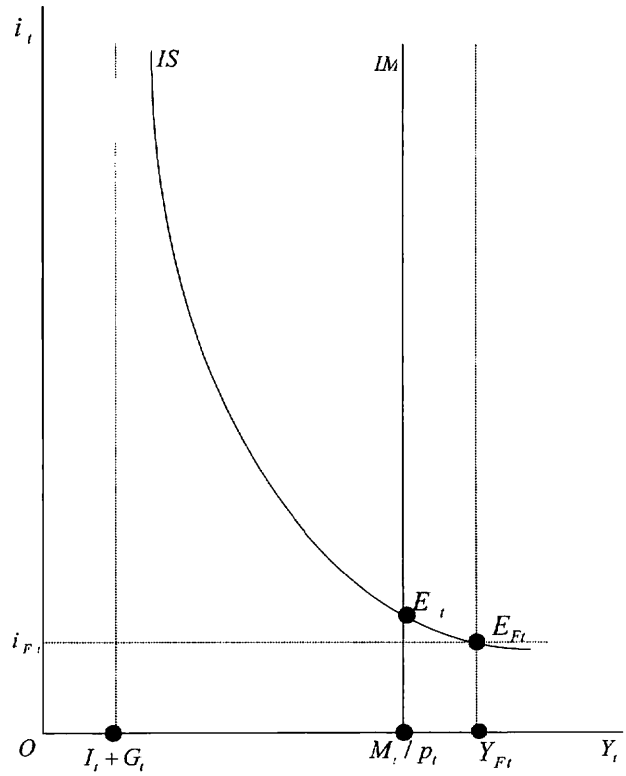

Figure 3. The Monetarist Special Case.

The monetary authority can increase money supply without precipitating monetary disequilibrium only up to the critical value given by the right hand side of inequality (27). Once the critical value is reached and the corresponding equilibrium interest rate falls to zero, the monetary authority must take it as given and adjust money supply so as to maintain equilibrium in the commodity and money markets. To use the terminology of Romer (2000), the switch from a money supply rule to an interst rate rule is bound to take place at this point. Under the present setup, this state of the economy may be identified with the Keynesian "liquidity trap" in the sense that the nominal interest rate cannot fall any further.[21] We reproduce (24) obtained by setting $i_t = 0$ in (22) in a slightly different form:

[21] Usually, "liquidity trap" is defined as the state in which liquidity preference becomes absolute after the rate of interest has fallen to a very low level. See Keynes (1936, p. 207) and Friedman (1974, p. 24). The present special case differs from such a state since the consumeris assumed to possess no liquidity preference. The liquidity trap in the usual sense could arise in the present model when the consumer has a liquidity preference (i.e., $\gamma > 0$) and the rate of interest falls to zero. Note, however, that such a state would never be realized in equilibrium.

$$Y_{Kt} = \frac{1+\beta}{\beta} I_t + G_t + \frac{1}{\beta}\left[(1+\pi_t)Z_{t+1} + \frac{V_t}{p_t}\right]. \tag{28}$$

One can easily see that the investment multiplier is given by $(1 + \beta)/\beta$ and that the balanced budget multiplier is equal to unity. The real financial wealth, expected rate of inflation and expected real value of earnings in the future positively affect the equilibrium income. Their multiplier is given by $1/\beta$ and is smaller than unity. The central bank's open market operation does not affect Y_{Kt} since it leaves V_t unchanged at its given historical value. If Y_{Kt} is less than the full employment income Y_{Ft}, this equilibrium may be interpreted as the Keynesian special case where monetary policy becomes powerless under the "liquidity trap" and the equilibrium national income is determined only by exogenously given government expenditure, private investment, real financial wealth and the expected real value of earnings together with the expected rate of inflation.

PROPOSITION 9. *If the consumer has no liquidity preference (i.e., $\gamma = 0$), the Keynes-Hansen special case arises when $i_t = 0$ and $Y_{Kt} < Y_{Ft}$.*

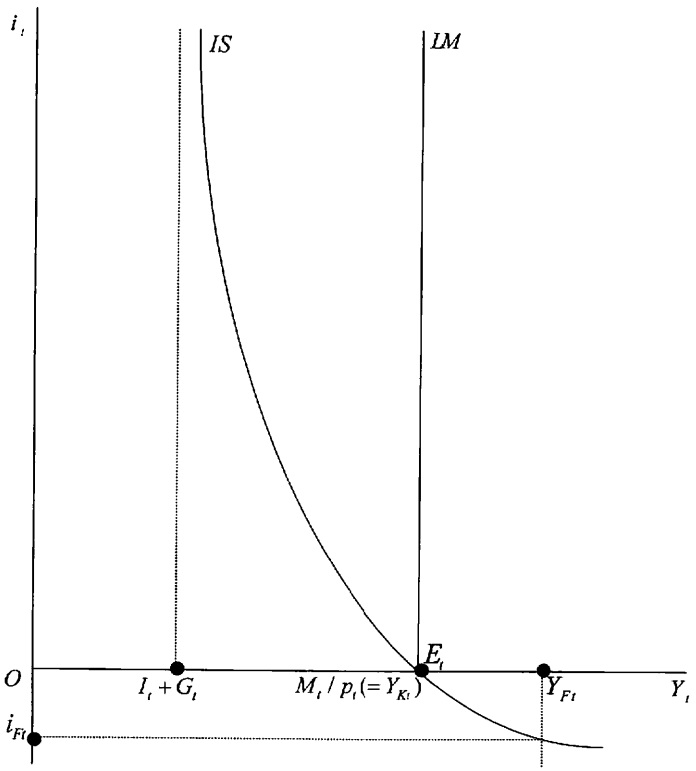

Figure 4. The Keynes–Hansen Special Case.

Even though open market operation is powerless in controlling effective demand, it does not mean that money is insignificant. To achieve money market equilibrium represented by (25), the central bank must adjust money supply through open market operation to satisfy

$$\frac{M_t}{p_t} = \frac{1+\beta}{\beta} I_t + G_t + \frac{1}{\beta}\left[(1+\pi_t)Z_{t+1} + \frac{V_t}{p_t}\right]. \tag{29}$$

Figure 4 shows the Keynes–Hansen Equilibrium at point E_t on the horizontal axis where the IS curve intersects with the LM curve (a vertical line in this case). On the other hand, money printing does affect Y_{Kt}. If the central bank is assumed to adjust smoney supply directly through money printing or money withdrawal without recource to market operartion, (28) is modified to

$$Y_{Kt} = \frac{1+\beta}{\beta-1} I_t + \frac{\beta}{\beta-1} G_t + \frac{1}{\beta-1}\left[(1+\pi_t)Z_{t+1} + \frac{A_{t-1}}{p_t}\right]. \tag{30}$$

In this case, all the multipliers are naturally enhanced. In any case, money is important in the sense that money supply is to be adjusted to sustain the equilibrium income.

7. INCOME EXPECTATION AND PRICE ADJUSTMENT

We have thus far confined ourselves to the short-run equilibrium of the economy in period t assuming that the consumer's expectation of future non-interest incomes and the price level are exogenously pre-determined. In this section we introduce static income expectation and consider a simple dynamics of price adjustment toward the long-run full-employment equilibrium. In so doing we consider the simple Monetarist-Keynesian special case discussed in the foregoing section. In order to keep matters as simple as possible, let us focus on the static economy where $I_t = 0$, $G_t = G$, $V_t = V$, and $Y_{Ft} = Y_F$. We also assume that the economy is in liquidity trap in the sense that $i_t = 0$ and the state of zero-interest rate is expected to continue in all future periods. Furthermore, the representative consumer is supposed to entertain static expectations with respect to the price level and the national income, or $\pi_t = 0$ and $Y^e_{t+s} = Y_t$ for all t. The price level is given in each period but adjusted over time in the manner to be specified below. In contrast, the national income is endogenously determined in each period at the level consistent with the consumer's static expectation.

The assumption of liquidity trap implies that the national income coincides with the non-interest national income, i.e., $Y_t = X_t$. Together with the assumption of static expectations, this simplifies the expression of Z_{t+1} as follows:

$$Z_{t+1} = \frac{1-\rho}{\rho}(Y_t - G), \tag{31}$$

when the consumer is supposed to discount future incomes at a positive rate of ρ (see Appendix). Substituting (31) into (28) and setting $Y_{Kt} = Y_t$, we have

$$Y_t = G + \frac{\rho}{\rho(\beta-1)-1} \cdot \frac{V}{p_t}, \tag{32}$$

provided that

$$\rho(\beta - 1) > 1 . \tag{33}$$

PROPOSITION 10. *Suppose that the economy is static and the Monetarist-Keynesian special case prevails. Condition* (33) *ensures the existence of market equilibrium under static income expectation. The equilibrium national income depends positively on the government expenditure and the real financial wealth, and negatively on the consumer's propensity to save and subjective discount rate of future incomes.*

Note that the fiscal multiplier is unity as before, but the real financial wealth effect on the national income is considerably enhanced, compared with the case of exogenously given income expectations. This is because the increase in the current income due to an increase in the real financial wealth gives rise to corresponding increases in expected future incomes. The contrast brings out the importance of how a change in the current income affects income expectations in future periods.

The price level is assumed to be given in each period, but suppose that it is adjusted upward (resp. downward) across periods when the current output is greater (resp. smaller) than the full-employment output. This adjustment process may be interpreted to reflect the underlying Walrasian adjustment of the wage rate in the labor market.[22] To be specific, it is assumed to proceed according to

$$\frac{p_{t+1} - p_t}{p_t} = \alpha \frac{Y_t - Y_F}{Y_F}, \quad \alpha > 0 . \tag{34}$$

Taking account of (32), we can rewrite (34) as

$$p_{t+1} = \left(1 - \alpha\left(1 - \frac{G}{Y_F}\right)\right) p_t + \frac{\alpha\rho}{\rho(\beta - 1) - 1} \cdot \frac{V}{Y_F} = \phi(p_t) . \tag{35}$$

This is a linear difference equation of the price level with the stationary value:

$$\tilde{p} = \frac{\rho V}{(Y_F - G)\big(\rho(\beta - 1) - 1\big)} . \tag{36}$$

Thus, condition (33) also guarantees the existence of the stationary eqquilibrium. Figure 5 illustrates the dynamics of the price adjustment, assuming

$$\alpha\left(1 - \frac{G}{Y_F}\right) < 1 . \tag{37}$$

This assumption is satisfied if the speed of adjustment is slow, e.g., if $\alpha < 1$. The process of price adjustment monotonically leads to the stationary equilibrium, E_L, in the long run where the full employment income is realized. Clearly, there can also be oscillatory or divergent solutions for (34) depending on the speed of adjustment.

PROPOSITION 11. *Suppose that the economy is static and the Monetarist-Keynesian special case prevails with static income expectation. Suppose also that the*

[22] This follows the conventional assumption of price adjustment employed in the literature since Dornbusch (1976).

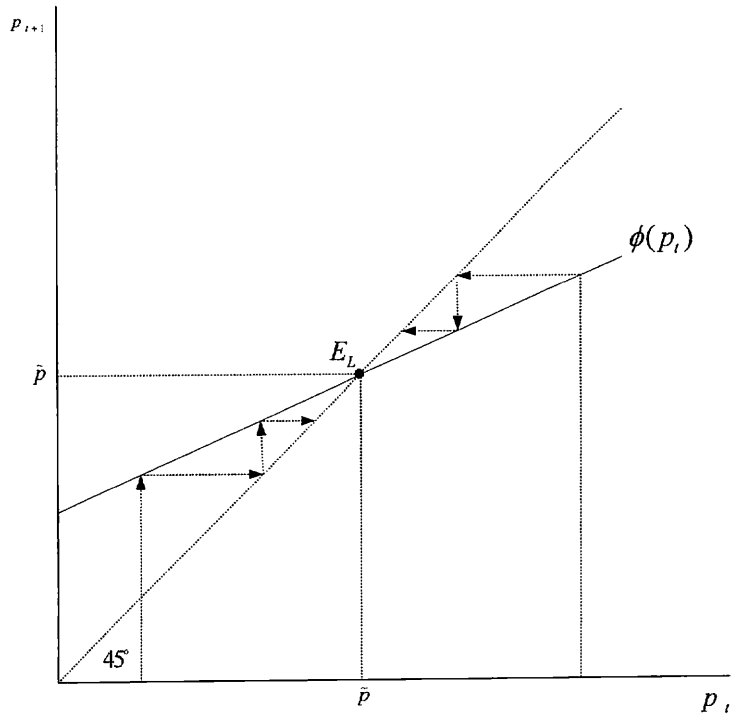

Figure 5. Dynamics of Price Adjustment.

price level is adjusted according to the mechanism defined by (34). *The long-run full-employment equilibrium exists if and only if the condition* (33) *is satisfied. Moreover, it is globally stable if the speed of adjustment is sufficiently small, or*

$$\alpha < \frac{Y_F}{Y_F - G}. \tag{38}$$

If this mechanism works, the Keynesian equilibrium will coincide with the classical full-employment equilibrium in the long run. It may take a very long time, however, for this happy coincidence to be realized. The prolonged stagnation of the Japanese economy during 1990's extending into the 21 Century suggest that the mechanism could work but only slowly.

8. CONCLUDING REMARKS

The state of the Japanese economy at the beginning of the 21st century may be roughly approximated by the Keynesian equilibrium described in the preceding sec-

tion.[23] In fact, the the Keynes–Hansen special case becomes relevant in the deep depression where the people expect extremely low earnings in the future and their propensity to consume is also very weak. The model seems to shed some light to the diagnoses and remedies proposed by different camps of economists for the ailing Japanese economy. The analysis of the model suggests that while the government's fiscal expansion is effective in increasing the equilibrium income unless it negatively affects the public's long-run expectations, the central bank must also increase money supply conformably to support the fiscal policy. Thus, money is important, but the monetary policy in the form of open market operation is powerless without fiscal expansion. It is also noteworthy that the expected real value of earnings in the future, as well as the expected rate of inflation, affects the equilibrium income. Thus "structural reforms," improving the expected future income would unambiguously increase the equilibrium income. Raising the expected rate of inflation may also be helpful if it is feasible. It would be, however, extremely difficult to create inflation expectations and control the level of real balances appropriately under the assumed circumstances.

The limitations of the present analysis are more or less obvious. In order to avoid misunderstandings, however, let us mention some of them and consider the possibility of excuse or extension. First, the present formulation of the representative consumer's utility maximization assumes away the distinction between different individuals and different periods in the future. The abstraction from individual differences may be serious in some cases where redistributional or strategic relationships are important, but it can be justified as a first approximation when such relationships are unimportant at least in the analysis of the aggregate economy. The abstraction of periodical differences may be restrictive if one is interested in the entire profile of the consumer's life-time consumption, but it is tolerable in view of her bounded rationality when one wishes to explore her decision of how much to consume in the present period and how much to save for future periods. Second, the results of the paper rests on the simplifying but annoying assumption that the government refrains from borrowing and carries no outstanding debt. Undoubtedly, this assumption is unrealistic and dissatisfactory in view of the present Japanese economy conflicted with an enormous amount of national public debt. The relaxation of the assumption would, however, complicate the analysis considerably. Third, in order to illuminate the demand side of the economy, we deliberately simplified the supply side by assuming that the representative consumer (or worker) is willing to work up to certain hours at a given real wage and that firms are ready to produce as much as demanded in the market. Moreover, money wage and the price level are assumed to be fixed in the short run. There are some well-known ideas to justify these assumptions[24] but we have not attempted to incorporate them into the present model. Fourth, the treatment of investment in this paper is obviously restrictive, but it can be modified without much difficulty.

[23] Many authors, notably Krugman (1998), argue that the Japanese economy has been stuck in the "liquidity trap" for a long time.

[24] See for instance, Blanchard and Fischer (1989), Chapter 9.

APPENDIX

As we discussed in the text, the representative consumer's long term expectation for future earnings (captured by Z_{t+1}) is considered to affect her consumption decision. For instance, we may formulate Z_{t+1} as,

$$Z_{t+1} = (1 - \rho_{t+1})(X^e_{t+1} - T^e_{t+1}) + \frac{(1 + \pi_{t+1})(1 - \rho_{t+2})(X^e_{t+2} - T^e_{t+2})}{1 + i_{t+1}} + \cdots$$

where ρ_s is the consumer's subjective discount rate of expected earning in period s and π_s $(= (p_s - p_{s+1})/p_s))$ is the expected rate of inflation from period s to period $s + 1$, and X^e_{t+s} and T^e_{t+s} are the expected non-interest income and the expected tax in period $t + s$.The consumer may lose her job permanently because of serious illness or sudden accident, or she may not be able to secure incomes as expected for some other reasons such as possible changes in social security provisions or in business climate in future periods. In the above formulation of Z_{t+1}, ρ_s may be interpreted to reflect this kind of Knightian uncertainty.

When the consumer's expectations are static, i.e., $\pi_s = \pi$, $i_s = i$, $\rho_s = \rho$ and $X_s - T_s = X - T$ for $s = t + 1, t + 2, \ldots$, the above formulation simplifies to

$$Z_{t+1} = \frac{(1 + i)(1 - \rho)}{\rho + i - (1 - \rho)\pi}(X - T)\,.$$

Thus, Z_{t+1} converges to a finite value even when the expected rate of nominal interest is zero. Clearly, it increases with the expected rate of future inflation and decreases with the subjective discount rate given the real value of non-interest income flow net of tax.The above expression can also be written

$$Z_{t+1} = \frac{(1 + r)(1 - \rho)}{r + \rho}(X - T)$$

where r is the real rate of interest defined by the Fisher relation:

$$r = \frac{i - \pi}{1 + \pi}\,.$$

Thus, Z_{t+1} takes on a positive finite value even when the real interest is negative as long as $r + \rho > 0$. An increases in the real rate of interest decreases Z_{t+1}.

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